Estimating past distribution of vanishing weed vegetation in South Moravia

Odhad původního rozšíření mizející plevelové vegetace na jižní Moravě

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The weed communities have changed dramatically in the 20th century. Because no weed vegetation relevés were recorded for South Moravia early in this century, changes in potential distribution of the most endangered vegetation type, the association *Caucalido daucoidis-Conringietum orientalis,* are evaluated using records of its diagnostic species. The diagnostic species group of this association was specified by the statistical calculation of fidelity. It includes *Scandix pecten-veneris*, *Caucalis platycarpos*, *Bupleurum rotundifolium*, *Thymelaea passerina*, *Nigella arvensis*, and *Ajuga chamaepitys*. The coincidence distribution maps of these diagnostic species were prepared. The resulting maps show that the potential distribution of *Caucalido-Conringietum* is the South Moravian region of thermophilous flora and possibly the adjacent regions of mesophilous flora. The incidence of this plant association in the area declined remarkably in the second half of the 20th century, but in the 1990s its diagnostic species appeared again at several sites.

K e y w o r d s : *Caucalidion lappulae, Caucalido-Conringietum*, floristic records, plant communities, Czech Republic

Introduction

Weed communities strongly depend on crops and agrotechniques. They have experienced profound changes due to substantial shifts in agricultural management in the 20th century. Some ecologically specialized species declined, whereas nitrophilous or herbicide-tolerant species spread, which resulted in the development of species-poor, often monodominant communities (Hilbig 1982). The weed vegetation consisting of specialized annual archaeophytes has declined. This trend is striking in weed communities adapted to extreme habitats (Holzner & Immonen 1982, Hilbig 1987).

Perhaps the most remarkable example of such communities is the *Caucalido daucoidis-Conringietum orientalis* Klika 1936. This community used to be present on calcareous soils in warm and dry parts of Bohemia (Klika 1936), but recently has become rare and highly endangered by human activities (Kropáč 1995). It was never recorded in Slovakia (Jarolímek et al. 1997) and only rarely in Austria (Mucina et al. 1993) and Poland (Kornaś 1959, Trcińska-Tacik 1991). In South Moravia, Laus (1908) noticed the occurrence of weed vegetation of this kind. His plant records from the vicinities of the town of Hustopeče and the villages of Kurdějov, Popice and Pouzdřany correspond to the species composition of this community. It occurred in different sites: in a stubble field, an abandoned field and a cultivated stand of *Onobrychis viciifolia*. Čouka (in Laus 1908) found a similar weed community in a cereal field near the town of Velká nad Veličkou (Bílé

Karpaty Mts.). Kühn (1978) also probably observed this vegetation in vineyards in warm parts of Moravia, but his information is unclear.

As it was not possible to reconstruct the former distribution of this community in South Moravia from phytosociological relevés, it was estimated using records of its diagnostic species. The purpose of this paper is to describe changes in the distribution of the *Caucalido-Conringietum* in South Moravia and to evaluate the potential of floristic records for estimating past distribution of vanishing plant communities.

Methods

It was difficult to define the species that are diagnostic of the *Caucalido-Conringietum*. Different authors list different diagnostic species (Kornaś 1959, Kropáč 1981, Mucina 1993, Otýpková 1999, Ries 1992). Some of the species are diagnostic only for small areas, others grow in other vegetation types as well. Therefore, the diagnostic species group was determined statistically by using large phytosociological database. A set of 19,540 phytosociological relevés of different types of herbaceous vegetation from the whole of the Czech Republic was taken from the Czech National Phytosociological Database (Chytrý & Rafajová 2003), managed in TURBOVEG (Hennekens & Schaminée 2001). This data set included 1135 relevés of weed vegetation (*Chenopodietea, Secalietea*) with additional relevés of ruderal vegetation, meadows, marsh grasslands, exposed bottoms, dry grasslands, pastures, forest clearings, vernal therophytic vegetation, sand grasslands and inland salt marshes.

The group of diagnostic species of the *Caucalido-Conringietum* association was specified in the following way: The group of character species of this community was adopted from Mucina (1993) and its validity evaluated by statistical calculation of fidelity, using *u*-value adapted for a hypergeometric distribution (u_{hyp}) (Chytrý et al. 2002) in the JUICE program (Tichý 2002). The starting group consisted of the species *Scandix pecten-veneris, Bupleurum rotundifolium*, *Adonis aestivalis*, *A. flammea* and *Caucalis platycarpos*. *Aperula arvensis* and *Turgenia latifolia*, also cited by Mucina (1993), were not included because they were not found in any relevé in the database. Fidelity for all the species in the data set to the relevés containing at least three of these six species was calculated. The analysis showed, that of the species not cited by Mucina, *Thymelaea passerina, Ajuga chamaepitys* and *Nigella arvensis* also belong to this diagnostic group, because they had higher fidelities than some species of the starting group (*Adonis aestivalis*, *A. flammea*). The other species cited by Mucina (1993) had a low fidelity so they were not included. The final group of diagnostic species suggested for the *Caucalido-Conringietum*, consisted of *Scandix pecten-veneris*, *Caucalis platycarpos*, *Bupleurum rotundifolium*, *Thymelaea passerina*, *Nigella arvensis* and *Ajuga chamaepitys* (Table 1). Table 1 gives also other species that were related to this group of diagnostic species and references to the diagnostic status given to these species by different authors. It is interesting, that although the starting group was adopted from Mucina (1993), this analysis gave a group of diagnostic species that best corresponded to that of Kropáč (1981).

In order to asses the potential distribution of the *Caucalido-Conringietum* in South Moravia, the BRNU and BRNM herbaria and local floristic literature were studied. The distribution of *Scandix pecten-veneris* was summarized by Chrtek et al. (1968) and that of

Table 1. – Diagnostic species (followed by #) of the *Caucalido-Conringietum*, based on the statistical calculation of fidelity using a large data set. Eighteen relevés from the dataset were assigned to this association. u_{hyp} = fidelity measure, n = number of species occurrences in the entire data set, n_p = number of species occurrences in the *Caucalido-Conringietum*. Species reported as diagnostic in the literature are indicated by an asterisk. Twenty species with highest fidelity are shown, followed by species not so ranked but indicated as diagnostic in the literature.

Rank	Species	u_{hyp}	n:n_p	Kornaś 1959	Kropáč 1981	Mucina 1993	Otýpková 1999	Ries 1992
1	*Caucalis platycarpos* #	58.84	85:17	*		*	*	*
2	*Bupleurum rotundifolium* #	57.63	4:4	*	*	*	*	
3	*Thymelaea passerina* #	57.25	10:6		*			
4	*Nigella arvensis* #	55.99	7:5		*			
5	*Ajuga chamaepitys* #	53.46	16:7		*			
6	*Scandix pecten-veneris* #	44.63	11:5	*	*			
7	*Agrostemma githago*	38.53	22:6					
8	*Stachys annua*	38.21	115:13	*	*	*	*	
9	*Fumaria vaillantii*	33.79	68:9	*			*	
10	*Adonis aestivalis*	30.00	86:9	*	*	*		
11	*Euphorbia falcata*	23.28	40:5	*	*			
12	*Euphorbia exigua*	22.53	188:10					
13	*Valerianella dentata*	22.12	122:8					
14	*Consolida regalis*	21.60	298:12					*
15	*Papaver rhoeas*	19.50	363:12					
16	*Avena fatua*	19.10	259:10					
17	*Camelina microcarpa*	18.65	92:6				*	*
18	*Bromus arvensis*	17.40	8:2					
19	*Bromus japonicus*	17.21	44:4					
20	*Centaurea cyanus*	16.97	261:9					
	Conringia orientalis	15.71	27:3	*				
	Reseda lutea	5.32	207:3					
	Falcaria vulgaris	5.14	410:4		*		*	*
	Descurainia sophia	3.87	350:3					*
	Cerinthe minor	3.24	71:1		*			
	Cardaria draba	2.16	146:1					*
	Erysimum repandum	2.15	147:1		*			
	Adonis flammea	–	2:0		*	*		
	Anthemis austriaca	–	73:0					*
	Allium rotundum	–	7:0	*				
	Bifora radians	–	10:0		*			
	Euphorbia virgata	–	14:0		*			
	Galium tricornutum	–	9:0		*			
	Kickxia spuria	–	56:0		*			

Ajuga chamaepitys by Smejkal (1961). These records were also used. Recent records of the diagnostic species in the Bílé Karpaty Mts. were taken from Otýpková (1999). The lists of the localities of all these species, together with literature sources, can be found in Lososová (2003).

Floristic records were summarized in coincidence maps prepared with program DMAP (Morton 2001), by mapping joint occurrences of the diagnostic species within squares of the standard Central European mapping grid. Dot sizes in grid cells are proportional to the number of species of the diagnostic species group. Plant names follow Ehrendorfer (1973).

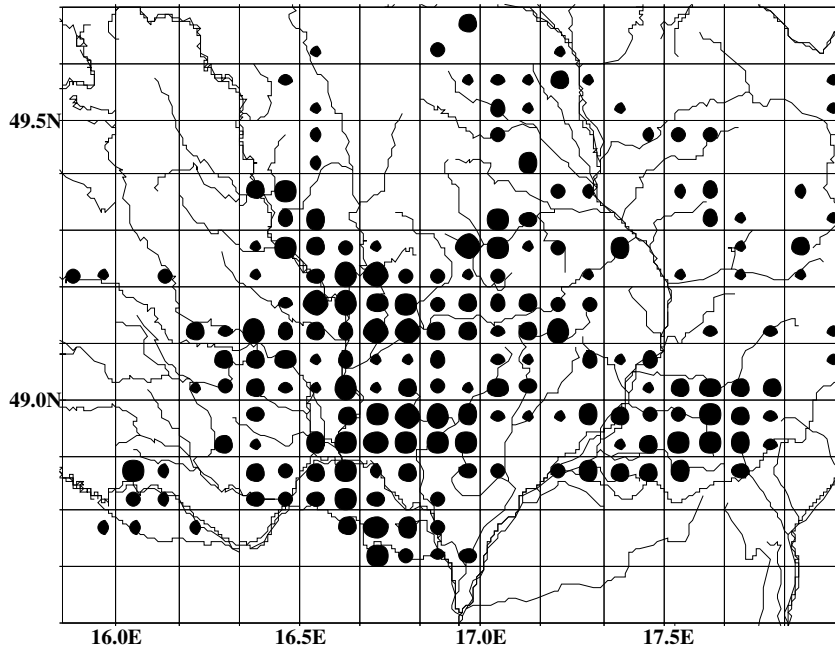

Fig. 1. – Cumulative distribution of diagnostic species group of the *Caucalido-Conringietum* association in South Moravia over the entire period of floristic research. Size of the dots is proportional to the number of diagnostic species in the particular square.

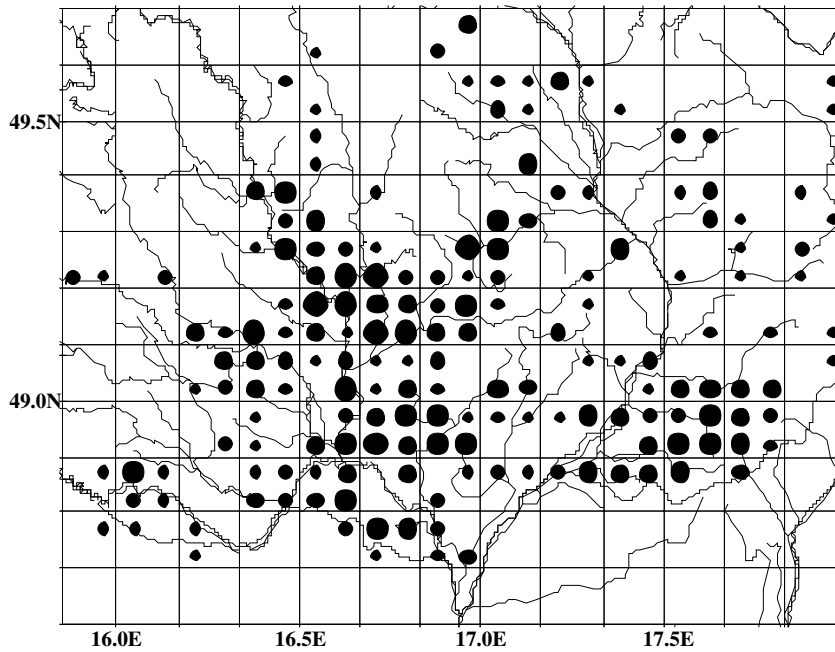

Fig. 2. – Distribution of diagnostic species group of the *Caucalido-Conringietum* association in South Moravia before 1950.

Results

Before 1950, the *Caucalido-Conringietum* association was probably widely distributed in the region of South Moravian thermophilous flora (Pannonicum; Skalický 1988) (Figs. 1, 2). Most records of the diagnostic species are from the vicinities of the towns Mikulov, Hustopeče, Miroslav, Moravský Krumlov and the southern and eastern suburbs of the city of Brno, e.g. Hády Hill, Stránská skála Hill, and Bílá hora Hill, as well as from the Bílé Karpaty Mts. in the east. In the west, the potential occurrence of the community was restricted by the Českomoravská vrchovina Uplands. The number of localities decreased to the north. Some isolated localities may have existed near the towns and villages of Prostějov, Kostelec na Hané and Konice. It is assumed that the lack of records from some regions, such as the vicinities of the towns of Hrušovany nad Jevišovkou, Kyjov and Uherské Hradiště is due to the poor botanical documentation of these regions.

After 1950, the number of localities for the diagnostic species decreased significantly (Fig. 3). *Scandix pecten-veneris* disappeared from all localities in the Czech Republic (Holub & Procházka 2000). The occurrence of the remaining species in Moravia was restricted to the warmest areas, including the vicinities of the towns of Znojmo, Mikulov, Hustopeče, Miroslav, Ivančice and Velká nad Veličkou.

The decline of these species stopped in the 1990s (Fig. 4). Recently, several localities have been recorded, namely the margins of arable fields and dry grasslands, near the towns of Hustopeče, Mikulov, Znojmo and Miroslav. Other localities are in the Bílé Karpaty Mts. and between the towns of Vyškov and Slavkov.

After 1995, the only stands of the *Caucalido-Conringietum*, according to the formal definition accepted in this paper, were at two sites in South Moravia[1]:

Relevé no. 1. Pavlov (distr. Břeclav), southern slope of Děvín Hill, field edge along the nature reserve boundary 1.9 km SW of the church, alt. 330 m, 10 m^2, cover 40%, 6 August 1996, recorded by J. Danihelka.
Caucalis platycarpos* 2,** *Setaria viridis* 2, *Bromus japonicus* 1, *Medicago lupulina* 1, ***Nigella arvensis 1, *Achillea collina* +, ***Ajuga chamaepitys*** +, *Alyssum alyssoides* +, *Anagallis arvensis* +, *A. foemina* +, *Consolida regalis* +, *Euphorbia exigua* +, *E. falcata* +, *Erodium cicutarium* +, *Fallopia convolvulus* +, *Lathyrus tuberosus* +, *Polygonum arenastrum* +, *Reseda luteola* +, *Setaria glauca* +, *Stachys annua* +, *Taraxacum officinale* agg. +, *Thymelaea passerina* **+,** *Viola arvensis* +, *Acer campestre* juv. r, *Buglossoides arvensis* r, *Chenopodium album* r, *Agropyron repens* r, *Hypericum perforatum* r.

Relevé no. 2. Miroslav (distr. Znojmo) near elevation point 297.1 of the Miroslavské kopce Hills, 0.5 km SE of the town, alt. 270 m, an abandoned part of a vineyard, 20 m^2, cover 70%, 22 July 1998, recorded by Z. Lososová.
Caucalis platycarpos 2, *Consolida regalis* 2, ***Nigella arvensis*** 2, *Amaranthus retroflexus* 1, *Chenopodium album* 1, *Hyoscyamus niger* 1, *Papaver rhoeas* 1, *Stachys annua* 1, ***Ajuga chamaepitys*** +, *Chenopodium hybridum* +, *Conyza canadensis* +, *Descurainia sophia* +, *Euphorbia esula* +, *Fallopia convolvulus* +, *Galium aparine* agg. +, *Hypericum perforatum* +, *Lamium amplexicaule* +, *Polygonum aviculare* agg. +, *Portulaca oleracea* +, *Reseda lutea* +, *Setaria viridis* +, *Silene noctiflora* +, *Tripleurospermum inodorum* +, *Malva neglecta* r, *Taraxacum officinale* agg. r.

Discussion

The method used in this paper can help estimate the past distribution of vanishing vegetation types or those that are poorly documented by relevés. The results depend on the qual-

[1] Species of the diagnostic group are in bold.

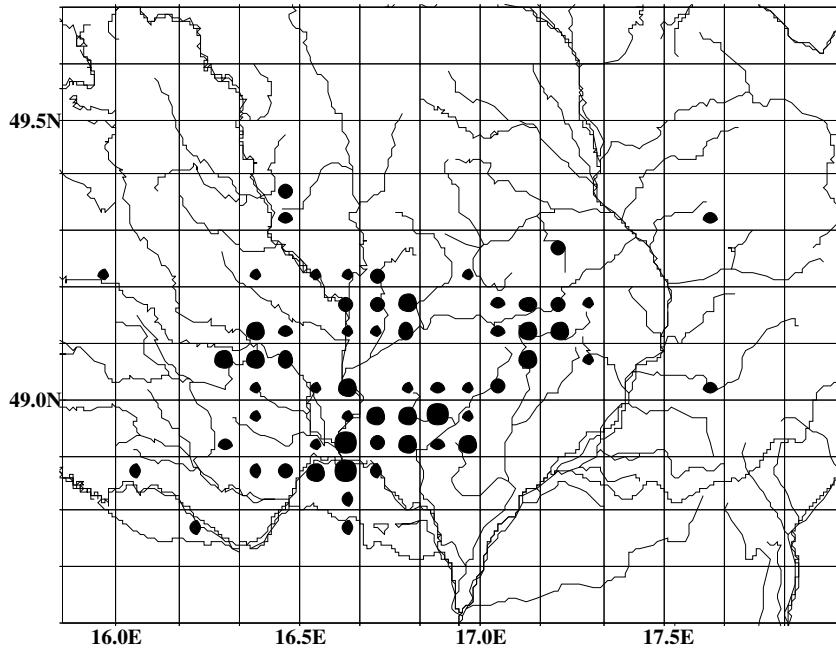

Fig. 3. – Distribution of diagnostic species group of the *Caucalido-Conringietum* association in South Moravia in 1950–1989.

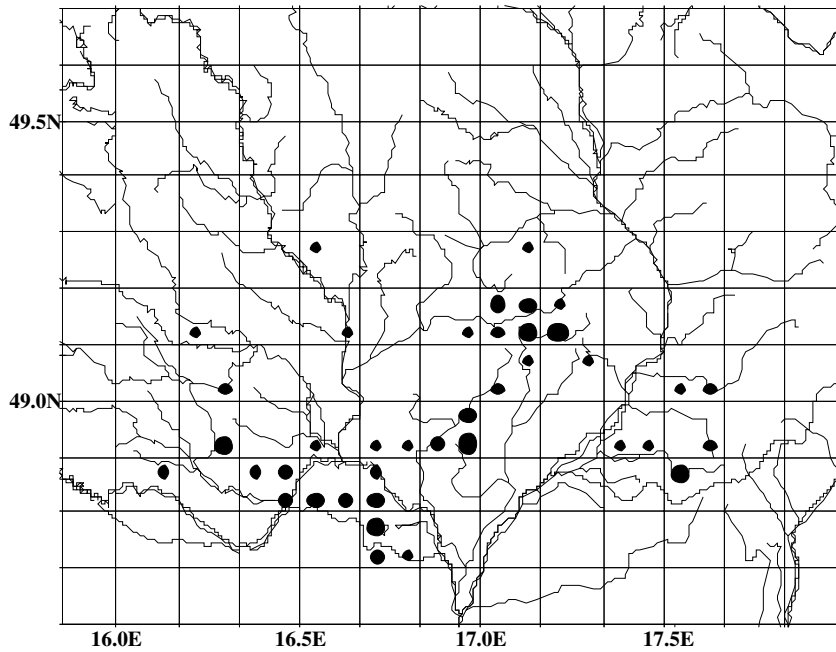

Fig. 4. – Distribution of diagnostic species group of the *Caucalido-Conringietum* association in South Moravia in 1990–2000.

ity of the floristic records. Many botanists prefer to collect "popular" species, and rarely record common species.

The floristic mapping indicates the potential distribution of plant communities. Coincidence maps may be useful in predicting occurrence of suitable habitats and regions, where the target vegetation may be found (Chytrý 1998, Schönfelder 1999, Scheuerer & Schönfelder 2000). In a similar way, Kornaś (1959) mapped the distribution of weed vegetation in southern Poland. He formed almost the same group of species and showed the affinity of the *Caucalido-Conringietum* for rendzinas.

The *Caucalido-Conringietum* community was certainly not present at every site where the diagnostic species were recorded (Fig. 1). The comments on herbarium labels often indicate, that the species grew not only in cereal fields but also along road verges adjacent to arable fields or in grassland. In addition, some collectors noticed that the diagnostic species often occurred together; for instance Formánek (1887) recorded the common occurrence of *Scandix pecten-veneris* and *Caucalis platycarpos* at Barbořín near the town of Kroměříž.

Probably only one species of the diagnostic group, *Caucalis platycarpos*, was common in the first half of the 20th century. *Scandix pecten-veneris* was never a widespread species (Klika 1936) and the same is true for *Bupleurum rotundifolium* (Šourková 1981) and *Nigella arvensis* (Strid 1971).

The management of most Moravian cereal fields has changed markedly, causing changes in weed communities. After 1950, *Caucalido-Conringietum* was replacted by other communities of the alliance *Caucalidion lappulae* or by species-poor weed vegetation (Kropáč 1988). The main reason for the disappearance of this specialized weed community was cleaning of seed material, chemical weed control and early harvesting. In the places, where the *Caucalido-Conringietum* was formerly distributed, the weed vegetation now consists of thermophilous and basiphilous species with a wide ecological range (*Consolida regalis*, *Silene noctiflora*, *Euphorbia exigua*, *Descurainia sophia*, *Papaver rhoeas*, *Anagallis arvensis*). A similar situation is observed in other Central European countries, e.g. Switzerland (Brun-Hool 1963), Germany (Tüxen 1962, Hilbig & Bachthaler 1992, Pfützenreuter 1994) and southern Poland (Trcińska-Tacik 1991). However, in the 1990s, some new localities for these specialized weed species were recorded in the Czech Republic (Danihelka et al. 1995, Kubát 1999, Lososová & Otýpková 1999, Lososová 2003). This trend is presumably associated with a reduction in the application of herbicides and fertilizers after the socio-economic changes in 1989.

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Souhrn

K nejohroženějším typům plevelové vegetace, s výskytem mnoha silně ustupujících druhů, patří asociace *Caucalido daucoidis-Conringietum orientalis*. Její rozšíření na jižní Moravě je doloženo pouze ojedinělými fytocenologickými snímky. Potenciální výskyt tohoto společenstva je však možné odhadovat na základě floristických údajů. Výpočtem fidelity ve velkém souboru fytocenologických snímků nelesní vegetace ČR byla stanovena skupina diagnostických druhů daného společenstva, která obsahuje *Ajuga chamaepitys, Bupleurum rotundifolium, Caucalis platycarpos, Nigella arvensis, Scandix pecten-veneris* a *Thymelaea passerina.*

Na základě rozšíření diagnostických druhů byly sestaveny koincidenční síťové kartogramy potenciálního rozšíření společenstva. Lze předpokládat, že společenstvo *Caucalido-Conringietum* se dříve vyskytovalo v celém termofytiku jižní Moravy a v přilehlých oblastech mezofytika. Od roku 1950 silně ustoupilo a v současnosti je doloženo fytocenologickými snímky pouze ze dvou lokalit, ačkoli floristické údaje dokumentují výskyt diagnostických druhů společenstva na četných dalších místech. Jinde je nahrazeno dalšími společenstvy svazu *Caucalidion lappulae*, složenými z méně specializovaných plevelných druhů. Zvolenou nepřímou metodu považuji za vhodnou k mapování potenciálního rozšíření ustupujících společenstev a k mapování společenstev, o kterých neexistuje dostatek fytocenologických údajů.

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