Formalized classification of the weed vegetation of arable land in Slovenia

Formalizovaná klasifikace plevelové vegetace Slovinska

Urban Šilc & Andraž Čarni

Institute of Biology, Scientific Research Center of the Slovenian Academy of Sciences and Arts, Novi trg 2, 1000 Ljubljana, Slovenia, e-mail: urban@zrc-sazu.si

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A phytosociological synthesis of weed vegetation in Slovenia using the Braun-Blanquet approach was performed. Historical and new data (482 relevés after stratified resampling) were used and classified formally using the Cocktail method. Eleven different syntaxa: *Kickxietum spuriae, Galio tricornuti-Ranunculetum arvensis, Geranio-Allietum, Mercurialietum annuae, Veronicetum trilobae-triphyllidi, Alchemillo-Matricarietum,* basal community *Alchemilla arvensis*-[*Scleranthion annui*], *Panico-Chenopodietum, Hyoscyamo-Chenopodietum hybridi, Galeopsido-Galinsogetum, Echinochloo-Setarietum* were distinguished and are presented in a synoptic table. Ecology, diagnostic and constant species, distribution and threats to weed syntaxa are presented. Delimitation of the high-mountain association *Galeopsido-Galinsogetum* presents problems as it is species-poor and is composed of generalist species. Some problems of using the Cocktail method to classify species poor stands are pointed out. Comparison of classified syntaxa and their diagnostic species in Slovenian and Moravian datasets shows that there are in both areas common central asociations of higher syntaxa, which are widely distributed in Central Europe: *Veronicetum trilobae-triphyllidi, Alchemillo-Matricarietum, Panico-Chenopodietum* and *Echinochloo-Setarietum*. There are differences in various classifications of vernal communities and those that thrive in only one area.

Keywords: Cocktail method, diagnostic species, Slovenia, *Stellarietea mediae*, weed vegetation

Introduction

Weed vegetation has been subject to radical changes over the last decades due to very high anthropogenic pressure and the subject of interest of numerous publications in recent years. The first study of weed vegetation in Slovenia was done by Zalokar (1937, 1939). An overview of weed vegetation research in Slovenia was made by Wraber (1996), in which he noted the relatively poor and geographically uneven research effort. There are a few local studies (e.g. Seljak 1989, Kaligarič 1992a, Lešnik 1995, Šilc 2005a, 2005b) using traditional expert-based classification of original data. There is no national classification of all available relevé material.

For neighbouring regions there are several regional or national classifications of weed syntaxa made using traditional phytosociological methods (Mucina 1993, Jarolímek et al. 1997, Borhidi 2003, Kropáč 2006). A formalized Cocktail method was used for classifying a large dataset of weed relevés from S Moravia, Czech Republic (Lososová 2004). The Cocktail method reproduces the inductive approach of traditional phytosociology. It was used to classify several different vegetation types (Kočí et al. 2003, Lososová 2004, Roleček 2005, Havlová 2006) and was particularly useful in transboundary classification of vegetation (Bruelheide & Chytrý 2000, Lososová 2004). It is also used to compare the delimitation of syntaxa classified by expert-based (traditional) classification (Kočí et al. 2003).

The objectives of the present study were (1) to perform a formalized phytosociological classification of weed vegetation relevé material from Slovenia and determine diagnostic species, (2) to determine the agreement with expert-based classification, (3) and discuss the relationship with a previously classified data set of weed vegetation from Moravia (Lososová 2004).

Methods

Study area and data sampling

The Republic of Slovenia covers about 20,000 km^2 with a diverse climate and geology. Slovenia has a climate transitional between a mild, rainy Atlantic and summer-dry, winter cold continental climate. Due to the diversity of bedrocks soils range from rendzic leptosol to cromic cambisol and from dystric leptosol to podsol. The phytogeographical division of Slovenia by Wraber (1969) was used. Abbreviations of phytogeographical regions used in the text are as follows: AL – Alpine, PA – pre-Alpine, DN – Dinaric, PD – pre-Dinaric, SM – sub-Mediterranean and SP – sub-Pannonian.

In the Turboveg database (Hennekens & Schaminée 2001) there are 11,200 relevés of all vegetation types from Slovenia, made by various authors over the last 66 years. Within the database there are 792 relevés originally assigned to the weed vegetation of *Violenea arvensis* subclass.

Relevés were made according to the standard Central European phytosociological method (Braun-Blanquet 1964, Westhoff & van der Maarel 1973). Piskernik (1982) used the synusial approach and own cover scale, which was converted to the Central European standard. To avoid oversampling of some areas, stratified resampling of the data set was performed and one relevé per syntaxon per locality was randomly selected (Botta-Dukát et al. 2005). The syntaxonomical assignment of relevés was that of the authors. Selection yielded 4289 relevés of all vegetation types and 482 relevés of weed vegetation, respectively.

To describe the ecological conditions the indicator values (EIV) were calculated (Ellenberg et al. 1992). The nomenclature of vascular plants follows Ehrendorfer (1973). For stands assigned directly to higher syntaxa a deductive approach was used (Kopecký & Hejný 1978, Zelnik 2002).

Cocktail classification

The Cocktail method (Bruelheide 2000) is used to define sociological groups of species in weed communities (cf. Lososová 2004). The phi coefficient is used to measure fidelity. It ranges between –1 and +1. The phi coefficient for site groups was standardized to equal size, Fisher's exact test computed and species with non-significant fidelity excluded from the groups of diagnostic species (Tichý & Chytrý 2006).

The methods used to create sociological species groups (Table 1) and the Cocktail definitions are those used by Kočí et al. (2003). Definitions of vegetation units are created by combinations of species groups using logical operators such as AND, OR or AND NOT. In some cases just the presence of a single species or its dominance by operator UP and threshold cover value was used. Hierarchy of logical operators is indicated by parentheses.

Table 1. – Sociological species groups. Phi value of each species is indicated in parentheses. The number of relevés in which the group occurs is the number of relevés that contain at least half of the group's species.

Species group	No. of relevés	Species (phi values)
Allium vineale	9	*Muscari racemosum* (0.86), *Allium vineale* (0.75), *Ornithogalum divergens* (0.67)
Aphanes arvensis	138	*Aphanes arvensis* (0.83), *Myosotis arvensis* (0.76), *Legousia speculum-veneris* (0.74), *Viola arvensis* (0.71), *Papaver rhoeas* (0.68), *Veronica arvensis* (0.59), *Anthemis arvensis* (0.56), *Apera spica-venti* (0.65), *Matricaria chamomilla* (0.54)
Chenopodium polyspermum	82	*Oxalis fontana* (0.69), *Chenopodium polyspermum* (0.64)
Galeopsis tetrahit	23	*Galeopsis tetrahit* (0.51), *Mentha arvensis* (0.39)
Galium tricornutum	23	*Galium tricornutum* (0.75), *Bifora radians* (0.73), *Rapistrum rugosum* (0.69), *Avena barbata* (0.57), *Consolida regalis* (0.56), *Ajuga chamaepitys* (0.51)
Kickxia spuria	2	*Euphorbia exigua* (0.71), *Kickxia spuria* (0.71), *K. elatine* (0.50), *Thlaspi perfoliatum* (0.41), *Stachys annua* (0.32)
Mercurialis annua	77	*Solanum nigrum* (0.71), *Mercurialis annua* (0.64), *Amaranthus retroflexus* (0.63)
Veronica hederifolia	32	*Arabidopsis thaliana* (0.87), *Veronica triphyllos* (0.64), *Erophila verna* (0.64), *Veronica hederifolia* (0.65)
Veronica triphyllos	12	*Veronica triphyllos* (0.96), *Erophila verna* (0.74), *Arabidopsis thaliana* (0.60)
Stellaria media agg.	422	*Stellaria media* agg. (0.83), *Veronica persica* (0.73), *Capsella bursa-pastoris* (0.73), *Lamium purpureum* (0.69)
Setaria pumila	251	*Echinochloa crus-galli* (0.76), *Digitaria sanguinalis* (0.72), *Setaria pumila* (0.72), *Chenopodium album* agg. (0.68), *Galinsoga parviflora* (0.61)

Cocktail definitions were applied to 482 relevés using JUICE software (Tichý 2002). Due to marginal overlapping of some Cocktail definitions, some relevés were assigned to two or three associations. These relevés were then assigned by calculation of the frequency-fidelity index to the constancy columns of the synoptic table. The same procedure was used for relevés unassigned to any of the associations, after the unequivocally assigned relevés were included in the columns of the synoptic table (Kočí et al. 2003, Tichý 2005).

Diagnostic species of the association were defined as those with phi ≥ 0.3. This value was selected subjectively to yield an informative list of diagnostic species.

Table 2. – Synoptic table of weed communities in Slovenia. Column numbers correspond to the numbering of communities in the text. The numbers in columns are percentage frequencies (except col. 1 and 9 where number of presences are given), upper indices are fidelity values, represented by the phi coefficient (multiplied by 100). High fidelity (phi > 0.3) or high frequency (80%) values are in bold.

Column	1	2	3	4	5	6	7	8	9	10	11
No. of relevés	1	28	12	41	48	74	55	127	2	39	55
Mean altitude	216	229	178	197	257	249	267	259	150	537	294
Mean Ellenberg indicator values:											
Light	6.8	6.9	6.8	7.0	6.6	6.7	6.7	6.8	6.6	6.8	6.9
Temperature	6.0	6.2	6.3	6.3	5.8	5.9	5.9	6.1	5.8	5.8	6.1
Continentality	3.8	3.9	3.6	3.9	3.4	3.8	3.7	3.8	4.2	3.6	3.9
Moisture	4.6	4.3	4.6	4.7	4.9	5.1	4.9	5.1	5.2	5.2	5.0
pH	7.2	7.6	7.1	7.0	6.5	6.2	6.7	6.4	6.6	6.7	6.6
Nutrients	5.6	5.3	6.5	6.9	6.3	6.1	5.9	6.8	7.3	6.7	6.8
Kickxietum spuriae											
Euphorbia exigua	**1^{100}**	.	.	.	.	.	.	.	.	.	.
Thlaspi perfoliatum	**1^{99}**	.	.	.	.	.	.	1	.	.	.
Kickxia spuria	**1^{98}**	.	.	.	.	.	.	1	.	.	2
Galio tricornuti-Ranunculetum arvensis											
Galium tricornutum	.	**82^{86}**	.	.	.	.	2	.	.	8	.
Avena barbata	.	**54^{69}**	.	.	.	.	.	.	.	.	.
Consolida regalis	.	**57^{63}**	.	.	4	11^{11}	2	.	.	8	.
Bifora radians	.	**36^{58}**	.	.	.	.	2	.	.	.	.
Ranunculus arvensis	.	**64^{55}**	.	.	10$^{7.8}$	12$^{9.4}$	**36^{30}**	.	.	10	.
Rapistrum rugosum	.	**32^{54}**	.	.	.	.	.	.	.	3	.
Agrostemma githago	.	**43^{50}**	.	.	4	3	18^{21}	.	.	5	.
Ajuga chamaepitys	.	**25^{47}**	.	.	.	.	.	.	.	3	.
Vicia sativa agg.	.	**54^{43}**	**58^{47}**	5	4	1	2	2	.	10$^{7.2}$	2
Vicia villosa	.	**29^{41}**	.	.	8^{11}	8^{11}	4	.	.	.	.
Fallopia convolvulus	1	**86^{36}**	25	27$^{9.5}$	15	39^{15}	18$^{5.6}$	31^{12}	1	49^{19}	15
Anagallis arvensis	1	**61^{32}**	8	29^{14}	.	22^{10}	25^{12}	24^{12}	.	18^{8}	9
Geranio-Allietum											
Allium vineale	.	.	**83^{85}**	2	2	.	.	.	.	.	.
Muscari racemosum	.	.	**50^{62}**	5	2	.	.	.	.	.	.
Ornithogalum umbellatum	.	.	**58^{60}**	5	2	.	.	.	.	.	.
Calepina irregularis	.	.	**33^{56}**	2	.	.	.	.	.	.	.
Crepis taraxacifolia	.	.	**42^{54}**	.	.	.	.	.	.	.	.
Cerastium tenoreanum	.	.	**33^{50}**	.	2	1	2	.	.	.	.
Senecio vulgaris	.	.	**67^{47}**	**44^{30}**	17^{11}	4	2	22^{14}	.	3	5
Trifolium incarnatum subsp. *moli*	.	.	**17^{41}**	.	.	.	.	.	.	.	.
Valerianella carinata	.	.	**17^{41}**	.	.	.	.	.	.	.	.
Erodium cicutarium	.	.	**33^{41}**	15^{17}	6	7$^{7.6}$	.	1	.	.	2
Veronica hederifolia	.	.	**50^{36}**	5	**100^{73}**	12$^{7.6}$	13^{8}	1	.	3	.
Geranium dissectum	.	.	**42^{36}**	20^{16}	2	9$^{7.3}$	9$^{6.9}$	8$^{5.8}$	.	8	2
Fumaria officinalis	.	7	**33^{36}**	17^{18}	6	.	4	3	.	.	.
Bromus sterilis	.	.	**42^{35}**	7	2	1	2	.	.	.	.
Euphorbia helioscopia	.	.	**58^{33}**	51^{29}	40^{22}	22^{11}	11	45^{25}	.	13	25^{14}
Veronica persica	1	25	**92^{32}**	80^{28}	71^{24}	47^{15}	55^{18}	49^{16}	.	64^{22}	44^{14}
Solanum luteum	.	.	**17^{32}**	10^{19}	.	.	.	.	.	.	.
Geranium rotundifolium	.	.	**17^{31}**	5	.	.	.	1	.	.	.
Lamium amplexicaule	.	.	**25^{30}**	10^{11}	17^{20}	7$^{7.6}$	.	2	.	3	.

Column	1	2	3	4	5	6	7	8	9	10	11
Mercurialietum annuae											
Mercurialis annua	.	7	25^{22}	$\mathbf{68^{62}}$	.	.	.	$6^{4.7}$	.	.	.
Amaranthus retroflexus	.	.	25	$\mathbf{78^{48}}$	.	9	.	$\mathbf{68^{41}}$	.	8	38^{22}
Solanum nigrum	.	.	42^{28}	$\mathbf{54^{37}}$	.	.	.	27^{18}	.	10	11
Veronicetum trilobae-triphyllidi											
Arabidopsis thaliana	.	.	.	.	$\mathbf{54^{71}}$	.	2	.	.	.	2
Erophila verna	.	.	.	.	$\mathbf{29^{53}}$	1	.	.	.	.	.
Veronica triphyllos	.	.	.	.	$\mathbf{27^{52}}$	.	.	.	.	.	.
Lamium purpureum	.	.	33	17	$\mathbf{92^{45}}$	57^{27}	25^{11}	53^{25}	.	56^{27}	36^{17}
Aphanes arvensis	.	.	.	.	$\mathbf{69^{42}}$	$\mathbf{88^{54}}$	$\mathbf{91^{56}}$	9	.	3	.
Veronica polita	.	.	.	2	$\mathbf{29^{40}}$	5	4	$5^{5.9}$	.	.	2
Cardamine hirsuta	.	.	8	2	$\mathbf{35^{37}}$	3	4	5	.	$10^{9.9}$	7
Viola arvensis	1	4	8	5	$\mathbf{83^{36}}$	$\mathbf{93^{41}}$	$\mathbf{98^{43}}$	39^{16}	.	$26^{9.4}$	15
Cerastium glomeratum	.	.	25	5	$\mathbf{56^{32}}$	46^{26}	38^{21}	28^{15}	1	3	2
Alchemillo-Matricarietum											
Matricaria chamomilla	.	.	.	.	27^{17}	$\mathbf{100^{67}}$	.	18^{11}	.	8	4
Apera spica-venti	.	.	.	.	$12^{9.1}$	$\mathbf{55^{45}}$	$\mathbf{47^{38}}$	1	.	5	2
Myosotis arvensis	1	.	.	2	60^{28}	$\mathbf{86^{41}}$	$\mathbf{95^{45}}$	$19^{7.3}$	.	26^{11}	16^{6}
Scleranthus annuus	.	.	.	.	8^{14}	$\mathbf{20^{34}}$	.	1	.	3	.
Legousia speculum-veneris	.	32 22	.	.	21^{13}	$\mathbf{47^{32}}$	$\mathbf{91^{64}}$	1	.	3	.
Anthemis arvensis	.	39 25	.	.	$17^{9.6}$	$\mathbf{50^{32}}$	$\mathbf{69^{45}}$	$13^{7.4}$	.	10	$16^{9.4}$
Raphanus raphanistrum	.	.	.	2	17^{17}	$\mathbf{31^{32}}$	7	16^{16}	.	5	5
BC *Aphanes arvensis*-[*Scleranthion annui*]											
Valerianella rimosa	.	.	.	.	.	$7^{9.3}$	$\mathbf{35^{50}}$	.	.	5	.
Valerianella locusta	.	.	.	2	23^{27}	4	$\mathbf{42^{49}}$	.	.	.	.
Bromus secalinus	.	.	.	.	2	11^{16}	$\mathbf{29^{45}}$	.	.	.	.
Vicia angustifolia	.	.	8	.	19^{16}	16^{14}	$\mathbf{45^{41}}$	4	.	8	7
Arenaria serpyllifolia	.	7	17	5	29^{20}	23^{15}	$\mathbf{56^{39}}$	$9^{4.8}$	.	10	7
Cerastium brachypetalum	.	.	.	.	17^{23}	.	$\mathbf{27^{39}}$	.	.	.	.
Centaurea cyanus	.	.	.	.	15^{15}	24^{26}	$\mathbf{36^{39}}$	1	.	3	5
Papaver rhoeas	1	64^{28}	8	5	56^{25}	66^{29}	$\mathbf{85^{38}}$	5	1	$18^{6.3}$	7
Veronica arvensis	.	.	17	2	48^{25}	54^{28}	$\mathbf{71^{38}}$	6	1	5	4
Vicia hirsuta	.	4	8	2	10	31^{26}	$\mathbf{42^{35}}$	4	.	3	2
Panico-Chenopodietum											
Digitaria sanguinalis	.	.	17	17^{10}	.	9	4	$\mathbf{74^{49}}$	.	5	45^{30}
Chenopodium polyspermum	.	.	.	17	.	$16^{6.8}$	2	$\mathbf{91^{47}}$	2	38^{19}	$16^{6.9}$
Polygonum persicaria	.	.	8	49^{20}	2	18	7	$\mathbf{80^{34}}$	.	62^{26}	51^{21}
Amaranthus powellii	.	.	.	.	.	.	.	$\mathbf{19^{32}}$	.	3	7^{12}
Hyosciamo-Chenopodietum hybridi											
Chenopodium hybridum	.	.	.	.	.	.	.	.	$\mathbf{2^{98}}$	.	.
Galeopsido-Galinsogetum											
Mentha arvensis	.	25^{15}	.	.	4	32^{19}	31^{18}	37^{22}	.	$\mathbf{64^{40}}$	31^{18}
Galeopsis tetrahit	.	.	.	.	4	$15^{9.8}$	2	6	.	$\mathbf{44^{32}}$	9
Galinsoga parviflora	.	.	.	$24^{9.9}$	.	$19^{7.2}$	4	63^{29}	.	$\mathbf{67^{31}}$	53^{24}
Echinochloo-Setarietum											
Echinochloa crus-galli	.	.	8	$24^{9.8}$	.	9	2	$\mathbf{95^{45}}$	.	3	$\mathbf{89^{42}}$
Setaria pumila	1	.	33	41^{17}	.	7	.	$\mathbf{87^{39}}$	.	10	$\mathbf{69^{31}}$
Stellarietea mediae											
Stellaria media	1	7	100^{30}	76^{22}	96^{28}	85^{25}	49^{13}	83^{24}	2	87^{25}	58^{16}
Cirsium arvense	1	$32^{7.7}$	58^{17}	39^{10}	50^{14}	54^{15}	64^{19}	57^{16}	.	77^{23}	51^{14}

Column	1	2	3	4	5	6	7	8	9	10	11
Capsella bursa-pastoris	.	.	83^{25}	46^{12}	92^{28}	74^{22}	$38^{9.7}$	76^{23}	1	69^{20}	55^{15}
Chenopodium album agg.	.	36^{10}	25	71^{23}	15	41^{12}	9	88^{29}	2	54^{17}	71^{23}
Oxalis fontana	1	.	8	2	8	38^{17}	$20^{7.7}$	61^{28}	2	10	5
Sonchus asper	1	.	17	24^{10}	2	9	$16^{6.1}$	31^{13}	.	31^{13}	5
Sonchus oleraceus	.	11	25	39^{23}	10	1	4	24^{13}	.	$15^{8.1}$	25^{14}
Sonchus arvensis	.	4	8	7	8	3	9	15^{11}	.	31^{24}	33^{26}
Equisetum arvense	1	4	.	10	12	7	$20^{5.2}$	$21^{5.7}$	.	15	33^{10}
Sinapis arvensis	.	32^{30}	.	12^{11}	.	4	2	$10^{8.8}$	.	8	7
Vicia tetrasperma	.	.	.	5	6	16^{17}	24^{25}	2	.	3	4
Setaria viridis	.	.	17	20^{15}	.	7	.	28^{22}	.	5	$13^{9.2}$
Amaranthus hybridus s. str.	.	.	8	22^{27}	.	1	.	$6^{6.1}$	.	.	$7^{8.3}$
Atriplex patula	1	.	.	10	.	4	.	20^{12}	.	3	$11^{5.6}$
Galinsoga ciliata	.	.	.	.	.	3	.	17^{15}	1	33^{29}	7
Diplotaxis muralis	.	7	17	27^{29}	2	.	.	4	.	.	4
Euphorbia falcata	1	29^{23}	.	2	.	.	.	1	.	3	.
Amaranthus lividus	.	.	.	5	.	3	.	24^{24}	.	.	9
Other											
Convolvulus arvensis	.	39^{11}	58^{17}	61^{18}	$29^{7.1}$	72^{22}	80^{25}	65^{20}	.	54^{16}	67^{21}
Polygonum aviculare agg.	1	25	.	$29^{6.7}$	17	$36^{9.2}$	16	53^{15}	1	$38^{9.9}$	62^{18}
Calystegia sepium	1	.	42	$44^{9.6}$	4	$38^{7.8}$	$33^{6.2}$	46^{10}	.	49^{11}	58^{14}
Taraxacum officinale agg.	1	4	17	$46^{9.5}$	48^{10}	20	24	$29^{4.5}$	1	18	31^{5}
Agropyron repens	.	29	42	29	4	53^{13}	44^{10}	$35^{7.5}$	.	51^{13}	$38^{8.6}$
Rorippa sylvestris	.	.	17	12	6	$16^{6.5}$	$20^{8.5}$	29^{13}	.	23^{10}	45^{22}
Ranunculus repens	.	.	17	10	35	$35^{5.2}$	$40^{6.5}$	$45^{7.8}$	.	$41^{6.8}$	$51^{9.5}$
Galium aparine	.	21	.	.	58^{17}	74^{22}	75^{22}	$23^{4.5}$	.	51^{14}	13
Poa annua	.	.	33	15	29^{8}	8	4	$22^{5.3}$	1	$26^{6.7}$	5
Rumex obtusifolius	.	.	.	5	$29^{7.1}$	12	18	26^{6}	1	$33^{8.6}$	$29^{7.1}$
Cynodon dactylon	1	.	33^{18}	$20^{9.7}$	.	4	$11^{4.6}$	6	.	3	$11^{4.6}$
Stachys palustris	.	.	.	5	6	$15^{9.8}$	20^{14}	34^{24}	.	21^{14}	9
Erigeron annuus	.	11	.	5	$29^{7.6}$	20	7	$24^{5.6}$	1	8	11
Plantago major	.	.	17	10	8	12	7	$31^{7.8}$	1	10	13
Medicago lupulina	1	32^{11}	.	$20^{5.9}$	4	.	9	8	.	5	9
Rumex crispus	.	46^{24}	25	$17^{7.6}$	8	1	.	2	.	3	2
Polygonum lapathifolium	1	.	.	12	2	8	7	54^{24}	.	15	31^{13}
Trifolium repens	.	.	.	7	8	18	9	12	1	38^{10}	13
Poa trivialis	.	.	.	2	23	$36^{8.4}$	44^{11}	3	.	8	.
Plantago lanceolata	.	7	8	.	12	7	4	9	.	21	7
Achillea millefolium	.	4	.	.	10	8	16	10	.	21	11
Ranunculus bulbosus	.	.	33^{21}	5	4	.	.	1	.	.	4
Leontodon hispidus	.	.	.	5	.	.	.	11	.	$28^{7.7}$	$25^{6.7}$
Aristolochia clematitis	.	.	25^{26}	17^{18}	.	.	.	1	.	.	.
Medicago sativa	.	25^{28}	.	.	2	.	.	.	.	.	.

Results

The 11 groups of weed vegetation formally classified by Cocktail definitions for Slovenia are presented in Table 2. In the descriptions of syntaxa, species with a high fidelity (phi ≥ 0.3) or a high frequency (80%) are in bold.

Class: *Stellarietea mediae* R. Tx., Lohmeyer et Preising in R. Tx. ex von Rochow 1951
Subclass: *Violenea arvensis* Hüppe et Hofmeister ex Jarolímek et al. 1997
Order: *Centaureetalia cyani* R. Tx., Lohmeyer et Preising in R. Tx. ex von Rochow 1951
Alliance: *Caucalidion lappulae* R. Tx., Lohmeyer et Preising in R. Tx ex von Rochow 1951
1. *Kickxietum spuriae* Kruseman et Vlieger 1939
2. *Galio tricornuti-Ranunculetum arvensis* Kaligarič 2001
Alliance: *Veronico-Euphorbion* Sissingh ex Passarge 1964
3. *Geranio-Allietum* R. Tx. ex von Rochow 1951
4. *Mercurialietum annuae* Kruseman et Vlieger 1939
5. *Veronicetum trilobae-triphyllidi* Slavnić 1951 corr. Holzner 1973
Order: *Atriplici-Chenopodietalia albi* R. Tx. (1937) Nordhagen 1940
Alliance: *Scleranthion annui* (Kruseman et Vlieger 1939) Sissingh in Westhoff et al. 1946
6. *Alchemillo-Matricarietum* R. Tx. 1937
7. Basal community[1] *Alchemilla arvensis*-[*Scleranthion annui*]
Order: *Oxalidion europaeae* Passarge 1978
8. *Panico-Chenopodietum* R. Tx. 1937
9. *Hyoscyamo-Chenopodietum hybridi* Mucina 1993
10. *Galeopsido-Galinsogetum* Poldini et al. 1998
Order: *Panico-Setarion* Sissingh in Westhoff et al. 1946
11. *Echinochloo-Setarietum* Felföldy 1942 corr. Mucina 1993

1. *Kickxietum spuriae* Kruseman et Vlieger 1939

Diagnostic species: ***Euphorbia exigua, Kickxia spuria, Thlaspi perfoliatum***
Cocktail definitions: Group Kickxia OR (Group Chenopodium polyspermum AND Kickxia elatine UP10)

The species *Kickxia spuria*, which is also a diagnostic species, prevails. Diagnostic species of higher syntaxa are more abundant, which accords with Kaligarič (2001), i.e. most communities of the *Caucalidion lappulae* alliance are based on dominance of one or two diagnostic species of the alliance, but species characteristic of order and class are more frequent. Stands thrive in stubble fields or newly ploughed fields. The sites are base-rich, usually on gentle slopes. *Kickxietum spuriae* was found in the SP phytogeographic area. Due to geographical stratification only one relevé was included in the analysis. In neighbouring countries, this association occurs in Croatia (Hulina 2002). Due to the intensification of agriculture, stubble field vegetation and its characteristic species are threatened with extinction (Lešnik 2001).

2. *Galio tricornuti-Ranunculetum arvensis* Kaligarič 2001

Diagnostic species: *Agrostemma githago, Ajuga chamaepitys, Anagallis arvensis,* ***Avena barbata, Bifora radians, Consolida regalis,*** *Fallopia convolvulus,* ***Galium tricornutum, Ranunculus arvensis, Rapistrum rugosum,*** *Vicia sativa* agg., *V. villosa*

[1] Classified by using a deductive approach (Kopecký & Hejný 1978)

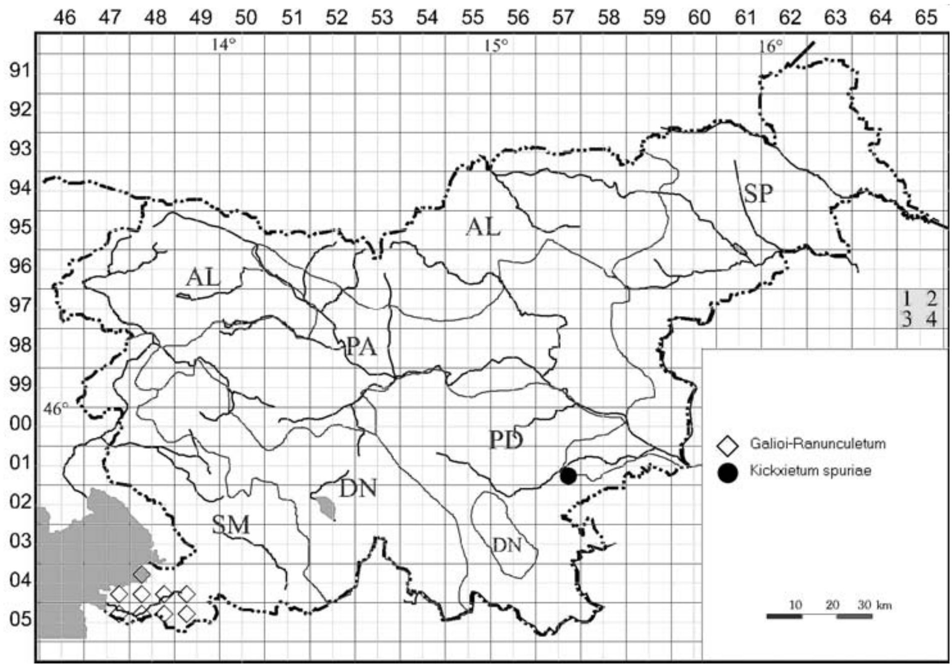

Fig. 1. – Distribution of communities of the alliance *Caucalidion* in Slovenia.

Constant species: *Anagallis arvensis, Avena barbata, Consolida regalis,* ***Fallopia convolvulus, Galium tricornutum,*** *Papaver rhoeas, Ranunculus arvensis, Vicia sativa* agg.
Cocktail definitions: Group Galium tricornutum

Species *Galium tricornutum* and *Bifora radians* are characteristic of these stands and *Consolida regalis, Agrostemma githago* and *Ranunculus arvensis* are also abundant. This community grows in warm, moist and base rich sites on flysch soils. Stands prevail on extensively cultivated cereal fields. It has so far been found in Koprsko Primorje (SM region) and is endemic to Slovenia. Potentially it could be present further north (Kras, Brkini, Vipava Valley and Goriška) or east in the interior of Istria (Kaligarič 2001). Stands are threatened due to changes in cultivation (mechanization, use of treated commerical seeds and herbicides); they still exist because of small fragmented fields, uneven relief and the existence of traditional cultivation methods in the distribution area.

3. *Geranio-Allietum* R. Tx. ex von Rochow 1951

Diagnostic species: ***Allium vineale,*** *Bromus sterilis,* ***Calepina irregularis, Cerastium tenoreanum, Crepis taraxacifolia,*** *Erodium cicutarium, Euphorbia helioscopia, Fumaria officinalis, Geranium dissectum, G. rotundifolium, Lamium amplexicaule,* ***Muscari racemosum, Ornithogalum umbellatum****, Senecio vulgaris, Solanum luteum, Trifolium incarnatum* subsp. *molineri, Valerianella carinata, Veronica hederifolia, V. persica, Vicia sativa* agg.
Constant species: ***Allium vineale, Capsella bursa-pastoris,*** *Cirsium arvense, Convolvulus arvensis, Euphorbia helioscopia, Senecio vulgaris,* ***Stellaria media, Veronica persica,*** *Vicia sativa* agg.
Cocktail definitions: (Group Allium vineale OR (Allium vineale AND Group Mercurialis annua)) NOT Agropyron repens UP10

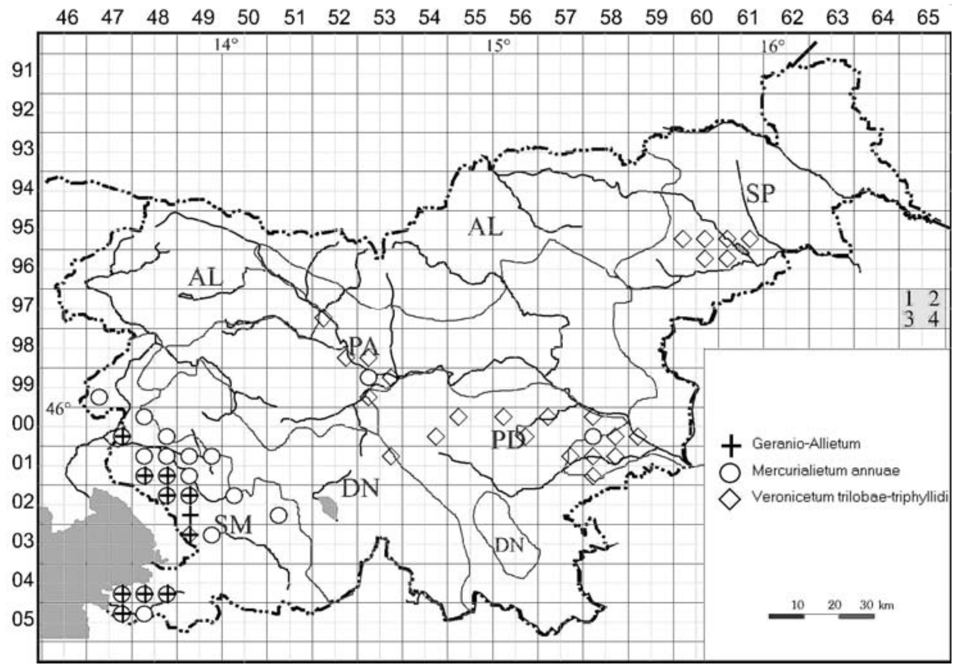

Fig. 2. – Distribution of communities of the alliance *Veronico-Euphorbion* in Slovenia.

Geophytes like *Allium vineale*, *Ornithogalum umbellatum*, *Muscari racemosum*, *Gagea villosa* and *Allium ameloprasum* give a special character to this community. More constant species are: *Stellaria media*, *Veronica persica* and *Capsella bursa-pastoris*. The community occurs in vineyards on terra rossa soils, rarely on cromic cambisol. It is found in extremely warm, dry and heavily fertilized vineyards. Stands are most developed early in spring (March–May). This association occurs in the sub-Mediterranean part of Slovenia (karst area, coast; Fig. 1). It is likely that it never occured in continental areas. In neighbouring countries, it is found in Italy (Poldini et al. 1998), Austria (Mucina 1993) and Germany (von Rochow 1951, Wilmanns 1975). Changes in vine cultivation have threatened this community. It is most developed only in vineyards that are cultivated in summer and not trench-ploughed. Mineral manuring in spring is also a cause of decline (Seljak 1989).

4. *Mercurialietum annuae* Kruseman et Vlieger 1939

Diagnostic species: *Amaranthus retroflexus,* ***Mercurialis annua,*** *Senecio vulgaris, Solanum nigrum*
Constant species: *Amaranthus retroflexus, Chenopodium album* agg.*, Convolvulus arvensis, Euphorbia helioscopia, Mercurialis annua, Solanum nigrum, Stellaria media, Veronica persica*
Cocktail definitions: Group Mercurialis annua AND Mercurialis annua UP5

Mercurialis annua is the dominant and most abundant species of this association. *Mercurialietum annuae* is found on fertile, regularly and carefully cultivated soils, rich in potassium and other bases. It is a markedly thermophilous community, but with a mesophilous character in the sub-Mediterranean part of Slovenia. It is found in hoe-fields (gardens, vineyards, potato fields, tree nurseries; Seljak 1989, Kaligarič 1992b) and most developed in late summer and early autumn. The association is widely distributed in the sub-Mediterranean part of Slovenia (Fig. 2). Some localities are also in PA and PD areas (urban sites and vineyards). Outside Slovenia, the association occurs in Hungary (Borhidi 2003) and Croatia (Hulina 1978, Topić 1984). Mucina (1993) reports this association as extinct in Austria.

5. *Veronicetum trilobae-triphyllidi* Slavnić 1951 corr. Holzner 1973

Diagnostic species: *Aphanes arvensis,* ***Arabidopsis thaliana,*** *Cardamine hirsuta, Cerastium glomeratum,* ***Erophila verna,*** *Lamium purpureum,* ***V. hederifolia,*** *V. polita,* ***Veronica triphyllos,*** *Viola arvensis*
Constant species: *Aphanes arvensis, Arabidopsis thaliana,* ***Capsella bursa-pastoris,*** *Cerastium glomeratum, Galium aparine,* ***Lamium purpureum,*** *Myosotis arvensis, Papaver rhoeas,* ***Stellaria media, Veronica hederifolia,*** *V. persica,* ***Viola arvensis***
Cocktail definitions: Group Veronica hederifolia OR (Veronica triphyllos AND Group Aphanes arvensis)

Veronica hederifolia is the most abundant and frequent species in this association. Phenological development is at its maximum before the cereals are fully developed. As cereals compete for nutrients and light, this species declines (Otte 1990). *Veronica triphyllos* is relatively rare in Slovenia and is found in the NE parts (Lešnik 1995). Lešnik (2001) estimates that it grows in 4–6% of the fields in Slovenia, but is in decline. This community is most developed in early spring and is dominated by ephemerophytes. It occurs in ploughed fields, stubble fields, vineyards and cereals, that are not higher than 30 cm. Stands develop on humid soils with minimal agrotechnical treatment. Distribution is shown in Fig. 2, new localities are expected mainly in NE Slovenia. This association is widespread in Central and SE Europe: Austria (Mucina 1993), Czech Republic (Kropáč 1997, 2006, Lososová 2004), Serbia (Slavnić 1951), Slovakia (Mochnacký 2000) and Hungary (Borhidi 2003). This community thrives in winter wheat on less fertile sandy soils (Albrecht et al. 2000), which are rare and harbour fields that are usually first abandoned.

6. *Alchemillo-Matricarietum* R. Tx. 1937

Diagnostic species: *Anthemis arvensis, Apera spica-venti,* ***Aphanes arvensis,*** *Legousia speculum-veneris,* ***Matricaria chamomilla,*** *Myosotis arvensis, Raphanus raphanistrum, Scleranthus annuus, Viola arvensis*
Constant species: *Apera spica-venti,* ***Aphanes arvensis,*** *Capsella bursa-pastoris, Cirsium arvense, Convolvulus arvensis, Agropyron repens, Galium aparine, Lamium purpureum,* ***Matricaria chamomilla, Myosotis arvensis,*** *Papaver rhoeas,* ***Stellaria media,*** *Veronica arvensis,* ***Viola arvensis***
Cocktail definitions: (Group Aphanes arvensis NOT Group Veronica hederifolia) AND Matricaria chamomilla

Stands are two-layered. The upper layer of weeds is well developed because of competition for light with relatively high and dense crop plants. The majority of the biomass is concentrated in the upper layer of the community (Jarolímek et al. 1997). Characteristic species of classes *Artemisietea* and *Molinio-Arrhenatheretea* are abundant as they invade this community from neighbouring marginal grasslands, especially grasses resistant to herbicides. *Alchemillo-Matricarietum* is the most common association in corn fields, but is rarely found in root crops or newly ploughed fields, as recorded by Brun-Hool (1963) and Mochnacký (2000). It occurs in the colline belt on flat relief on various soils, mostly loamy soils developing on bedrock without skeleton. This community is most developed in summer (June–July), when cereals are mature. Probably it is distributed over the whole

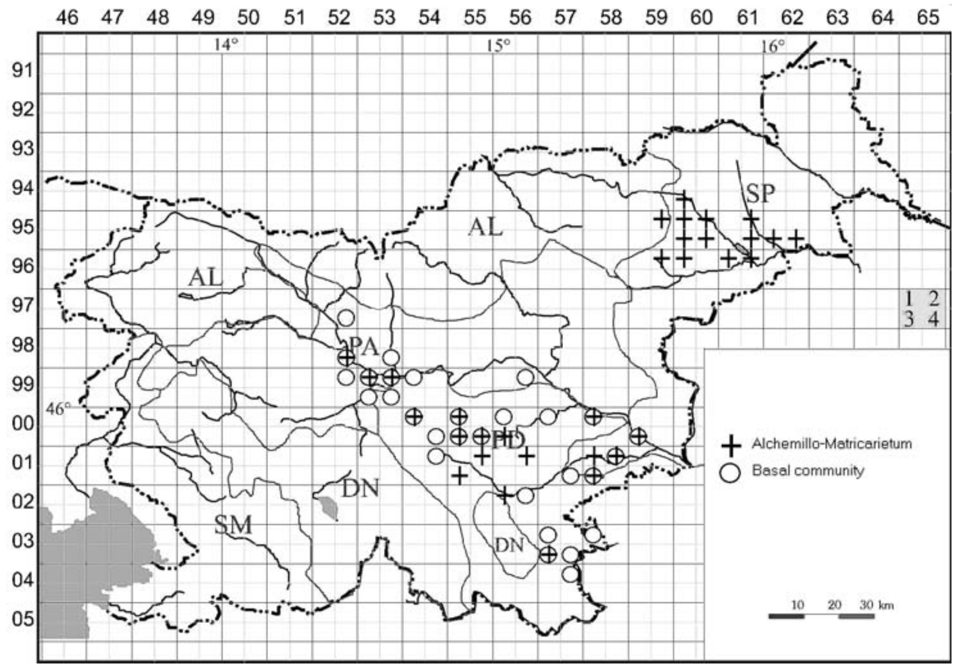

Fig. 3. – Distribution of communities of the alliance *Scleranthion annui* in Slovenia.

of Slovenia, except in SM region (Fig. 3). It is one of the most common weed associations in Central Europe. Its distribution ranges from Poland (Anioł-Kwiatkowska 1990) to Macedonia (Kratovalieva 2002). Intensification of agriculture threatens this association, which is then replaced by impoverished stands of the basal community *Aphanes arvensis*-[*Scleranthion annui*]. Syntaxa characteristic of extreme sites (acid, wet) are declining as farmers abandon such fields.

7. Basal community *Aphanes arvensis*-[*Scleranthion annui*]

Diagnostic species: *Anthemis arvensis, Apera spica-venti,* ***Aphanes arvensis,*** *Arenaria serpyllifolia, Bromus secalinus, Centaurea cyanus, Cerastium brachypetalum,* ***Legousia speculum-veneris,*** *Myosotis arvensis, Papaver rhoeas, Ranunculus arvensis, Valerianella locusta,* ***Valerianella rimosa,*** *Veronica arvensis, Vicia angustifolia, V. hirsuta, Viola arvensis*

Constant species: *Anthemis arvensis,* ***Aphanes arvensis,*** *Arenaria serpyllifolia, Cirsium arvense, Convolvulus arvensis, Galium aparine,* ***Legousia speculum-veneris, Myosotis arvensis, Papaver rhoeas,*** *Veronica arvensis, V. persica,* ***Viola arvensis***

Cocktail definitions: (Group Aphanes arvensis NOT Group Veronica hederifolia) NOT Matricaria chamomilla

The basal community *Aphanes arvensis*-[*Scleranthion annui*] comprises impoverished stands of the above described association of *Scleranthion annui* without characteristic species and is classified according to the deductive method (Kopecký & Hejný 1978). Some diagnostic species are also present with relative high fidelity and frequency in the association *Alchemillo-Matricarietum. Matricaria chamomilla* disappears from intensely

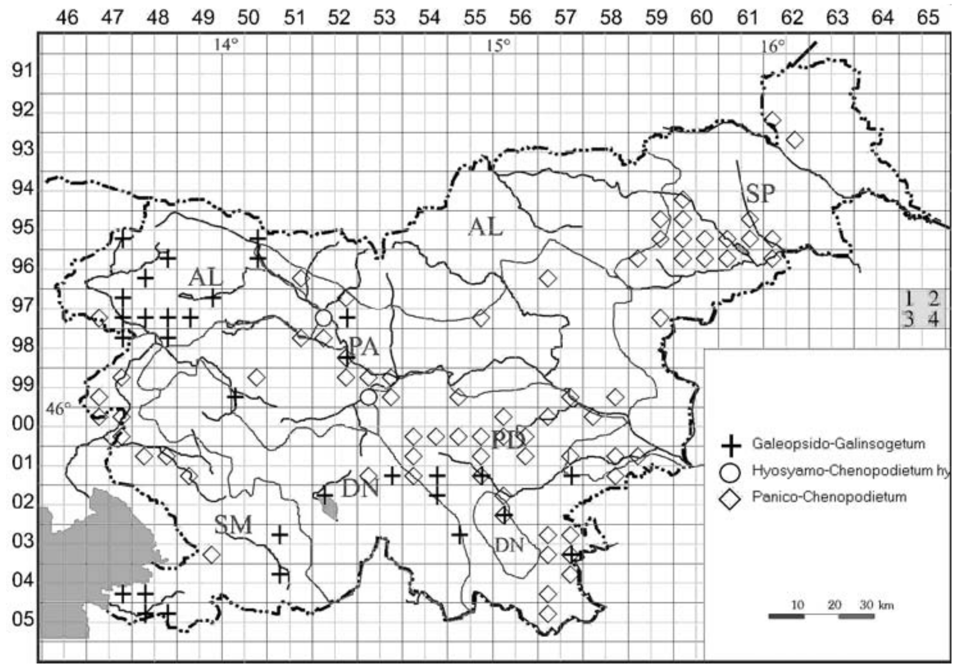

Fig. 4. – Distribution of communities of the alliance *Oxalidion europaeae* in Slovenia.

cultivated fields (Dunker & Hüppe 2000). The basal community is widely distributed in PA, PD and SP. Probably it occurs throughout the whole of Slovenia, as the current distribution is largely a consequence of the sampling effort. The basal community occurs throughout the whole area of distribution of the association *Alchemillo-Matricarietum* and many relevés classified in this association belong to the basal community.

8. *Panico-Chenopodietum* R. Tx. 1937

Diagnostic species: *Amaranthus powellii, A. retroflexus, Chenopodium polyspermum, Digitaria sanguinalis, Echinochloa crus-galli, Polygonum persicaria, Setaria pumila*

Constant species: *Amaranthus retroflexus, Capsella bursa-pastoris,* ***Chenopodium album* agg., *Ch. polyspermum,*** *Cirsium arvense, Convolvulus arvensis, Digitaria sanguinalis,* ***Echinochloa crus-galli,*** *Galinsoga parviflora, Lamium purpureum, Oxalis fontana, Polygonum lapathifolium, P. persicaria, P. aviculare* agg., ***Setaria pumila, Stellaria media***

Cocktail definitions: (Group Chenopodium polyspermum AND Group Setaria pumila) NOT Group Aphanes arvensis

Stands are three layered. In the upper layer (150 cm) *Chenopodium album*, *Amaranthus retroflexus*, *A. powellii*, *Cirsium arvense* and *Echinochloa crus-galli* dominate. Most of the stand's biomass is in the middle layer and is made up of *Chenopodium polyspermum*, *Setaria pumila*, *Polygonum lapathifolium* and *Polygonum persicaria*. In the lower layer are species that do not require high light intensities and temperatures. This community occurs in root crops and stubble fields in late summer and autumn. It grows in wet and shaded soils, in depressions in fields or soils compacted by mechanization. This community occurs throughout Slovenia (Fig. 4) and all of Central Europe (Lososová 2004). It is not threatened, but due to the draining and abandonment of wetter areas suitable sites are becoming rarer.

9. *Hyoscyamo-Chenopodietum hybridi* Mucina 1993

Diagnostic species: ***Chenopodium hybridum***
Constant species: ***Chenopodium album* agg.*, Ch. hybridum, Ch. polyspermum, Oxalis fontana, Stellaria media***
Cocktail definitions: Chenopodium hybridum UP 20

Stands are dominated by *Chenopodium hybridum*. This community grows on moist, nutrient-rich soils. It is characteristic of gardens. Only the locality in Ljubljana, central Slovenia, has so far been published (Šilc 2004). Recently, stands in Kranj and the surroundings of Ljubljana were reported (Šilc & Košir 2006) and new sites are likely to be recorded.

10. *Galeopsido-Galinsogetum* Poldini et al. 1998

Diagnostic species: *Galeopsis tetrahit, Galinsoga parviflora, Mentha arvensis*
Constant species: *Capsella bursa-pastoris, Chenopodium album* agg., *Cirsium arvense, Convolvulus arvensis, Agropyron repens, Galinsoga parviflora, Galium aparine, Lamium purpureum, Mentha arvensis, Polygonum persicaria,* ***Stellaria media,*** *Veronica persica*
Cocktail definitions: Group Galeopsis tetrahit NOT (Echinochloa crus-galli OR Group Aphanes arvensis OR Matricaria chamomilla)

In stands *Galinsoga parviflora* dominates, but this species can be completely replaced by *G. ciliata*. Stands are two-layered, with *Galeopsis tetrahit*, *Chenopodium album* and *Sonchus arvensis* in the upper layer, and *Mentha arvensis*, *Stellaria media*, *Lamium purpureum* and *Fallopia convolvulus* in the lower layer. This community occurs in small fields and gardens in the vicinity of villages in mountain belts. The fields are located on saddles, terraced slopes, levelled wide mountain ridges (fields in alpine valleys of PA are on steeper slopes) with brown soils on marl or skeletal rendzinas (glacier moraines). Altitudinal range is between 600 and 1050 m a.s.l. Soils on skeletonal rendzinas are less fertile than on flysh and marl, but manuring with stable manure has improved the structure of the soils. The main factor affecting this habitat is the cold and wet mountain climate. Potato is a typical crop for this region, sometimes beans or cabbage, often grown as a mixture in the same field. Fields are cultivated manually and mechanized cultivation is rare. They are dug over in spring and sometimes weeded during the growing season. Potatoes are harvested in September. This association is distributed in the AL region. Some root-crop relevés were assigned to this association as they lack thermophilous C4 plants. The reason is intensive agriculture not the mountain climate. This association is recorded in Italy (Poldini et al. 1998) and Slovenia (Šilc & Čušin 2005). Stands are threatened by the abandonment of farming in the mountains.

11. *Echinochloo-Setarietum* Felföldy 1942 corr. Mucina 1993

Diagnostic species: *Echinochloa crus-galli, Setaria pumila*
Constant species: *Calystegia sepium, Capsella bursa-pastoris, Chenopodium album* agg., *Cirsium arvense, Convolvulus arvensis,* ***Echinochloa crus-galli,*** *Galinsoga parviflora, Polygonum persicaria, P. aviculare* agg., *Ranunculus repens, Setaria pumila, Stellaria media*

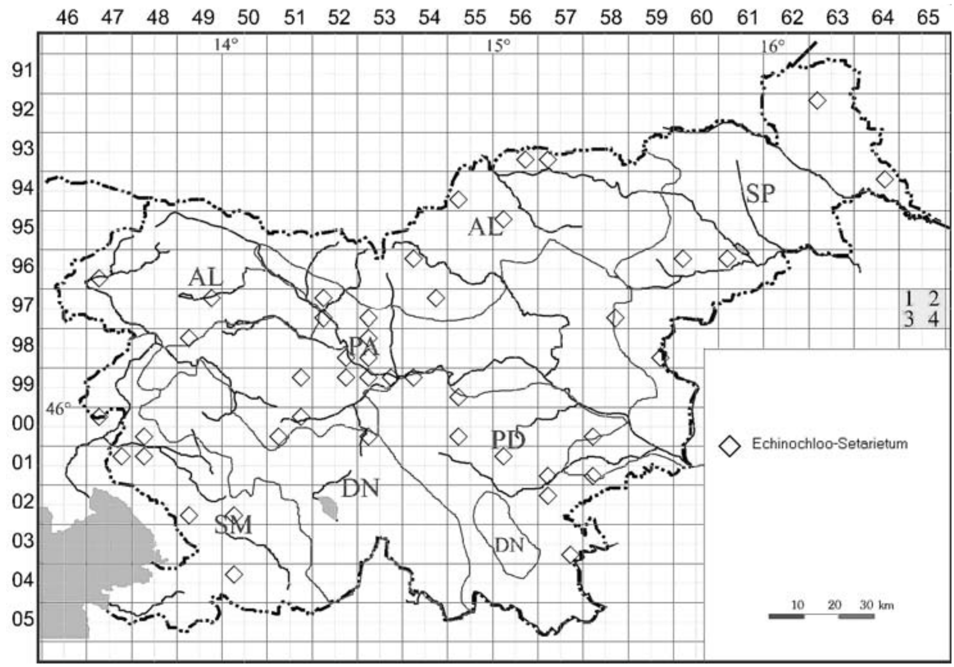

Fig. 5. – Distribution of the association *Echinochloo-Setarietum* in Slovenia.

Cocktail definitions: Group Setaria pumila NOT (Group Chenopodium polyspermum OR Group Mercurialis annua)

The physiognomy of stands is similar to that of the association *Panico-Chenopodietum*. The community is three-layered. The upper layer (150 cm) is dominated by *Chenopodium album*, *Amaranthus retroflexus*, *A. powellii*, *Cirsium arvense* and *Echinochloa crus-galli*. The middle layer consists of species up to 100 cm in height. In the lower layer are species less demanding of high light intensity and high temperature: *Plantago major* and *Trifolium repens*. The *Echinochloo-Setarietum* is found in root crops and stubble fields. In contrast to the association *Panico-Chenopodietum,* this community is found on thermophilous sites, dominated by C4 plants. It is widespread in Slovenia (Fig. 5) and also occurs in Hungary (Borhidi 2003), Italy (Poldini et al. 1998) and Austria (Mucina 1993). This association is not threatened, but weed vegetation is under constant anthropogenic pressure that equalizes sites. The stands are therefore becoming similar and hardly recognizable and divisible.

The environmental affinities of the relevés were determined by Ellenberg indicator values (Fig. 6). Stands of the *Caucalidion* alliance include most basiphilous, dry and warm types of weed vegetation. The alliances *Oxalidion* and *Panico-Setarion* include the vegetation associated with soils richest in nutrients.

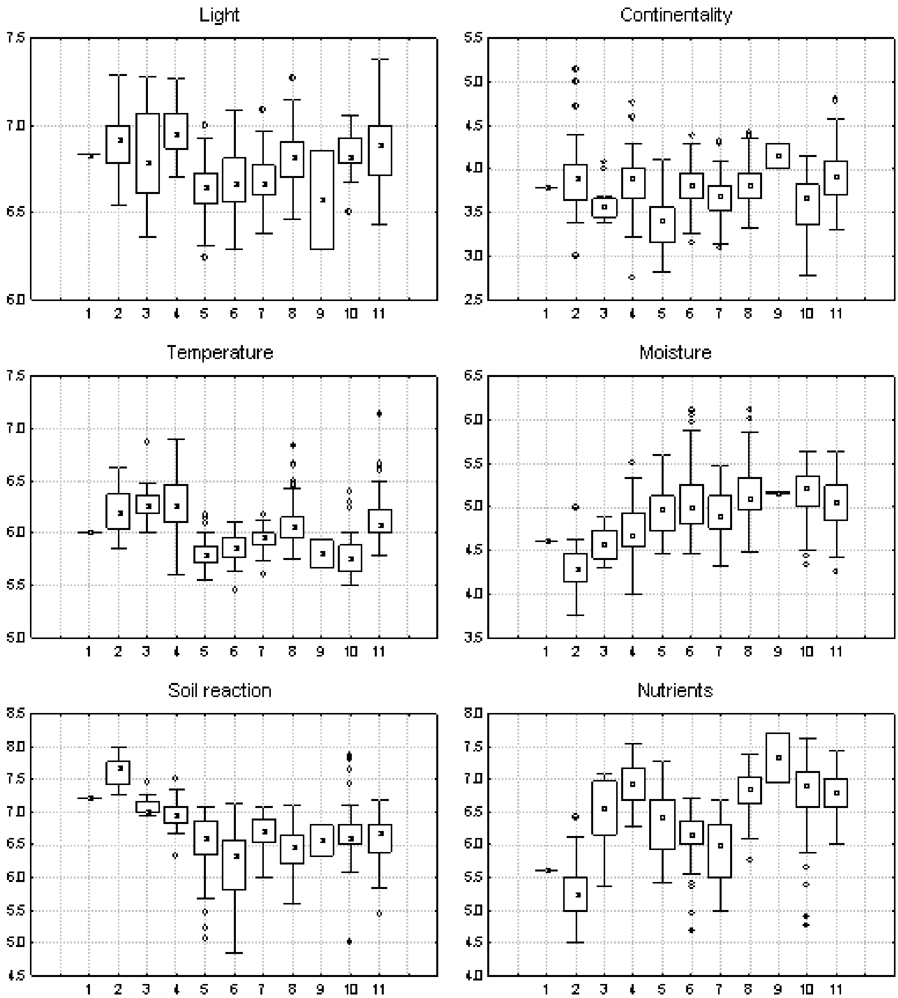

Fig. 6. – Ellenberg indicator values of weed communities in Slovenia, numbers refer to columns in the Table 2. □ – median, □ – 25–75%, ⌶ – non-outlier range, ○ – outliers, × – extreme values.

Discussion

Traditional syntaxa in national classification

Application of 11 formal definitions of phytosociological syntaxa to the dataset of 482 relevés unequivocally classified 377 relevés, of which 264 were in the same syntaxa as with traditional classification. Hundred and five unassigned relevés were classified a posteriori by calculation of the frequency-positive fidelity index. That 54% of the relevés were unambiguously classified is comparable to that obtained using a dataset of subalpine tall herbs (Kočí et al. 2003), where 52% of relevés were assigned to the same associations as by the expert-based method.

There are problems with this method of classification as discussed by Lososová (2004). In our dataset delimitation by formal classification of (i) ephemerophytic and vernal communities and (ii) communities negatively defined by the absence of species, was difficult. Delimitation of plant communities of ephemerophytes and phenological aspects used to separate associations in the phytosociological sense is well supported and seems appropriate (Zalokar 1939, Kropáč et al. 1971). A similar classification was obtained by Lososová (2004) using the same formal classification method.

Lososová et al. (2006), however, reported greater similarity between vernal communities than between vernal and summer communities at the same site. But classification of the Slovenian dataset reveals a strong similarity between associations *Veronicetum trilobae-triphyllidi* and *Aphano-Matricarietum*, that appear on the same sites at different seasons. The most problematic is delimitation of the association *Galeopsido-Galinsogetum*, an association of high altitudes, characterized by the presence of species characteristic of moist sites and by an absence of C4 plants (Poldini et al. 1998, Šilc & Čušin 2005). This association is well defined on a regional scale using traditional classification, but the formalized classification does not conform with the expert-based classification. *Galeopsido-Galinsogetum* is a floristically unspecific community, as it is dominated by common species and negatively defined towards weed vegetation of root crops by the absence of C4 species. Altitude and a montane environment are reasons for the absence of C4 plants.

There could be various reasons for the poor agreement with the traditional classification, such as altitude, agricultural methods or sampling. The change of scale from local to regional changes the affinity of some species to species groups. Sociological species groups from a mountainous area are not always recognized at the regional scale (Kuželová & Chytrý 2004). Influences of higher altitudes on the floristic composition with an increase in the number of species from adjacent vegetation and a low proportion of alien species have been recorded (Lososová et al. 2004). Modern agricultural techniques result in fragmented stands that lack C4 plants in lowlands. Their floristic composition is similar to that of the depauperated montane stands. These relevés were then a posteriori assigned according to similarity.

The preferential sampling could also be a reason, since authors sometimes make relevés in stands with rare species and generalists. Such relevés of species poor stands and those with rare species blur the classification. Kočí et al. (2003) also found a poor agreement between expert-based associations composed mainly of generalist species and the corresponding Cocktail definitions.

Nevertheless the Cocktail method proved useful for classifying weed vegetation types in our Slovenian dataset. Some new syntaxa were added (*Hyoscyamo-Chenopodietum hybridi*, basal community *Aphanes arvensis-Scleranthion*, *Galeopsido-Galinsogetum*, *Kickxietum spuriae*) and *Panico-Polygonetum persicariae* was merged with *Panico-Chenopodietum* compared to the synopsis of weed communities of Slovenia (Wraber 1996). We delimited all syntaxa that were described from Slovenia and relevés not classified by the Braun-Blanquet nomenclature were assigned to these delimited syntaxa.

Comparison with the weed vegetation of southern Moravia

This formalized method of classification was also applied to weed vegetation data fom S Moravia (Lososová 2004). This area differs from Slovenia in geography, altitude range and presence of certain habitats that define the floristic composition of individual syntaxa.

Both landscapes share certain common central associations of higher syntaxa (sensu Dierschke 1994): *Veronicetum trilobae-triphyllidi, Alchemillo-Matricarietum, Panico-Chenopodietum* and *Echinochloo-Setarietum,* widely distributed in Central Europe. But the majority of communities are found only in one dataset. The most striking differences between both regions are in the vernal communities. In the Slovenian dataset only there is only one vernal community: *Veronicetum trilobae-triphyllidi*. All ephemerophytes are grouped in one sociological species group and have a high tendency to occur together. In the Moravian dataset there are two communities, *Veronicetum trilobae-triphyllidi* and *Erophilo-Arabidopsietum*, with two well defined diagnostic species groups.

There are also differences in the diagnostic species of the syntaxa that are common to both datasets. The diagnostic species composition of common associations differ, but species with highest fidelity in these associations are the same. The following explanations are suggested for these differences: (i) use of different indices, (ii) differently set threshold of fidelity for diagnostic species, (iii) different Cocktail definitions of syntaxa and (iv) different scale or variability in the areas studied.

In the case of the Slovenian dataset the phi coefficient for site groups standardized for group size (Tichý & Chytrý 2006) and a new index for the assigment of relevés (Tichý 2005) was used. In the paper by Lososová (2004), the phi coefficient without standardization for group size was used. Tichý & Chytrý (2006) report differences in synoptic tables produced with standardized and non-standardized coefficients, when the groups of diagnostic species are similar. The differences could result from the differently selected levels of fidelity that define diagnostic species. The threshold is selected arbitrarily after inspection of the synoptic table. The aim of classification is to get a list of characteristic species that is short and not characteristic of several syntaxa.

Comparison of the coherence of species groups at different scales (Bruelheide & Chytrý 2000, Kuželová & Chytrý 2004) points out to the varying success in reproducing defined groups in the national dataset at the local scale. Species show different affinities to a species group at different scales. Since both datasets are local from the Central European point of view, certain species show fidelity to different associations in both datasets. This is because they reflect local environmental gradients and vegetation patterns. Combination or direction of climatic gradients, which are not prevalent in all geographic regions, and vegetation units recognized at a smaller scale cannot always be transferred to a larger scale (Diekmann 1997, Kuželová & Chytrý 2004).

Although the composition of species groups differs between the areas some of them are stable. Stability of the composition of a species group depends on gradients in a study area and they are most stable in regions with central positions on the major gradient (Kuželová & Chytrý 2004, Petřík & Bruelheide 2006). The same is valid in our case for diagnostic species groups of central associations (sensu Dierschke 1994), which display the same pattern across different scales and areas, as they share the same ecological and spatial requirements. On the other hand some local vegetation types occur in local specific environmental gradients, and do not fit into mechanically defined units at the regional scale (Kuželová & Chytrý 2004).

Comparisons of formalized classifications are as effective and unrewarding as comparisons of traditional vegetation classifications from different countries with different research traditions. But in the future formalized classifications should use datasets collected over a greater area and spanning national boundaries, comprising ecologically relevant regions.

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Souhrn

Práce je fytocenologickou syntézou plevelové vegetace Slovinska na základě historických i současných vegetačních snímků (celkem 482), klasifikovaných pomocí metody Cocktail. Bylo rozlišeno 11 syntaxonů (*Kickxietum spuriae, Galio tricornuti-Ranunculetum arvensis, Geranio-Allietum, Mercurialietum annuae, Veronicetum trilobae-triphyllidi, Alchemillo-Matricarietum,* bazální společenstvo *Alchemilla arvensis*-[*Scleranthion annui*], *Panico-Chenopodietum, Hyoscyamo-Chenopodietum hybridi, Galeopsido-Galinsogetum, Echinochloo-Setarietum*), prezentovaných pomocí synoptické tabulky (tab. 2). Ke každému syntaxonu je uvedena ekologie, diagnostické a konstantní druhy, rozšíření a případné ohrožení. Problematické je vymezení vysokohorské asociace *Galeopsido-Galinsogetum*, která je druhově chudá a tvořená převážně generalisty. Práce dále diskutuje některé problémy spojené s aplikací metody Cocktail při klasifikaci druhově chudých společenstev. Srovnání slovinské plevelové vegetace s moravskou, která byla v nedávné minulosti také zpracována stejnými metodami, ukazuje, že obě území mají společné centrální asociace některých vyšších syntaxonů, které jsou ve střední Evropě rozšířené: *Veronicetum trilobae-triphyllidi, Alchemillo-Matricarietum, Panico-Chenopodietum* a *Echinochloo-Setarietum*. Vedle výskytu syntaxonů typických pouze pro jednu z oblastí spočívají hlavní rozdíly v klasifikaci jarních plevelových společenstev.

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