

***Ranunculo traunfellneri-Paederotetum luteae*: new rock crevices association from the Julian Alps (South-Eastern Calcareous Alps)**

Ranunculo traunfellneri-Paederotetum luteae: nova asociacija skalnih razpok v Julijskih alpah (Jugovzhodne Apneniške Alpe).

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Abstract. Vegetation of rock crevices in the Krn Mts. (the Julian Alps) is briefly presented. The association *Ranunculo traunfellneri-Paederotetum luteae* ass. nova was newly described. It was classified into the alliance *Cystopteridion fragilis*. Other confirmed or identified associations are *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* (*Cystopteridion*), *Potentillo clusianae-Campanuletum zoysii*, *Campanulo carnicae-Moehringietum villosae*, *Paederoto luteae-Minuartietum rupestris*, *Saxifragetum squarroso-crustatae* and *Potentilletum nitidae* (*Androsaci-Drabion tomentosae*).

Keywords: vegetation, phytosociology, phytogeography, *Asplenietea trichomanis*, *Cystopteridion*, endemism, Alps

Izvleček. V prispevku je kratko predstavljena vegetacija skalnih razpok v Krnskem pogorju (Julijske Alpe). Asociacija *Ranunculo traunfellneri-Paederotetum luteae* je opisana na novo in v sintaksonomskem oziru pripada zvezi *Cystopteridion fragilis*. Ostale ugotovljene ali potrjene asociacije so *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* (*Cystopteridion*), *Potentillo clusianae-Campanuletum zoysii*, *Campanulo carnicae-Moehringietum villosae*, *Paederoto luteae-Minuartietum rupestris*, *Saxifragetum squarroso-crustatae* in *Potentilletum nitidae* (*Androsaci-Drabion tomentosae*).

Ključne besede: vegetacija, fitocenologija, fitogeografija, *Asplenietea trichomanis*, *Cystopteridion*, endemizem, Alpe

Introduction

The vegetation of calcareous rock crevices in the alpine belt (*Potentilletalia caulescentis*, *Androsaci helveticae-Drabion tomentosae* sensu T. Wraber) and altimontane-subalpine belt (*Potentillion caulescentis*) of the South-eastern Calcareous

Alps (the Julian Alps, the Karavanke Mts. and the Kamnik Alps) is fairly well known and has been the subject of research of many phytosociologists (e.g. AICHINGER 1933, WRABER 1967, LORENZONI 1967, WRABER 1969, SUTTER 1969, POLDINI 1969, WRABER 1970, 1972, 1978, 1980, HADERLAPP 1982, WRABER 1986, 1990, DAKSKOBLER 1994, 2000, DAKSKOBLER & ČUŠIN 2002, FRANZ 2002, SURINA 2005). As a result, many new syntaxa for the South-eastern Calcareous Alps have been recorded and subsequently confirmed, e.g. *Potentillo clusianae-Campanuletum zoysii*, *Potentilletum caulescentis*, *Spiraeo-Potentilletum caulescentis*, *Potentilletum nitidae*, *Paederoto luteae-Minuartietum rupestris*, *Potentillo caulescentis-Ostryetum carpinifoliae*, *Phyteumato scheuhzeri-Moehringietum villosae* and *Campanulo carnicae-Moehringietum villosae*.

In contrast, rock crevices communities of shaded calcareous rocks from the montane-alpine belt (*Cystopteridion fragilis*) are only poorly known. The only relevant phytosociological researches were carried out by LAUSI & GERDOL (1980), who studied stands of the association *Caricetum brachystachydis* in the western Julian Alps, and SURINA (2005), who identified stands of the association *Valeriano elongate-Asplenietum viridis* var. geogr. *Campanula zoysii* also for the Julian Alps. The aim of this paper is to present some novelties in the vegetation of shady and moist calcareous rock crevices (*Cystopteridion fragilis*) of the Krn Mts. in the Julian Alps.

Material and Methods

Phytosociological research of rock crevices vegetation (*Asplenietea trichomanis*) was conducted by applying the sigmatistic method (BRAUN-BLANQUET 1964). The two indices were calculated for each taxon, while we first performed a linear transformation of coverage values for individual taxa (van der MAAREL 1979): (a) coverage index (I_c) and (b) a share of coverage ($D_{\%}$) (LAUSI & al. 1982, SURINA 2004). Using the SYN-TAX computer programme (PODANI 1993) and an extensive synoptic phytosociological table, comparisons with similar stands from the Alps were made (see also SURINA 2005). The measure of dissimilarity was the complement of the coefficient »similarity ratio«. We used the Furthest Neighbour – Complete Linkage clustering method (CL), Minimization of Increase of Error Sum of Squares (MISSQ) and the ordination method of Principal Coordinates Analysis (PCoA). Groups of diagnostic species were formed on the basis of our own criteria, but with regard to numerous authors. The floristic composition of the researched stands was analysed according to chorological groups and Raunkiaer's plant life forms. Here we followed Flora alpina (AESCHIMANN & al. 2004), which was simultaneously a nomenclature source for the phanerogams. Names of mosses are in agreement with the Annotated Check-list of the Mosses of Slovenia (MARTINČIČ 2003), while the nomenclature of higher syntaxa is according to THEURILLAT and co-workers (1995). The research was carried out at the Institute of Biology, Scientific Research Centre of Slovenian Academy of Sciences and Arts in Ljubljana (Slovenia).

Results and Discussion

Altogether 82 relevés of the class *Asplenietea trichomanis* were made in the Krn Mts. By means of cluster analyses and diagnostic species, the relevés were classified into lower rank syntaxa (Tab. 1). We have identified seven rock-crevices associations in the Krn Mts. (Tab. 1): *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* (1), hygrophilous stands with predominating *Paederota lutea* (2), *Paederoto luteae-Minuartietum rupestris* (3), *Potentillo clusianae-Campanuletum zoysii* (4), *Potentilletum nitidae* (5), *Campanulo carnicae-Moehringietum villosae* and stands with predominating *Saxifraga crustata* (*Saxifragetum squarroso-crustatae*). The two last were not included in the present consideration.

Table 1. Reduced synoptic table of syntaxa of the class *Asplenietea trichomanis* in the Krn Mts. (Julian Alps) – only characteristic and differential (d) species of syntaxa of the class *Asplenietea trichomanis* are listed; 1 – *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* var. geogr. nova, 2 – *Ranunculo traunfellneri-Paederotetum luteae* ass. nova, 3 – *Paederoto luteae-Minuartietum rupestris*, 4 – *Potentillo clusianae-Campanuletum zoysii*, 5 – *Potentilletum nitidae*.

Tabela 1. Skrajšana sintezna tabela sintaksonov razreda *Asplenietea trichomanis* iz Krnskega pogorja (Julijske Alpe) – navedene so samo značilne in razlikovalne vrste (d) sintaksonov razreda *Asplenietea trichomanis*; 1 – *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* var. geogr. nova, 2 – *Ranunculo traunfellneri-Paederotetum luteae* ass. nova, 3 – *Paederoto luteae-Minuartietum rupestris*, 4 – *Potentillo clusianae-Campanuletum zoysii*, 5 – *Potentilletum nitidae*.

No. of relevés		1	2	3	4	5
		8	11	11	28	9
Characteristic and differential (d) species of the associations						
AT	<i>Asplenium viride</i>	He	5	3	.	1
PC3	<i>Valeriana elongata</i>	He	5	1	.	1
PC2	<i>Paederota lutea</i>	He	5	5	3	5
d	<i>Ranunculus traunfellneri</i>	Ha	2	4	.	2
PC3	<i>Minuartia rupestris</i> ssp. <i>rupestris</i>	Ha	.	1	5	.
d	<i>Astragalus australis</i>	He	.	.	5	.
PC1d	<i>Saxifraga burseriana</i>	Ha	.	3	5	1
PC3d	<i>Festuca alpina</i> ssp. <i>alpina</i>	He	.	.	5	1
PC3	<i>Campanula zoysii</i>	He	4	.	.	5
PC1	<i>Potentilla clusiana</i>	He	4	.	3	4
PC2	<i>Potentilla nitida</i>	Ha	1	.	.	2
d	<i>Carex firma</i>	He	3	2	2	5
d	<i>Sesleria sphaerocephala</i>	He	2	.	.	3
d	<i>Gentiana terglouensis</i>	He	.	.	1	2
<i>Cystopteridion fragilis</i> (CF3)						
	<i>Cystopteris alpina</i>	He	5	4	.	1
	<i>Cystopteris fragilis</i>	He	2	5	.	.
	<i>Silene pusilla</i>	Ha	2	2	.	.
	<i>Cerastium subtriflorum</i>	He	.	2	.	1
d	<i>Adenostyles glabra</i>	He	2	3	.	.
d	<i>Aster bellidiastrum</i>	He	4	3	.	3
d	<i>Viola biflora</i>	He	4	3	.	2
<i>Physoplexido-Potentillion caulescentis</i> (PP3)						
	<i>Athamanta turbi</i>	He	.	2	.	1
	<i>Saxifraga tenella</i>	Ha	1	.	.	.
<i>Potentillion caulescentis</i> (PC3)						
	<i>Paederota bonarota</i>	He	1	.	.	1
	<i>Petrocallis pyrenaica</i>	Ha	.	.	.	1
	<i>Phyteuma sieberi</i>	He	2	2	.	2
	<i>Saxifraga squarrosa</i>	Ha	4	.	.	5
<i>Potentillion caulescentis</i> (PC2)						
	<i>Saxifraga crustata</i>	Ha	.	3	5	2
	<i>Arabis bellidifolia</i> ssp. <i>stellulata</i>	Ha	3	.	.	1
	<i>Campanula carnica</i> ssp. <i>carnica</i>	He	.	4	1	.
	<i>Festuca stenantha</i>	He	.	3	.	2
	<i>Rhamnus pumila</i>	Fa	.	.	.	1
	<i>Saxifraga hostii</i> ssp. <i>hostii</i>	Ha	.	1	.	.
<i>Potentilletalia caulescentis</i> (PC1)						
	<i>Campanula cochlearifolia</i>	He	5	4	4	4
	<i>Primula auricula</i>	He	.	4	1	2
	<i>Asplenium ruta-muraria</i>	He	.	3	.	2
	<i>Woodsia pulchella</i>	He	1	.	.	.
	<i>Potentilla caulescens</i>	He	.	.	.	1
<i>Asplenietea trichomanis</i> (AT)						
	<i>Valeriana saxatilis</i>	He	2	3	3	3
	<i>Saxifraga paniculata</i>	Ha	.	1	2	1
	<i>Asplenium trichomanes</i> ssp. <i>trichomanes</i>	He	.	1	.	.
	<i>Eritrichium nanum</i>	Ha	.	.	.	1

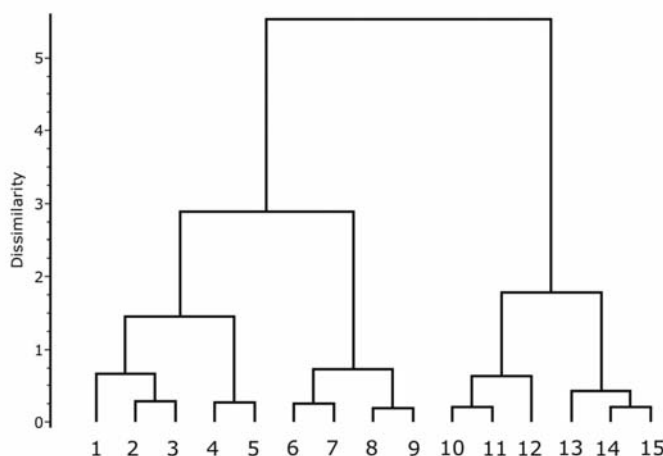


Figure 1. Dendrogram of some calcareous rock crevices associations in the South-eastern Alps (MISSQ, similarity ratio); *Valeriano elongatae-Asplenietum viridis* (1, 2, 4 & 5), *Ranunculo traunfellneri-Paederotetum luteae* ass. nova (3), *Potentillo clusianae-Campanuletum zoysii* (6, 7 – var. *Potentilla nitida*, 8 – var. *Rhodothamnus chamaecistus* & 9 – var. *Campanula zoysii*), *Saxifragetum burserianae* (10 & 11), *Paederoto luteae-Minuartietum rupestris* (12) & *Campanuletum morettianae* (13-15) (for localities see Appendix).

Slika 1. Dendrogram nekaterih asociacij skalnih razpok na karbonatni podlagi v Jugovzhodnih Alpah (MISSQ, similarity ratio); *Valeriano elongatae-Asplenietum viridis* (1, 2, 4 & 5), *Ranunculo traunfellneri-Paederotetum luteae* ass. nova (3), *Potentillo clusianae-Campanuletum zoysii* (6, 7 – var. *Potentilla nitida*, 8 – var. *Rhodothamnus chamaecistus* & 9 – var. *Campanula zoysii*), *Saxifragetum burserianae* (10 & 11), *Paederoto luteae-Minuartietum rupestris* (12) & *Campanuletum morettianae* (13-15) (lokalitete so razvidne iz priloge).

Stands with predominating *Paederota lutea* are clustered together with stands of the association *Valeriano-Asplenietum* from the Dolomites of Lienz (1), Vette di Feltre (4), Erera-Brendol-Campotorondo (5) as well as from the Krn Mts. (2), apart from stands of the associations *Potentillo-Campanuletum* (6-9), *Saxifragetum burserianae* (10-11), *Paederoto-Minuartietum* (12) and *Campanuletum morettianae* (13-15; Fig. 1). The unique synsystematic position of these stands is clearly seen in the synoptic table and was subsequently confirmed by principal coordinate analysis and other methods of hierarchical classification (e.g. Fig. 1).

Ranunculo traunfellneri-Paederotetum luteae ass. nova

Floristic composition of the association

Characteristic and differential species of the association are *Paederota lutea*¹⁻³ with the highest presence and share of coverage ($D_{\%}=11,9$), and *Ranunculus traunfellneri*⁺¹ ($D_{\%}=3,8$), which is present in more than 70 % of relevés. Most (10 out of 26) rock crevice species (*Asplenietea tri-chomanis*) are characteristic and differential for the alliance *Cystopteridion fragilis* (Tabs. 2-4): *Cystopteris fragilis*⁺¹, *C. regia*⁺, *Cerastium subtriflorum*⁺, *Silene pusilla*⁺, *Aster bellidiastrium*⁺¹, *Viola biflora*⁺ and *Adenostyles glabra*⁺.

Table 2. Analytical table of the association *Ranunculo traunfellneri-Paederotetum luteae* ass. nova.

Tabela 2. Analizna tabela asociacije *Ranunculo traunfellneri-Paederotetum luteae* ass. nova.

Successive number	1	2	3*	4	5	6	7	8	9	10	11				
Altitude (m)	1515	1515	1490	1560	1550	1570	1580	1770	1515	1785	1960				
Exposition	W	NW	NE	NNW	N	NW	NW	E	NW	NE	NEE				
Inklination (°)	90	95	90	90	90	90	90	90	90	90	90				
Coverness	40	30	25	10	40	30	20	20	20	20	20				
Herb layer (%)															
Moss layer (%)	20	10	5	1	20	1	10	10	10	10	1				
Relevé area (m ²)	15	5	6	10	4	6	20	10	9	20	4				
Number of species	14	9	36	19	23	21	22	20	12	19	18	fr	%	I _c	D _%
Characteristic and differential species of the association															
PC2 <i>Paederota lutea</i>	He	3	2	2	1	2	3	2	2	2	2	11	100	58	11,9
TRdCF3 <i>Ranunculus traunfellneri</i>	He	+	+	+	+	1	+	+	.	1	.	8	73	18	3,8
<i>Cystopteridion fragilis</i> (CF3)															
<i>Cystopteris fragilis</i>	He	+	1	+	+	+	1	1	+	1	.	9	82	22	4,6
<i>Cystopteris alpina</i>	He	.	.	+	+	+	+	.	+	.	+	7	64	14	2,9
<i>Silene pusilla</i>	Ha	+	.	.	.	.	.	.	.	+	+	4	36	8	1,7
<i>Cerastium subtriflorum</i>	He	.	+	+	.	.	.	.	.	.	+	3	27	6	1,3
TRd <i>Aster bellidiastrum</i>	He	.	.	1	+	+	.	.	+	+	+	6	55	13	2,7
TRd <i>Viola biflora</i>	He	.	+	+	.	+	.	+	+	+	.	6	55	12	2,5
TRd <i>Adenostyles glabra</i>	He	+	.	+	.	+	+	.	+	.	.	5	45	10	2,1
PC3dCF3 <i>Valeriana elongata</i>	He	.	.	.	.	.	.	+	.	.	.	1	9	2	0,4
<i>Potentillion caulescentis</i> (PC3) & <i>Physoplexido-Potentillion caulescentis</i> (PP3)															
PP3 <i>Athamanta turbihi</i>	He	.	.	+	+	.	.	.	.	+	.	4	36	8	1,7
<i>Phyteuma sieberi</i>	He	.	.	.	+	.	.	+	.	.	+	3	27	6	1,3
<i>Minuartia rupestris</i> ssp. <i>rupestris</i>	Ha	.	.	.	.	.	.	.	.	+	.	1	9	2	0,4
<i>Potentillion caulescentis</i> (PC2)															
<i>Campanula carnica</i> ssp. <i>carnica</i>	He	1	+	+	.	.	+	.	+	+	.	7	64	15	3,1
<i>Saxifraga crustata</i>	Ha	.	.	+	+	+	.	.	.	+	.	5	45	10	2,1
<i>Festuca stenantha</i>	He	.	.	.	.	+	+	.	+	+	+	5	45	10	2,1
<i>Saxifraga hostii</i> ssp. <i>hostii</i>	Ha	.	.	.	.	.	.	.	.	.	+	1	9	2	0,4
<i>Potentilletalia caulescentis</i> (PC1)															
<i>Campanula cochlearifolia</i>	He	.	.	1	1	+	1	1	+	.	1	8	73	22	4,6
<i>Primula auricula</i>	He	+	+	+	+	.	.	+	+	+	.	7	64	14	2,9
<i>Valeriana saxatilis</i>	He	1	+	1	.	+	.	+	.	+	.	6	55	14	2,9
<i>Asplenium ruta-muraria</i>	He	.	.	+	+	+	.	+	+	.	.	5	45	10	2,1
<i>Saxifraga burseriana</i>	Ha	+	.	+	+	.	.	.	.	+	+	5	45	10	2,1
<i>Asplenietea trichomanis</i> (AT)															
<i>Asplenium viride</i>	He	+	.	+	.	+	+	.	+	.	1	6	55	13	2,7
<i>Valeriana tripteris</i>	He	+	.	.	.	+	.	+	+	.	.	4	36	8	1,7
<i>Saxifraga paniculata</i>	Ha	.	.	.	.	.	.	.	.	.	+	1	9	2	0,4
<i>Asplenium trichomanes</i> ssp. <i>trichomanes</i>	He	.	.	.	.	.	.	.	+	.	.	1	9	2	0,4
<i>Elyno-Seslerietea</i> s. lat. (ES)															
<i>Euphrasia salisburgensis</i>	Te	.	.	+	+	+	+	+	.	.	+	7	64	14	2,9
<i>Hedysarum hedysaroides</i> ssp. <i>exaltatum</i>	He	+	.	+	+	+	+	.	.	.	.	6	55	12	2,5
<i>Juncus monanthos</i>	He	+	.	+	.	+	+	+	.	.	.	6	55	12	2,5
<i>Anemone narcissiflora</i>	Ge	.	.	+	.	+	.	.	.	+	.	4	36	8	1,7
<i>Sesleria albicans</i>	He	.	.	+	+	+	.	.	.	+	.	4	36	8	1,7
<i>Carex firma</i>	He	.	.	+	+	.	.	.	+	.	.	3	27	6	1,3
<i>Hieracium villosum</i>	He	.	.	.	+	.	+	.	.	.	.	2	18	4	0,8
<i>Myosotis alpestris</i>	He	.	.	+	.	.	.	.	+	.	.	2	18	4	0,8
<i>Thlaspietia rotundifolii</i> s. lat. (TR)															
<i>Pimpinella alpina</i>	He	.	.	+	.	+	+	.	+	.	+	5	45	10	2,1
<i>Saxifraga aizoides</i>	Ha	.	.	+	.	.	+	.	+	+	.	5	45	10	2,1
<i>Dryopteris villarii</i>	He	+	.	+	.	+	.	.	+	.	.	4	36	8	1,7
<i>Geranium argenteum</i>	He	.	.	.	.	.	.	.	+	.	1	2	18	5	1,0
<i>Rhodiola rosea</i>	He	.	.	.	.	.	+	+	.	.	.	2	18	4	0,8
Other species															
<i>Rhodothamnus chamaecistus</i>	Fa	.	.	+	+	1	+	+	.	.	+	6	55	13	2,7
<i>Saxifraga rotundifolia</i>	He	.	.	+	.	.	+	.	.	.	.	2	18	4	0,8
<i>Rhododendron hirsutum</i>	Fa	.	.	+	.	.	.	+	.	.	.	2	18	4	0,8

The presence of *Valeriana elongata* (9 %) in stands of the association *Ranunculo-Paederotetum*, in comparison with stands of the association *Valeriano-Asplenietum* var. geogr. *Campanula zoysii* (88 %) is rather low as well as presence of *Athamantha turbith*⁺ (*Physoplexido-Potentillion*), *Phyteuma sieberi*⁺ and *Minuartia rupestris*⁺ (*Potentillion*). The most frequent species and with the highest shares of coverage from the alliance *Potentillion* are: *Campanula carnica* ssp. *carnica*⁺, *Saxifraga crustata*⁺ and *Festuca stenantha*⁺ as well as *Campanula cochlearifolia*⁺, *Primula auricula*⁺, *Valeriana saxatilis*⁺, *Asplenium ruta-muraria*⁺ and *Saxifraga burseriana*⁺ from the order *Potentilletalia*. *Asplenium viride*⁺ is the only characteristic species of the class *Asplenetia trichomanis* with a higher presence (55 %).

Table 3. Phytosociological groups (characteristic, differential and diagnostic species) of the association *Ranunculo traunfellneri-Paederotetum luteae* ass. nova.

Tabela 3. Fitocenološke skupine (značilne, razlikovalne in diagnostične vrste) v asociaciji *Ranunculo traunfellneri-Paederotetum luteae* ass. nova.

Syntaxa	No. of species	I _c	D _%
<i>Cystopteridion fragilis</i> (CF3)	10	162	33,3
<i>Potentillion caulescentis</i> (PC3) & <i>Physoplexido-Potentillion caulescentis</i> (PP3)	3	16	3,5
<i>Potentillion caulescentis</i> (PC2)	4	37	7,7
<i>Potentilletalia caulescentis</i> (PC1)	5	71	14,6
<i>Asplenetia trichomanis</i> (AT)	4	25	5,4
<i>Elyno-Seslerietea</i> s. lat. (ES)	22	97	19,8
<i>Thlaspietia rotundifolia</i> s. lat. (TR)	8	43	8,9
Other species	9	33	6,8
Total	65	484	100

Other relatively frequent species are *Euphrasia salisburgensis*⁺, *Hedysarum hedysaroides* ssp. *exaltatum*⁺, *Juncus monanthos*⁺ (*Elyno-Seslerietea* s. lat.), *Pimpinella alpina*⁺, *Saxifraga aizoides*⁺ (*Thlaspietia rotundifolia* s. lat.) and *Rhodothamnus chamaecistus*⁺. The complete floristic composition of the association *Ranunculo-Paederotetum* is shown in Tab. 2, while species that occur only in one relevé are listed in the Appendix. As in other syntaxa from the alliance *Cystopteridion*, the moss layer is well developed and covers from 1 to 20 % of the relevé area (mean value is 10 %).

The majority of the relevé area is covered by hemicryptophytes (D_%=79,4) and chamaephytes (D_%=11,7; Tab. 4). Therophytes (D_%=3,3) are well represented only by *Euphrasia salisburgensis*, and geophytes (D_%=2,1) by *Anemone narcissiflora*. Among phanerophytes (D_%=3,5) there are only two heathers: *Rhodothamnus chamaecistus* and *Rhododendron hirsutum*.

Table 4. Plant life form spectrum in the association *Ranunculo traunfellneri-Paederotetum luteae* ass. nova.

Tabela 4. Spekter življenjskih oblik v asociaciji *Ranunculo traunfellneri-Paederotetum luteae* ass. nova.

Plant life forms	No. of taxa	I _c	D _%
Hemicryptophytes	45	385	79,4
Chamaephytes	14	57	11,7
Phanerophytes	2	17	3,5
Therophytes	2	16	3,3
Geophytes	2	10	2,1
Total	65	484	99,94

Chorological groups in the association

In terms of number of species (13) and share of coverage ($D\%$ =22,8), the south-European-montane geoelement predominates in stands (Tab. 5). There were also higher numbers of species of the E-Alpine (11; $D\%$ =18,8), E-Alpine – Illyrian (9; $D\%$ =20) and SE-European – montane (8; $D\%$ =5,4) geoelement. Five species belong to the European – Asiatic – north-American (5; $D\%$ =7,4), and four to the Arctic – Alpine geoelement (4; $D\%$ =6). The number of species by geoelements, together with their coverage indices and shares of coverage are shown in Table 5.

Table 5. Chorological groups (geoelements) in the association *Ranunculo traunfellneri-Paederotetum luteae* ass. nova.

Tabela 5. Horološke skupine (geoelementi) v asociaciji *Ranunculo traunfellneri-Paederotetum luteae* ass. nova.

Geoelement	No. of taxa	I _c	D _%
S-Eur.-Mont.	13	110	22,8
E-Alp.	11	91	18,8
E-Alp./Illyr.	9	96	20,0
SE-Eur.-Mont.	8	26	5,4
Eurasiat./N-Am.	5	35	7,4
Arct.-Alp.	4	28	6,0
Eur.	2	22	4,6
E-Alp./Apen.	2	16	3,4
Eur./N-Am.	2	14	3
Alp.	2	4	1,0
Cosmop.	1	22	4,6
Alp./Apen.	1	5	1,0
Eur.-Mont.	1	2	0,4
Eurasiat.	1	2	0,4
Eurasiat./Afr.	1	2	0,4
Eurasiat./N-Am./Austr.	1	2	0,4
Medit.-Mont.	1	2	0,4
Total	65	480	100,0

According to AESCHIMANN and co-workers (2004), there are four endemic (*Cerastium carinthiacum* ssp. *australpinum*⁺, *Hedysarum hedysaroides* ssp. *exaltatum*⁺, *Phyteuma sieberi*⁺ and *Saxifraga burseriana*⁺) and seven subendemic species (*Campanula carnica* ssp. *carnica*⁺¹, *Cerastium subtriflorum*⁺, *Ranunculus traunfellneri*⁺¹, *Rhododendron hirsutum*⁺, *Rhodothamnus chamaecistus*⁺¹, *Saxifraga hostii* ssp. *hostii*⁺ and *Valeriana elongata*⁺) for the South-eastern Alps.

Ecology, variability and syndynamics of the association

Stands of the association *Ranunculo-Paederotetum* thrive in similar ecological conditions as those of the association *Valeriano-Asplenietum* s. lat. (e.g. WIKUS 1959: 40, MUCINA 1993: 254, see also SURINA 2005) and other syntaxa from the alliance *Cystopteridion*: shady, moist and frigidophilous rock-crevices. In contrast to stands of *Valeriano-Asplenietum* s. lat., sites are significantly more mesophilous, since stands of *Ranunculo-Paederotetum* prefer lower altitudes and they are not restricted exclusively to northern exposures (Fig. 2). Consequently, stands are floristically richer, since the ecological conditions are less extreme and thus suitable for less sciophilous taxa. In the Krn Mts., the median altitude of stands of *Valeriano-Asplenietum* var. geogr. *Campanula zoysii* is 1737 m (max. 2090 m), whereas that of *Ranunculo-Paederotetum* is 1560 m (max. 1960 m) (see also SURINA 2005). Figure 2: We noted 65 taxa in 11 relevés; min. 9 and max. 36 per relevé area. The coefficient of variation is 36.2 % and is relatively high due to the number of accidental species which thrive well in less extreme ecological conditions: lower altitude, better light conditions, thus warmer and dryer sites as well as longer vegetation period.

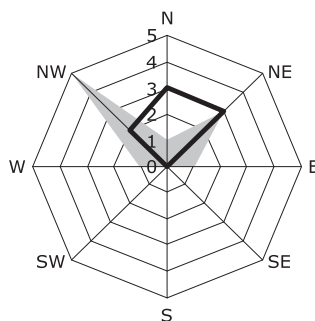


Figure 2. Exposure of stands of the associations *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* (bold line) and *Ranunculo traunfellneri-Paederotetum luteae* (grey area) in the Krn Mts (Julian Alps).

Slika 2. Ekspozicija sestojev asociacij *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* (odebeljena črta) in *Ranunculo traunfellneri-Paederotetum luteae* (siva površina) v Krnskem pogorju (Julijske Alpe).

Syntaxonomical position and distribution area of the association

Classification of the association *Ranunculo-Paederotetum* into the alliance *Cystopteridion* is not questionable and is based on coverage and presence of diagnostic species (characteristic and differential), floristical composition, high frequency of species of the alliance *Cystopteridion* (Tabs. 1-3), and numerical analysis (Fig. 1). The combination of relatively hygrophilous species is due to the ecological conditions of the stands. The association has no exclusive characteristic species and it is distinguished from other similar syntaxa from the alliance *Cystopteridion* by a characteristic combination of diagnostic species, negative differentiation, as well as coverage and presence of differential species. The characteristic and differential species, *Paederota lutea* (as edificatory) and *Ranunculus traunfellneri*, are relatively frequent in other stands of the class *Asplenietea trichomanis* (Tab. 1), but the highest frequencies (presence) and coverage indices (I_c & $D_{\%}$) are reached in stands of the association *Ranunculo-Paederotetum*. Stands of the association *Ranunculo-Paederotetum* are syntaxonomically intermediate between stands of the association *Valeriano-Asplenietum* var. geogr. *Campanula zoysii* (*Cystopteridion*) and *Potentillo-Campanuletum* (*Potentillenion*); with the latter especially the hygrophilous variant *Rhodothamnus chamaecistus* (see also SURINA 2005).

To date, stands of the association *Ranunculo-Paederotetum* have been phytosociologically documented only in the Krn Mts. (the Julian Alps), but similar stands have also been observed in the Italian part of the Julian Alps (L. Poldini, pers. comm.) and the Kamnik Alps. The area of distribution of the association probably extends throughout the South-eastern Calcareous Alps.

Nomenclature type (*holotypus*) of the association *Ranunculo traunfellneri-Paederotetum luteae* ass. nova: Tab. 2, Relevé No. 3, *holotypus hoc loco*.

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The paper presents some results of research on subalpine and alpine vegetation in the Krn Mts. (Julian Alps), which was the topic of my PhD thesis. Dr. Igor Dakskobler (Institute of Biology, Science and Research Centre of the Slovenian Academy of Sciences and Arts, Ljubljana), my mentor, has guided me in many field trips in the Julian Alps. Prof. Tone Wraber (Department of Biology, University of Ljubljana), Dr. Branko Vreš (Institute of Biology, Science and Research Centre of Slovenian Academy of Sciences and Arts, Ljubljana) and Emer. Prof. L. Poldini (Department of Biology, University of Trieste) have allowed a continuous exchange of experience and immediate feedback on potential problems during my research. My sincere gratitude goes to all of them.

Appendix

Accidental species to Table 2

Elyno-Seslerietea: *Achillea clavinae* + (10), *Alchemilla sericoneura* + (7), *Arabis vochinensis* + (11), *Galium anisophyllum* + (11), *Gentiana anisodonta* + (3), *Laserpitium peucedanoides* + (3), *Minuartia sedoides* + (10), *Pedicularis rostratocapitata* + (3), *Poa alpina* + (7), *Polygonatum verticillatum* + (3), *Pulsatilla alpina* ssp. *alpina* + (10), *Ranunculus hybridus* + (3), *Silene acaulis* + (10); *Thlaspietia rotundifolia*: *Cerastium carinthiacum* ssp. *austroalpinum* + (11), *Festuca nitida* + (11), *Saxifraga sedoides* + (2); Other species: *Alchemilla velebitica* + (5), *Asperula aristata* + (8), *Lotus corniculatus* + (11), *Parnassia palustris* + (3), *Soldanella alpina* + (5) & *Thymus praecox* ssp. *polytrichus* + (11).

Sites of the relevés in Table 2

Slovenia, the Julian Alps, the Krn Mts.

1-2. moist and shady rock crevices on the western slope of the hill Palec above Pl. Lašca pasture. MTB: 9748/143, UTM: VM02; leg. & det.: I. Dakskobler & B. Surina, 8.8.2002; 1: *Ctenidium molluscum* +, *Orthothecium rufescens* +, *Tortella tortuosa* +; 2: *Orthothecium rufescens* +, *Tortella tortuosa* +. **3-7.** moist rock crevices on the northern slope of Mt. Lipnik above Laški plaz gorge. MTB: 9748/143, UTM: VM02; leg. & det.: I. Dakskobler & B. Surina, 9.8.2002; 3: *Ctenidium molluscum* +, *Plagiochila asplenoides* +, *Orthothecium rufescens* +; 5: *Ctenidium molluscum* +, *Tortella tortuosa* +, *Orthothecium rufescens* +; 6: *Conocephalum conicum* +, *Tortella tortuosa* +, *Distichium capillaceum* + *Fissidens* sp. +. **8.** shady rock crevices between the mountains Rdeči rob and Vrh Lipnika. MTB: 9748/143, UTM: VM02; leg. & det.: I. Dakskobler & B. Surina, 9.8.2002. **9.** shady rock crevices on the western slope of the hill Palec. MTB: 9748/143, UTM: VM02; leg. & det.: I. Dakskobler & B. Surina, 9.8.2002; *Orthothecium rufescens* +, *Tortella tortuosa* +. **10.** moist and shady rock crevices of a gorge on the eastern slope of Mt. Maselnik. MTB: 9748/134, UTM: UM92; leg. & det.: B. Surina, 14.8.2002; *Orthothecium rufescens* +, *Tortella tortuosa* +. **11.** moist and shady rock crevices on the northern slope of Mt. Krnčica. MTB: 9747/224, UTM: UM92; leg. & det.: B. Surina, 23.7.2003; *Tortella tortuosa* 1.

Sites of the relevés in Figure 1

1 – Dolomites of Lienz (WIKUS 1959; Tab. 1, 7 rel.), **2** – Krn Mts. (Julian Alps) (SURINA 2005; Fitosoc. tab. 1, 8 rel.), **3** – Krn Mts. (Julian Alps), **4** – Vette di Feltre (Dolomites) (PIGNATTI & PIGNATTI 1983; 7 rel.), **5** – Erera-Brendol-Campotorondo (Dolomites) (LASSEN 1983; rel. 6-9), **6-9** – Krn Mts. (Julian Alps) (SURINA 2005; Fitosoc. tab. 5; 6-rel. 12-17; 7-rel. 24-28, 8-rel. 1-11, 9-rel. 18-23), **10** – Vette di Feltre (Dolomites) (PIGNATTI & PIGNATTI 1983; 16 rel.), **11** – Erera-Brendol-Campotorondo (Dolomites) (LASSEN 1983; rel. 1-5), **12** – Julian Alps (WRABER 1986; 12 rel.), **13-14** – Dolomites (PIGNATTI & PIGNATTI 1978; 13-rel. 1-8, 14-rel. 9-15), **15** – Vette di Feltre (Dolomites) (PIGNATTI & PIGNATTI 1983; 12 rel.).

Nomenclature of the syntaxa mentioned

Paederoto luteae-Minuartietum rupestris T. Wraber 1986

Potentillo clusianae-Campanuletum zoysii Aichinger 1933 var. *Rhodothamnus chamaecistus* Surina 2005

Potentillo caulescentis-Ostryetum carpinifoliae Franz 2002

Phyteumato scheuchzeri-Moehringietum villosae Dakskobler 2000

Campanulo carnicae-Moehringietum villosae Dakskobler 2000

Campanuletum morettianae Pignatti & Pignatti 1978

Saxifragetum burserianae Pignatti & Pignatti 1983

Saxifragetum squarroso-crustatae Surina 2005

Spiraeo-Potentilletum caulescentis Poldini 1969

Potentilletum caulescentis Aichinger 1933

Valeriano elongatae-Asplenietum viride Wikus 1959 var. geogr. *Campanula zoysii* Surina 2005

Caricetum brachystachydis Lausi & Gerdol 1980

Ranunculo traunfellneri-Paederotetum luteae Surina 2005

Povzetek

Prispevek podaja kratek pregled vegetacije skalnih razpok v Krnskem pogorju (Julijske Alpe). S pomočjo srednjeevropske (sigmatistične) metode je bilo opravljenih 82 fitocenoloških popisov, ki so bili na podlagi diagnostičnih vrst (značilnic in razlikovalnic) oziroma klasterske analize razvršeni v fitocenološke tabele. Iz zveze *Androsaci-Drabion tomentosae* je bilo ugotovljenih pet asociacij: *Potentillo clusianae-Campanuletum zoysii*, *Paederota luteae-Minuartietum rupestris*, *Potentilletum nitidae*, *Saxifragetum squarroso-crustatae* ter *Campanulo carnicae-Moehringietum villosae*. Slednjih dveh nismo vključili v nadaljnje analize. Sestoji vlažnih in hladnejših skalnih razpok iz zveze *Cystopteridion* pripadajo dvema asociacijama, in sicer asociaciji *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* ter novo opisani asociaciji *Ranunculo traunfellneri-Paederotetum luteae* ass. nova. Značilni in diferencialni vrsti asociacije sta *Paederota lutea* in *Ranunculus traunfellneri*, ki se v sestojih pojavljata z največjo stalnostjo in pokrovnostjo. Sestoji asociacije uspevajo v vlažnih in hladnih skalnih razpokah na pretežno osojnih legah. V primerjavi s sestoji asociacije *Valeriano-Asplenietum viridis* so ti manj hladnoljubni, uveljavljajo pa se tudi na manjši nadmorski višini.

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