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***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*).

Gljučne 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 scheuchzeri-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 – *Valeriana 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 – *Valeriana 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
Cystopteridion fragilis (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
Physoplexido-Potentillion caulescentis (PP3)						
	<i>Athamanta turbith</i>	He	.	2	.	1
	<i>Saxifraga tenella</i>	Ha	1	.	.	.
Potentillion caulescentis (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
Potentillion caulescentis (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	.	.
Potentilletalia caulescentis (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
Asplenietea trichomanis (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

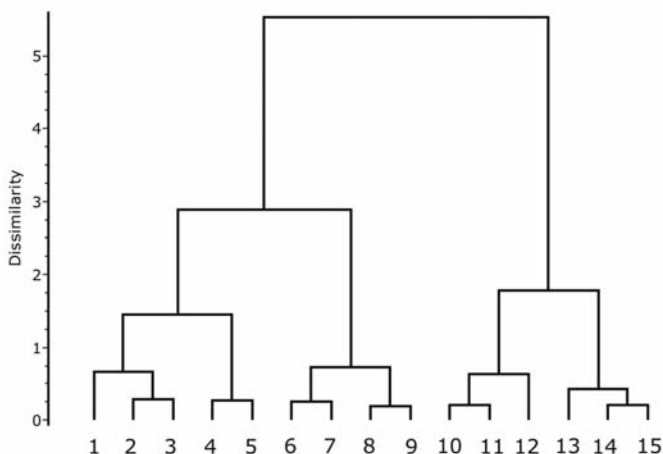


Figure 1. Dendrogram of some calcareous rock crevices associations in the South-eastern Alps (MISSQ, similarity ratio); *Valeriano elongatae-Asplenietum viridis* (1, 2, 4 & 5), *Ranunculo traunfellneri-Paederotetum luteae* ass. nova (3), *Potentillo clusianae-Campanuletum zoysii* (6, 7 – var. *Potentilla 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 ($D\phi_0=11,9$), and *Ranunculus traunfellneri*⁺¹ ($D\phi_0=3,8$), which is present in more than 70 % of relevés. Most (10 out of 26) rock crevice species (*Asplenietea trichomanis*) are characteristic and differential for the alliance *Cystopteridion fragilis* (Tabs. 2-4): *Cystopteris fragilis*⁺¹, *C. regia*⁺, *Cerastium subtriflorum*⁺, *Silene pusilla*⁺, *Aster bellidiastrum*⁺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 (m²)	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 bellidiastrium</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>Athamantha turbith</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>Thlaspietea 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 *Athamanta turbihi*⁺ (*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*⁺¹, *Saxifraga crustata*⁺ and *Festuca stenantha*⁺ as well as *Campanula cochleariifolia*⁺, *Primula auricula*⁺, *Valeriana saxatilis*⁺¹, *Asplenium ruta-muraria*⁺ and *Saxifraga burseriana*⁺ from the order *Potentilletalia*. *Asplenium viride*⁺¹ is the only characteristic species of the class *Asplenietea 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>Asplenietea trichomanis</i> (AT)	4	25	5,4
<i>Elyno-Seslerietea</i> s. lat. (ES)	22	97	19,8
<i>Thlaspietea rotundifolii</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*⁺ (*Thlaspietea rotundifolii* 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	99,4

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. *austroalpinum*⁺, *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 zoyisii* 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.

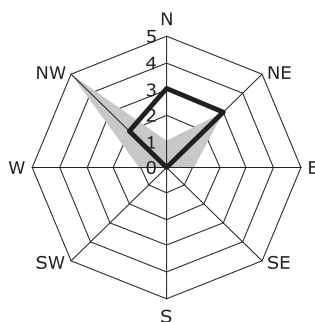


Figure 2. Exposure of stands of the associations *Valeriano elongatae-Asplenietum viridis* var. geogr. *Campanula zoysii* (bold line) and *Ranunculo traunfellneri-Paederotetum luteae* (grey area) in the Krn Mts (Julian Alps).

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 & $D_{q\%}$) 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); *Thlaspietea 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*, *Paederoto 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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Vrsta *Geum allepicum* Jacq. v Sloveniji

Geum allepicum Jacq. in Slovenia

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Izvleček. Prispevek obravnava prvo (subspontano) pojavljanje alepske sretene *Geum allepicum* Jacq. v Sloveniji, njene morfološke znake, opis rastišča in določevalni ključ. Vrsta je bila najdena maja leta 2000 na parkovni trati v središču Ljubljane (9953/1 – UTM 33T VM60) skupaj z navadno sreteno (*Geum urbanum* L.) in njunim križancem *Geum x spurium* Fisch. & Mey.

Ključne besede: Slovenija, flora, *Geum allepicum*

Abstract. The first (subspontaneous) occurrence of *Geum allepicum* in Slovenia is reported, with a discussion of its morphological characters, a description of its habitat, and an identification key. *Geum allepicum* was found in May 2000 on a Ljubljana centre lawn (9953/1 –UTM 33T VM60) together with the common *Geum urbanum* L. and their hybrid *Geum x spurium* Fisch. & Mey.

Keywords: Slovenia, flora, *Geum allepicum*

Uvod

Rod sretena (*Geum* L.) obsega 56 vrst in je razširjen večinoma na severni polobli (MEUSEL & al. 1965). V Sloveniji so po navedbi Martinčiča (MARTINČIČ in sod. 1999) bile do sedaj znane štiri vrste: plazeča (*G. reptans* L.), gorska (*G. montanum* L.), potočna (*G. rivale* L.) in navadna sretena (*G. urbanum* L.) ter križanec sudetska sretena (*G. x sudeticum* Tausch = *G. montanum* x *rivale*). V maju 2000 je bila v Ljubljani (Bežigrad) najdena alepska sretena (*G. allepicum* Jacq. subsp. *allepicum*) ter križanec med alepsko in navadno sreteno (*G. x spurium* Fisch. & Mey.). Oba taksona sta nova za floro Slovenije.

Material in metode

Meritve morfoloških znakov (velikost rastline, velikost cvetov in število plodov) so bile opravljene na herbarijskem materialu z novega in edinega naha-

jališča alepske sretene v Sloveniji. Material je shranjen v delovnem herbariju Biološkega inštituta Jovana Hadžija ZRC SAZU v Ljubljani. Pri opisu rastišča smo si pomagali s popisom prisotne vegetacije, ki smo ga opravili po standardni srednjeevropski fitocenološki metodi (BRAUN-BLANQUET 1964). Podatki za horološko analizo so shranjeni v bazi podatkov FloVegSi (Favna, flora, vegetacija in paleovegetacija Slovenije) Biološkega inštituta Jovana Hadžija ZRC SAZU v Ljubljani. Karto razširjenosti smo pripravili s pomočjo računalniškega programa FLOVEGSI (SELIŠKAR in sod. 2003) na osnovi zbranih podatkov v bazi FloVegSi in literaturnih navedb (JOGAN in sod. 2001).

Rastlinska imena navajamo predvsem po Mali flori Slovenije (MARTINČIČ in sod. 1999), v neka-terih primerih pa smo upoštevali Register flore Slovenije (TRPIN & VREŠ 1995).

Rezultati in diskusija

Geum allepicum Jacq. – alepska sretena

Opis: Trajnica, po habitusu podobna navadni sreteni, le z nekoliko debelejšimi (2-6 mm debeli-mi) in gosto dodolgodlakavimi stebli; visoka 50 – 90 (120) cm. Pritlični listi lihopernati, s (3) 4–6 pari stranskih krpic; spodnji stebelni listi podobni pritličnim. Socvetje 2 – 8 (10) cvetno. Cvetovi 15 – 20 (25) mm v premeru. Venčni listi okrogli do narobe jajčasti, (5) 7 – 9 (10) mm dolgi, često neko-liko daljši od čaše. Plodovi (oreški) številni (Sl. 2), (150) 200 – 350 (450), dolgi 8 – 12 (14) mm, pokriti s 3-5 mm dolgimi togimi laski (Sl. 1a). Hemikriptofit; VI – VII. $2n = 42$ (SMEJKAL 1995: 322)



Slika 1: Plodovi (oreški): a – *Geum allepicum*, b – *G. urbanum* (povzeto po Smrčinová E. v SMEJKAL 1995: 319).
Figure 1: Achenes: a – *Geum allepicum*, b – *G. urbanum* (according to Smrčinová E. in SMEJKAL 1995: 319)



Slika 2: Plodovi alepske sretene (*G. allepicum*).
Figure 2: Fruits of *G. allepicum*.



Slika 3: Plodovi neprave sretene (*G. x spurium*).
Figure 3: Fruits of *G. x spurium*.



Slika 4: Plodovi navadne sretene (*G. urbanum*).
Figure 5: Fruits of *G. urbanum*.

Splošna razširjenost: Vrsta je razširjena v zmernem pasu Vzhodne Evrope in Azije (*G. allepicum* subsp. *allepicum*) ter Severne Amerike (*G. allepicum* Jacq. subsp. *strictum* (Aiton) Clausen), adventivno pa se pojavlja še v Avstraliji (SMEJKAL 1995: 322) in na Novi Zelandiji (MEUSEL & AL. 1965: 532). V Evropi je razširjena v Romuniji, Madžarski, Poljski, Češki in Rusiji (VALENTIN 1968: 36).

Splošna oznaka rastišča: med grmovjem, na gozdnih robovih, suhih travnikih ter adventivno na pustih tleh, živih mejah, gradbiščih, parkih in tratah (WEBER 1995).

Oznaka nahajališča in rastišča v Sloveniji:

Nahajališče: Slovenija: Ljubljana, Črtomirova ulica, 300 m n.m. 9953/1 – UTM 33T VM60; 46° 3' 46" N, 14° 31' 19" E (op.: geografske koordinate odčitane glede na državni koordinatni sistem D 48 na Besslovem elipsoidu; Gauss-Krügerjeva projekcija); Leg. et det. B. Vreš, 11.5. 2000 (vir: delovni herbarij Biološkega inštituta ZRC SAZU: ZRC 11052).

Rastišče: Na pustih tleh na parkovni trati v združbi s prevladujočimi vrstami iz razreda *Molinio-Arrhenatheretea* ter na svežih, s hranili bogatih tleh pod parkovnimi drevesi v združbi s prevladujočimi vrstami iz razredov *Galio-Urtietea* in *Artemisietea* (Tab. 1), kjer se pogosto pojavlja tudi njena avtohtona sorodnica navadna sretena (*G. urbanum*).

***Geum x spurium* Fisch. & Mey. (= *G. allepicum* Jacq. x *urbanum* L.) – neprava sretena**

Opis: Križanec je po izgledu podoben starševskim vrstam, z nekaterimi vmesnimi znaki: cvetni peclji krajši kot pri navadni in polovico tako debeli kot pri alepski sreteni (1-2 mm); rastlina nekoliko večja od navadne sretene (40-60 (80) cm) in močnejše dlakava; pritlični listi podobni kot pri alepski sreteni; cvetovi nekoliko manjši kot pri alepski sreteni, večinoma sterilni; ob zrelosti večina oreškov zakrnelih, fertilnih le 5-10 plodov v glavici (Sl. 3); fertilnost peloda 0,6 %, kaljivost semen do 0,001 % (SMEJKAL 1995).

Splošna razširjenost in rastišče: križanec je razširjen v arealu, kjer uspevata obe starševski vrsti skupaj; je pogost, a često spregledan. Rastišče: podobno kot pri starševskih vrstah.

Oznaka nahajališča in rastišča v Sloveniji:

Nahajališče: Slovenija: Ljubljana, Črtomirova ulica, 300 m n.m. 9953/1 – UTM 33T VM60; 46° 3' 46" N, 14° 31' 19" E (op.: geografske koordinate odčitane glede na državni koordinatni sistem D 48 na Besslovem elipsoidu; Gauss-Krügerjeva projekcija); Leg. et det. B. Vreš, 9.6. 2000 (vir: delovni herbarij ZRC 11053).

Rastišče: Na svežih, s hranili bogatih tleh pod parkovnimi drevesi skupaj s starševskima vrstama (Tab. 1).

Razlikovalni ključ med navadno (*G. urbanum*) in alepsko sreteno (*G. allepicum*)

- cvetovi 10-15 mm v premeru; venčni listi (3) 4–7 (8) mm dolgi, narobe jajčasti, tako dolgi ali krajši od čaše; vratov (50) 60–80 (150); plodovi (oreški) v času zrelosti na bazi pokriti z 1-2 (3) mm dolgimi laski (Sl. 1b in 4)

...navadna sretena (*Geum urbanum* L.)

- cvetovi 15-20 (25) mm v premeru; venčni listi (5) 7–9 (10) mm dolgi, okrogli do narobe jajčasti, često nekoliko daljši od čaše; vratov (150) 200–350 (450); plodovi (oreški) v času zrelosti na bazi pokriti s 3-5 mm dolgimi togimi laski (Sl. 1a in 2)

...alepska sretena (*Geum allepicum* Jacq. subsp. *allepicum*)

Tabela 1: Fitocenološki popisi na rastišču alepske sretene (*G. allepicum*) v Ljubljani (Slovenija).Table 1: Phytosociological relevés on the site of *G. allepicum* in Ljubljana (Slovenia).

Zap. št. popisa / Succesive number	1	2	3	4	5	6	7	8	9	10	11	12	13
Št. popisa/ Rel. numb. (FloVegSi database)	9522	9525	9540	9551	9543	9544	9546	9547	9548	9550	9526	9552	9553
Datum popisa: (dan in mesec) 2000/ Date	9.6.	9.6.	9.6.	13.6.	9.6.	9.6.	9.6.	9.6.	9.6.	13.6.	9.6.	13.6.	13.6.
Lokaliteta / Locality of Relevés	Ljubljana, Črtomirova ulica, v parku, 300 m nm. v.; 9953/1 - UTM 33T VM60												
Velikost popisne ploskve v m ² / Relevé area	16	16	16	16	16	16	16	16	12	16	16	16	16
Celotna pokrovnost v % / Coverness (%)	100	100	100	100	100	100	100	100	100	100	100	100	90
Število vrst / Number of species	13	15	10	17	12	18	8	8	20	17	16	9	11
Takson / Taxon	frekv.												
MA <i>Geum alepicum</i>	1.2	1.2	2.2	+	1.1	1.2	3.2	4.2	3.1	1.2	.	.	10
MA <i>Dactylis glomerata</i>	3.1	2.1	3.1	3.2	.	+2	1.1	+	2.1	+	1.1	1.1	12
MA <i>Taraxacum officinale</i>	2.1	1.1	2.1	1.1	1.1	1.2	+	.	+	1.1	+	1.1	+2
MA <i>Lolium perenne</i>	1.1	+	1.1	+	3.1	3.1	2.1	+	+2	.	2.1	1.1	11
MA <i>Crepis biennis</i>	1.2	+	+	+	+	1.2	.	.	.	.	.	+	8
MA <i>Poa trivialis</i>	.	.	+2	1.1	1.1	+	+	.	1.1	+	.	+	8
MA <i>Trifolium pratense</i>	1.2	3.2	2.2	1.2	.	+	.	.	.	.	+2	.	7
MA <i>Trifolium repens</i>	+	.	1.2	.	2.2	2.1	+	.	+2	.	+	.	7
MA <i>Veronica chamaedrys</i>	+2	.	.	2.2	.	.	+2	.	+	.	+	.	6
MA <i>Plantago lanceolata</i>	.	+	.	+	+	+	+	.	.	.	.	.	5
MA <i>Centaurea jacea</i>	.	.	.	+	.	.	.	.	.	.	+	+	4
MA <i>Achillea millefolium</i>	.	.	+	.	.	.	.	.	.	.	1.1	.	3
MA <i>Poa pratensis</i>	+	+	.	.	.	.	.	.	.	.	+	.	3
MA <i>Potentilla reptans</i>	+	+	.	.	.	.	.	.	+	.	.	.	3
MA <i>Anthriscus sylvestris</i>	.	.	.	.	.	.	.	+	.	.	1.2	.	2
MA <i>Ranunculus repens</i>	.	.	.	.	.	.	.	.	+	+	.	.	2
MA <i>Prunella vulgaris</i>	.	.	.	.	.	.	.	+	.	+2	.	.	2
MA <i>Arrhenatherum elatius</i>	.	.	.	.	.	.	.	.	1.1	.	.	.	1
MA <i>Medicago lupulina</i>	.	+	.	.	.	.	.	.	.	.	.	.	1
MA <i>Ranunculus acris</i>	+	.	.	.	.	.	.	.	.	.	.	.	1
MA <i>Phleum pratense</i>	.	.	.	.	.	+	.	.	.	.	.	.	1
MA <i>Bellis perennis</i>	.	.	.	+	.	.	.	.	.	.	.	.	1
MA <i>Trisetum flavescens</i>	.	.	.	.	.	.	.	.	.	.	.	.	1
MA <i>Campanula patula</i>	.	.	.	.	.	.	.	.	.	.	.	+	1
MA <i>Galium mollugo</i>	.	.	.	.	.	.	.	.	.	.	.	+	1
MA <i>Festuca pratensis</i>	.	.	.	+	.	.	.	.	.	.	.	.	1
MA <i>Veronica serpyllifolia</i>	.	.	.	.	.	.	.	.	.	+	.	.	1
MA <i>Vicia cracca</i>	.	.	.	+	.	.	.	.	.	.	.	.	1
Ar <i>Picris hieracioides</i>	.	+	.	.	1.2	+2	.	.	.	.	.	.	4
Ar <i>Erigeron annuus</i>	+	.	.	.	+	+	.	.	+	2.2	2.2	.	6
Ar <i>Pastinaca sativa</i>	.	.	.	1.2	.	.	.	.	.	.	+	.	2
Ar <i>Solidago canadensis</i>	.	.	.	+	.	.	.	.	+	.	.	.	2
Ar <i>Melandryum album</i>	.	.	.	.	.	.	.	.	.	2.1	.	.	1
Ar <i>Elytrigia repens</i>	.	.	.	.	.	.	.	+	.	.	.	.	1
Ar <i>Convolvulus arvensis</i>	.	.	.	.	.	.	.	.	.	+	.	.	1
GU <i>Geum urbanum</i>	.	.	.	.	+	+	.	.	+2	1.2	1.1	2.2	3.1
GU <i>Glechoma hederacea</i>	.	.	.	.	.	.	.	2.2	.	+	.	4.5	2.1
GU <i>Urtica dioica</i>	.	.	.	.	.	.	.	.	+	+	.	.	2
GU <i>Calystegia sepium</i>	.	.	.	.	.	.	.	.	+	.	.	.	1
GU <i>Rubus caesius</i>	.	.	.	.	.	.	.	.	.	+	.	.	1
GU <i>Rumex obtusifolius</i>	.	.	.	.	.	.	.	.	.	.	+	.	1
Ch <i>Verbena officinalis</i>	.	.	.	+	.	.	.	.	.	.	.	.	1
Ch <i>Lolium multiflorum</i>	.	+	.	.	.	.	.	.	.	.	.	.	1
Ch <i>Hordeum murinum</i>	+2	.	.	.	.	.	.	.	.	.	.	.	1
Ch <i>Poa annua</i>	.	.	.	.	.	.	.	.	+	+	.	.	2
O <i>Hordeum</i> sp.	.	.	2.1	.	1.2	+2	.	.	.	.	1.1	.	4
O <i>Cichorium intybus</i>	.	.	.	1.1	1.1	+	.	.	.	.	.	+2	4
O <i>Plantago major</i>	.	+	.	.	.	+	.	.	+2	.	.	.	3
O <i>Geum x spurium</i>	.	.	.	.	.	.	.	.	+	+	.	.	2
O <i>Oxalis fontana</i>	.	.	.	.	.	.	.	.	+	+	.	.	2
O <i>Bromus hordeaceus</i>	.	+	.	.	.	+	.	.	.	.	.	.	2
O <i>Festuca</i> sp.	.	+	.	.	.	.	.	.	.	.	+	.	2
O <i>Sanguisorba minor</i>	.	.	.	.	.	.	.	.	.	+	.	.	1
O <i>Bromus</i> sp.	.	.	.	.	.	+	.	.	.	.	.	.	1
O <i>Sambucus nigra</i>	.	.	.	.	.	.	.	+	.	.	.	.	1
O <i>Scrophularia nodosa</i>	.	.	.	.	.	.	.	.	+	.	.	.	1

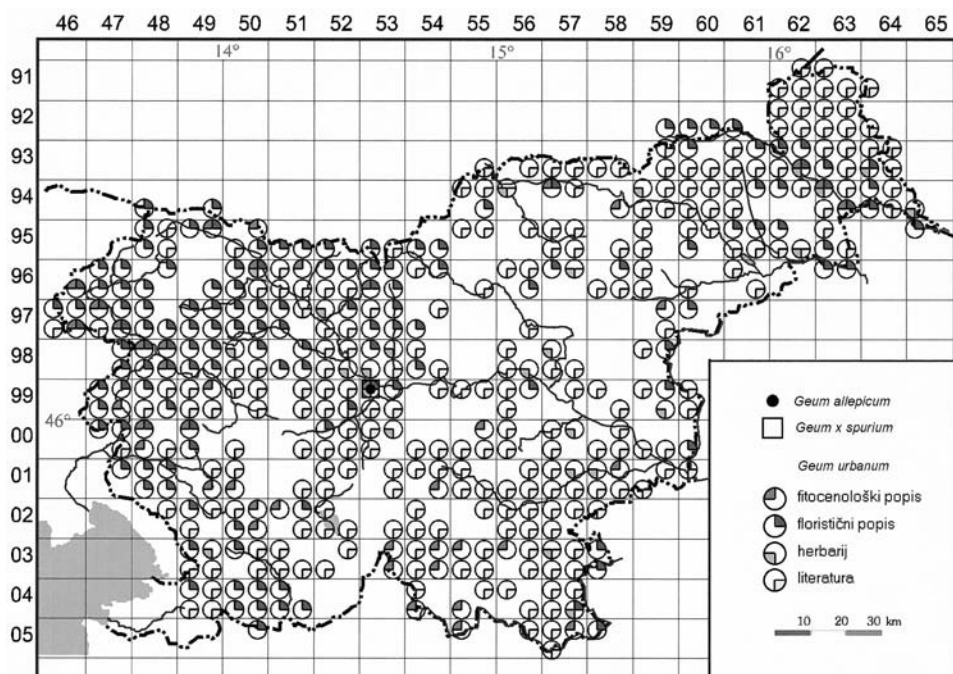
Legenda: MA = Molinio-Arrhenatheretea, Ar = Artemisietea vulgaris, GU = Galio-Urticetea, Ch = Chenopodietea, O = ostale.

Legend: MA = Molinio-Arrhenatheretea, Ar = Artemisietea vulgaris, GU = Galio-Urticetea, Ch = Chenopodietea, O = others.

Razširjenost vrst v Sloveniji

Navadna sretena (*G. urbanum*) je splošno razširjena vrsta v Sloveniji. Karto razširjenosti so pred nedavnim objavili JOGAN in sodelavci (2001: 181). Zaradi natančnejšega pregleda predstavitve razširjenosti obravnavanih vrst in križanca se nam je zdelo smiselno razširjenost vrste ponovno prikazati na skupni karti (podatki so urejeni po izvoru zbranih podatkov), hkrati s prikazom novega nahajališča alepske sretene in njenega križanca (Sl. 5).

V Sloveniji se, tako kot tudi v vsej ostali Evropi, pojavlja le tipična podvrsta alepske sretene *G. allepicum* subsp. *allepicum*. Na parkovni trati v središču Ljubljane se je pojavila slučajno, njen izvor pa je verjetno v travni semenski mešanici s poreklom iz vzhodne Evrope, ki se uporablja za zasejavanje parkov in zelenic po Ljubljani. Na edinem doslej znanem nahajališču v Sloveniji se je alepska sretena ohranila vsa leta doslej od njene prve najdbe dalje.



Slika 5: Razširjenost navadne (*G. urbanum*), alepske (*G. allepicum*) in neprave sretene (*G. x spurium*) v Sloveniji prikazana po srednjeevropski metodi florističnega kartiranja.

Figure 5: Distribution of *G. urbanum*, *G. allepicum* and *G. x spurium* in Slovenia according to Central European flora mapping.

Zahvala

Za pripravo karte razširjenosti vrst so podatke prispevali: B. Anderle, V. Babij, I. Dakskobler, A. Seliškar, B. Surina, D. Trpin, V. Žagar in M. Zupančič. Pri urejanju fitocenološke tabele in opredelitvi vegetacije mi je pomagal A. Seliškar. Angleško besedilo je pregledal M. Kuntner. Vsem se za pomoč iskreno zahvaljujem.

Summary

The genus *Geum* L. has a circumpolar distribution (mostly in the temperate zone of the northern hemisphere). It includes 56 species of which 5 taxa have been known to be present in Slovenia (MARTINČIČ et al. 1999): *G. reptans* L., *G. montanum* L., *G. rivale* L., *G. urbanum* L. and the hybrid *G. x sudeticum* Tausch (= *G. montanum* x *rivale*).

A new species for Slovenian flora, *Geum allepicum* was found in May 2000 on a Ljubljana centre lawn (9953/1 – UTM 33T VM60) together with the common *Geum urbanum* L. and their hybrid *Geum x spurium* Fisch. & Mey.

Geum allepicum is a perennial plant of 80 – 120 cm height, has an erect, branched stem and a thick and short rhizome. Basal leaves are pinnate, with 4-6 pairs of unequal leaflets; cauline leaves are 3- to 5-partite, large, with deeply cut stipules. Inflorescence is mostly with 3-6 yellow flowers, 15-20 (25) mm in diameter; petal leaves are (5) 7-9 (10) mm long, rounded or obovate. Achenes are 2,5-5 mm long, hairy at the base, numerous: (150) 200-350 (450), forming an obovoid head.

The species grows mostly in bushes, on forest edges and dry grasslands in the temperate zone of eastern Europe and Asia. In Slovenia it was found in Ljubljana centre on a fresh, nutrient rich soil together with the characteristic and common species of classes *Molinio-Arrhenatheretea*, *Artemisietea* and *Galio-Urticetea*.

Description of the new locality in Slovenia:

Ljubljana, Črtomirova street, 300 m a.s.l.; 46° 3' 46" N, 14° 31' 19" E; 9953/1 – UTM 33T VM60; Leg. et det. B. Vreš, 11.5. 2000 (source: Herbarium collection of the Institute of Biology SRC SASA: No. 11052).

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Questions as a basis for comparison of biology textbooks and workbooks

Vprašanja kot izhodišče za primerjavo bioloških učbenikov in delovnih zvezkov

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Abstract. This study focused on the analysis of three biology teaching sets and one textbook for 8th and 9th grade of elementary school. As a criterion we used the number and structure of questions assessable by Bloom's taxonomy of the cognitive domain.

It is obvious from the differences in the number and type of questions that the authors of the teaching materials differed in their understanding of the role of textbooks and workbooks in the teaching process. The analysed teaching sets included between 1.1 and 1.4 questions per page; most of them found in workbooks. The exception was one textbook with no questions for the students. The analysis of the questions using Bloom's scale of cognitive levels showed statistically significant differences between teaching sets. The average cognitive level of the questions in a teaching set was between 1.7 and 2.1.

The questions represent only one of indicators that show to what extent the didactic aspect was considered in the teaching sets, but the results suggest biology teaching material for elementary school is overly focused on lower cognitive levels, mostly recognition, not providing enough knowledge of higher cognitive levels.

Key words: textbooks, evaluation, Bloom's taxonomy of the cognitive domain.

Izvleček. V raziskavi smo analizirali tri učbeniške komplete in en učbenik za biologijo v 8. in 9. razredu osnovne šole. Za kriterij smo izbrali število in strukturo vprašanj, ki jih je mogoče vrednotiti po Bloomovi taksonomiji kognitivnih ciljev.

Pisci učnih gradiv očitno različno pojmujejo vlogo učbenika in delovnega zvezka v učnem procesu, saj so se pokazale razlike tako v številu kot v tipu vprašanj. Obravnavani učbeniški kompleti vsebujejo od 1.1 do 1.4 vprašanj na stran, večinoma je večji delež vprašanj v delovnih zvezkih. Posebnost je en učbenik, v katerem ni vprašanj za učence. Analiza vprašanj po Bloomovi lestvici kognitivnih stopenj je pokazala statistično pomembne razlike med učbeniški

kompleti. Povprečna vrednost kognitivne stopnje vprašanj v učbeniških kompletih se giblje med 1.7 in 2.1.

Vprašanja so samo en pokazatelj didaktične obdelanosti učbeniškega kompleta, vendar rezultati kažejo, da so v osnovnošolskih bioloških učnih gradivih preveč poudarjeni nižji kognitivni cilji, predvsem poznavanje, premalo pa je višjih kognitivnih ciljev.

Ključne besede: učbeniki, evalvacija, Bloomova taksonomija kognitivnih ciljev

Introduction

Biology in lower grades of elementary school forms part of various subjects, but in 8th and 9th grade it becomes a separate subject. Teaching material for new programmes is issued by various publishers, which has its advantages as well as disadvantages. A wider choice gives teachers a chance to select a teaching set they see best suited for their students and at the same time conforms to their teaching methods.

There are several dilemmas surrounding the use of science textbooks. Should biology teachers use textbooks or not? Should the textbooks be the focus of a course or just supplemental material? Who should determine textbook content and what should this content be? (KIRK & al. 2001). It turns out that a textbook is a valuable, and in many cases central, component of biology education that contributes to achieving biology teachers' goals. Many science teachers, new teachers in particular, use the assigned textbook as their content outline and story line for their courses (CHIAPPETTA & al. 1993, BYBEE 2001, GARINGER 2001). A study, conducted on a sample of Slovene elementary school teachers (VERČKOVNIK & STRGAR 2003), showed that for 60.0 % of teachers the textbook still represents a guide for their course and not a resource for unassisted student home work. Since textbooks have been shown to have tremendous impact on curricula, this is one variable of science instruction that needs further investigation (LLOYD 1990).

What constitutes a good science textbook and how can we identify it? The lists used in textbook selection are long and include such items as content accuracy, clear definition of terms, end-of-chapter questions, graphics and physical characteristics, pictures and diagrams, in-text laboratory activities, etc. (CHIAPPETTA & al. 1993). Others promote the evaluation of teaching material beyond simply their contents and instead focusing on cognitive and affective factors (GARINGER 2001). The study by LOWERY & LEONARD (1978) examined the questioning style among four widely used high school biology textbooks in terms of types, frequency, and placement of questions in textual reading materials. It also examined the science/learning (inquiry) processes elicited by the questions. TAMIR (1985) and ELTINGE & ROBERTS (1993) tried to assess the degree to which science was portrayed as a process of inquiry in high school biology textbooks, as the opposite of a portrayal of science as a collection of facts. ANDERSON & BOTTICELLI (1990) analysed textbooks based on explicit and implicit content analysis techniques. The purpose of LLOYD'S (1990) analysis was to identify text-based concepts and to describe how these concepts are elaborated in three biology textbooks. CHIAPPETTA & al. (1993) wanted to determine if the textbook under consideration reflects the themes of scientific literacy that science educators believe are important. CONRAD (1996) investigated linguistic variation in biology textbooks and articles. NINNES (2000) evaluated the ways in which secondary science textbooks incorporate and represent indigenous knowledge. HARRISON (2001) investigated the ways that models are used in school science textbooks. The study reported by KESIDOU & ROSEMAN (2002) focused on examining how well science textbooks meet the Project 2061 content and instruc-

tional criteria. DIMOPOULOS & al. (2003) analysed the pedagogic function of visual images included in school science textbooks.

According to the Slovene biology curricula for 8th and 9th grade of elementary school, students should learn in an active way; gain cognition through their own research and investigation; reveal the point of the given content by collecting data from different sources; compare information and employ critical thought; learn to analyse and make connections and generalizations. The curricula therefore prescribes attaining not only data but also knowledge of a higher cognitive level. Based on the finding that biology textbooks and workbooks have a central role in achieving the goals of the curricula, our intention was to evaluate to what extent they contribute to these objectives. The number and structure of the questions set in textbooks and workbooks serve as criteria. It was hypothesized that:

- There would be no differences among the texts in the ratio of questions per page.
- Bloom's taxonomy of the cognitive domain would show no significant differences among the texts.

The results would provide guidance for teachers. This kind of analysis should also be of help to the authors of new textbooks and workbooks.

Material and methods

The study, conducted in 2003, focused on the teaching material (textbooks and workbooks) in biology for 8th and 9th grade of elementary school. Their authors distributed content and categories between textbooks and workbooks at their own discretion. From the student's point of view we can regard the textbook and workbook as a complete whole – a teaching set. At the time of the study, two biology teaching sets for 8th grade were approved, as well as one teaching set and one textbook for 9th grade.

The list of the biology textbooks and supplemental workbooks analysed is as follows:

Textbook for the 8th grade of elementary school (Biologija 8. Učbenik za 8. razred devetletne osnovne šole. Novak Bernarda. Ljubljana, DZS, 2000.)

Workbook for the 8th grade of elementary school (Biologija 8. Delovni zvezek za 8. razred devetletne osnovne šole. Novak Bernarda. Ljubljana, DZS, 2000.)

Textbook for the 8th grade of elementary school (Biologija 8. Učbenik za 8. razred devetletne osnovne šole. Kralj Metka, Podobnik Andrej. Ljubljana, TZS, 2001.)

Workbook for the 8th grade of elementary school (Biologija 8. Delovni zvezek za 8. razred devetletne osnovne šole. Kralj Metka. Ljubljana, TZS, 2002.)

Textbook for the 9th grade of elementary school (Biologija 9. Učbenik za 9. razred devetletne osnovne šole. Svečko Marina. Ljubljana, DZS, 2002.)

Workbook for the 9th grade of elementary school (Biologija 9. Delovni zvezek za 9. razred devetletne osnovne šole. Svečko Marina. Ljubljana, DZS, 2001.)

Textbook for the 9th grade of elementary school (Biologija 9. Učbenik za 9. razred devetletne osnovne šole. Kordiš Tatjana. Ljubljana, Modrijan, 2002.)

* The supplemental workbook had not yet been published at that time.

Textbooks and workbooks were evaluated by analysing the questions for students. FISH AND GOLDMARK (1966) stated that the kinds of questions used in instruction determine the kinds of operations student perform (as cited in LOWERY & LEONARD 1978). The value of particular types and usage of questions in textbooks depends on certain assumptions. If one starts from the assumption based on Piagetian research that indicates direct and active experience is more valuable to students' learning than indirect and passive experience, then one would judge textbooks that ask questions within the experiential realm to be more desirable than those that ask non-experiential questions. We can also assume that asking a high proportion of questions is important or agree with many researchers that all forms of teaching (in this case, textbooks) should make greater use of »higher level« questions (LOWERY & LEONARD 1978).

As a criterion we took Bloom's Taxonomy of the Cognitive Domain that has already been used by CHALL & CONARD (1991) and SKIERSO (1991) to assess the processes and skills textbooks require learners to perform (as cited in GARINGER 2001). This method was chosen following positive experience in the preparation of tests for graduation from elementary school and graduation from grammar school (baccalaureate). These require an adapted three-level Bloom scale which makes the procedure more practical while retaining adequacy, but we decided on a full six-level scale nevertheless. All the questions assessable by taxonomy of the cognitive domain were collected in grid diagrams, distributed into cognitive levels, and statistically processed. The rating of a textbook will directly reflect the level of skills it demands. For example, a book that uses synthesis and analysis would rate higher than one that demands only comprehension (GARINGER 2001).

The questions were sorted by two independent evaluators. Where their assessment differed, the question was ranked after discussion and agreement. The questions were sorted into cognitive levels with regard to other texts in the teaching material. Evaluated out of context, many questions would be sorted into other categories. A question that was demanding at first glance, but was provided with an answer in the preceding text, was placed in a lower category. If the answer was given in the following text, the question was placed higher. Similar questions could therefore be arranged into different cognitive levels.

Important factors in the measurement of the effect of a textbook on pupils are the teacher's use of the textbook and his method of teaching. Experience teaches us that the course of teaching often encourages students to learn by heart. In this context MARENTIČ POŽARNIK (1992) stressed the importance of a well designed education and training for teachers to prepare them for proper selection and creative use of textbooks. Our analysis assumed an ideal teacher who promotes unassisted work and thinking and does not offer definite solutions, maintaining the potential value of the questions in the textbooks and workbooks.

Results and discussion

The teaching sets examined included between 1.1 and 1.4 questions per page (Tab. 1). A detailed analysis showed that in the set EF this ratio was the same for the workbook and the textbook, while sets AB and CD placed most questions in the workbooks. In Slovenia, textbooks are not designed so as to allow them to be written in, so the results are not surprising.

An exception is textbook G that can be classified as a classic textbook on the basis of its structure, and is at the moment the only one of that type among elementary school textbooks. A textbook can encompass a whole range of levels, and can therefore be a textbook with a strong didactic component, or, at the other end of the spectrum, a classic textbook with the content presented systematically and in language and style suitable for target readers, but does not include special didactic techniques, such as a motivating introduction, activity encouraging questions, knowledge testing questions, knowledge

reinforcement questions, etc. Given that the workbook to accompany this textbook has not yet been published, the suitability of such design cannot be assessed. Since textbook G does not include questions for students, which were the basic element of our work, it was not included in further analysis.

Table 1: Ratio of questions per page in the teaching sets examined.

Teaching set	Ratio
AB	1.4
CD 1.1	
EF	1.4
G* -	

*The supplemental workbook had not yet been published at that time.

The hypothesis that there would be no differences among the texts regarding the ratio of questions per page can therefore be refuted, since the results show that the authors of teaching material took various approaches, which leads to the conclusion that they hold different views of the role of the textbook in the teaching process. As MARENTIČ POŽARNIK (1992) stated, each textbook reflects the author's view of the learning and teaching processes, his or her understanding of knowledge and of the pupil's abilities.

Tab. 2 shows the percentage of questions of individual cognitive levels in each of the teaching sets. The three sets examined include between 201 and 323 questions that we were able to analyse using Bloom's taxonomy of the cognitive domain. The average cognitive level of the questions in the teaching sets was between 1.7 and 2.1. The differences between percentages of questions of individual cognitive levels among these three teaching sets are statistically significant ($\alpha=2P<0.1$, $\alpha=2P<0.001$). The results show that most questions fit into the first cognitive level (49.3 – 60.2 %). It is interesting that both 8th grade sets (AB and CD) have approximately the same percentage of questions of this level. All sets include considerably fewer questions of the second cognitive level (15.3 – 25.4 %). There are approximately the same number of questions of the third cognitive level in sets CD and EF (15.9 – 18.4 %), while the percentage in set AB is substantially lower (7.7 %). Set AB deviates in the fourth cognitive level as well, but this time in the other direction, since it contains as much as 17.3 % of the questions of this level, while the other two sets include considerably fewer (4.9 – 6.5 %). There are very few questions of the fifth and sixth level (up to 3.0 %).

Table 2: Distribution of questions of individual cognitive levels in the teaching sets using Bloom's scale.

Cognitive level	Percentage of questions		
	Set AB	Set CD	Set EF
1.	49.8	49.3	60.2
2.	20.7	25.4	15.3
3.	7.7	15.9	18.4
4.	17.3	6.5	4.9
5.	1.9	3.0	0.8
6.	2.5	0.0	0.4
Total	100	100	100

From the percentages of individual cognitive levels it is possible to deduce the teaching goals achievable with these sets. The National Examination Commission in Slovenia prepares the biology test sheets for the final examination for elementary school using an adapted Bloom's scale of the cognitive domain. It merged the 2nd and 3rd levels, and 4th, 5th and 6th levels, thus creating a three-level scale instead of a six-level scale. The Commission reached an agreement that the national biology examinations should include 35 % of questions regarding recognition, 50 % of questions regarding comprehension and 15 % of questions regarding higher cognitive levels (Tab. 3).

Table 3: Evaluation scale of cognitive levels for national examinations.

Cognitive level	Description	Percentage
1. recognition	recognition of facts, data, concepts, definitions, theories, formulas	35 %
2. comprehension, application	connecting causes and effects, seeking examples, giving own examples, solving new problems, translating of one type of symbolic record into other	50 %
3. independent problem solving, independent interpretation, analysis, synthesis, assessment	unknown situations, original solutions analysis, comparison, abstract thinking, generalization, deduction, synthesis, independent argumentation independent and critical assessment of phenomena, theories and solutions, supported by argument	15 %

Comparison of the National Examination Commission recommendations with the analysed teaching sets shows that the differences in the percentages of the questions of individual cognitive levels are substantial. There are approximately 15-25 % too many questions regarding basic knowledge, which are first level questions (Tab. 4). At the second-level, concerning comprehension and application of knowledge, the teaching set CD with 41.3 % comes closest to the recommendations of the Commission. The other two sets include only around 30 % of these questions, which is 20 % less than the Commission advises. The results regarding questions of the highest category are surprising. Set AB with 21.7 % of these questions is the only one that meets and even exceeds the recommended percentage. There are too few of these questions in the other two sets (9.5 % and 6.1 %).

Questions for pupils are only one of the indicators that show to what extent the didactic aspect was considered in the teaching sets. Other elements, which were not taken into consideration in our study, are also very important. But the results show that elementary school teaching material puts too much emphasis on lower cognitive levels, especially recognition. Basic knowledge is of course a necessary foundation that students must acquire, but the teaching process should include a wider scope of higher levels.

Table 4: Distribution of questions of individual cognitive levels in the teaching sets using an adapted three-level scale.

Cognitive level	Percentage of questions		
	Set AB	Set CD	Set EF
1.	49.9	49.3	60.2
2.	28.5	41.3	33.7
3.	21.7	9.5	6.1
Total	100	100	100

Similar conclusions concerning textbooks were also reached abroad. ELLIOT & NAGEL CARTER (1987) established that natural science textbooks adequately present natural science content, but do not encourage scientific thought. The authors of that study think that the most important message of the current natural science textbooks is that the natural sciences are a collection of findings that must be learned by heart. The textbooks therefore stress the content and learning of facts and principles, but there is little application and suitable activities to help the student understand nature and connect natural sciences with the problems of the modern world. They summarized their findings into a claim that the textbooks' stress is largely on the products of the natural sciences and less on the character of the natural sciences and its processes. A review of the 10 most popular high school biology textbooks in the US also found numerous facts, but little to explain the underlying scientific importance of the facts. The evaluators rated all 10 textbooks poor in »demonstrating use of knowledge« and »encouraging students to reflect on their own learning« (HOFF 2000).

Conclusions

The following are the most important findings:

- The teaching sets differ in number of questions per page. They include between 1.1 and 1.4. The workbooks contain the majority of the questions.
- The average cognitive level of the questions in teaching sets is between 1.7 and 2.1, which indicates an emphasis on recognition and a lack of higher cognitive levels.
- The difference in the structure of the questions of the teaching sets, analysed by Bloom's taxonomy of the cognitive domain, is statistically significant.
- The authors of teaching sets have a different perspective of the role of teaching materials.

Povzetek

Izhajajoč iz ugotovitve, da imajo biološki učbeniki in delovni zvezki osrednje mesto pri doseganju ciljev učnega načrta, je bil naš namen ovrednotiti, v kolikšni meri lahko pripomorejo k doseganju teh ciljev. Za kriterij smo izbrali število in strukturo vprašanj v treh učbeniških kompletih in enem učbeniku za 8. in 9. razred osnovne šole. Predpostavili smo, da med besedili ne bo razlik glede na število vprašanj na stran, in da ne bo statistično pomembnih razlik glede na Bloomovo taksonomijo kognitivnih ciljev. Vsa vprašanja, ki jih je mogoče vrednotiti po taksonomiji kognitivnih ciljev, smo

zbrali v mrežnih diagramih, jih po zahtevnosti razvrstili v kognitivne stopnje in statistično obdelali. Ocena je bila neposredno odvisna od nivoja zahtevnosti, ki ga učbeniški komplet omogoča razvijati.

Rezultati kažejo, da so imeli pisci učnih gradiv raznolik pristop. Ugotovili smo namreč, da obravnavani učbeniški kompleti vsebujejo od 1.1 do 1.4 vprašanj na stran. Večinoma je večji delež vprašanj v delovnih zvezkih. Posebnost je učbenik G, v katerem ni vprašanj za učence. Tega zato nismo mogli vključiti v nadaljnjo analizo. Po Bloomovi taksonomiji kognitivnih stopenj so se pokazale statistično pomembne razlike med učbeniški kompleti. Rezultati kažejo, da je največ vprašanj prve kognitivne stopnje (49,3 – 60,2 %), kar je približno 15-25 % preveč glede na priporočila Komisije za vodenje nacionalnih preizkusov znanja. Pri vprašanjih 2. in 3. stopnje, ki zajemajo razumevanje in uporabo znanja, se priporočilom Komisije najbolj približa učni komplet CD z 41,3 % takih vprašanj. V drugih dveh kompletih jih je okoli 20 % manj premalo. V najvišji kategoriji, torej vprašanj 4., 5. in 6. stopnje pa komplet AB z 21,7 % presenetljivo dosega in celo precej presega želeni delež teh vprašanj. V drugih dveh kompletih je teh vprašanj premalo (9,5 % oz. 6,1 %). Povprečna vrednost kognitivne stopnje vprašanj v kompletih se giblje med 1.7 in 2.1.

Vprašanja so samo en pokazatelj didaktične obdelanosti učbeniškega kompleta. Zelo pomembni so tudi drugi elementi, ki jih v naši raziskavi nismo zajeli. Vendar dobljeni rezultati kažejo, da so v osnovnošolskih bioloških učnih gradivih preveč poudarjeni nižji kognitivni cilji, predvsem poznavanje, premalo pa je višjih kognitivnih ciljev. Tudi nekatere raziskave učbenikov v tujini so prišle do podobnih zaključkov.

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IN MEMORIAM

Kako naj ti povrnem, zemlja,
za milost, ki mi jo daješ:
za mavrično iskro sonca v kaplji rose,
za vonj pokošenih travnikov, za žarenje zrelega ruja
po samotnih gmajnah, za srebro zimskih noči?
Kako neustavljivi zagon Življenja,
za slast rasti in padcev, iskanja in zmote,
celo za strah pred Ničem?
Kako naj ti vrnem, zemlja,
za neizrekljivi občutek,
da Sem?
Da sem v sredici kamna, v listu na drevesu,
odsvit zvezde, dih v dihu vesolja?
Iščem besede zahvale,
preproste, vseobsegajoče,
ki jih razumejo trave in živali,
iščem besedo,
kakršno položi v usta samo smrt.

Ivan Minatti

Prof. dr. Miran Vardjan, 1919 – 2005

15. oktobra je umrl prof. Miran Vardjan. 14. novembra smo se na žalni seji od njega poslovili njegovi sodelavci in prijatelji s Biološkega oddelka Biotehniške fakultete, Inštituta za biologijo in drugod.

Prof. dr. Miran Vardjan se je rodil 1. maja 1919. Rojstni dan je praznoval na praznik dela, kar simbolizira njegovo življensko pot, prežeto z delom ter željo po izpopolnjevanju starega in iskanju novega. Po maturi ga je zatekla vojna, nekaj časa je preživel v ujetništvu in v italijanski internaciji. Po osvoboditvi je učiteljeval, vendar ga ta zaposlitev ni zadovoljevala. Zato je ob delu končal Višjo pedagoško šolo v Ljubljani, skupino biologija-kemija, nato pa še študij biologije na tedanji Prirodoslovno matematični fakulteti. Postal je asistent na Inštitutu za botaniko pri prof. dr. Ernestu Mayerju. Ko sem bila v prvem letniku biologije, tega je že petdeset let, je vodil vaje iz splošne botanike. Še kot študentka sem na inštitutu postala tehnična sodelavka in sem med drugim pomagala asistentu Vardjanu pri njegovih poskusih za doktorsko disertacijo. Za eksperimentalno delo takrat ni bilo opreme, vendar so improvizacije to pomanjkanje kar uspešno nadomeščale. Doktoriral je leta 1959. Naslednje leto je postal docent in kasneje predstojnik na novo ustanovljeni Katedri za fitofiziologijo. Ker doma ni imel možnosti za izpopolnjevanje v fiziologiji rastlin, je odšel najprej v Tübingen k dr. Büningu, priznanemu raziskovalcu endogenih ritmov v povezavi s cvetenjem, nato pa še za eno leto v fitotron Gif pri Parizu k prof. Nitschu. Pri njemu se je usmeril v raziskave hormonalne kontrole rasti in razvoja rastlin, ki so bile v vzponu, saj so bili nekateri rastlinski hormoni odkriti šele nekaj let pred tem. Med tem smo se biologi preselili v novo stavbo na Aškerčevo 12, ki je bila zgrajena za Filozofsko in Naravoslovno fakulteto, kateri smo tedaj pripadali. V teh prostorih so bili ustvarjeni taki delovni pogoji, da je lahko uspešno uvedel v naš laboratorij takrat moderne metode dela za raziskovanje rastlinskih hormonov, ki jih je spoznal pri dr. Nitschu. Ob raziskovalnem delu je vzgajal tudi študente dodiplomskega in podiplomskega študija biologije, pa tudi agronomije in gozdarstva.

V prvih letih je prof. Vardjan raziskoval regulacijo razvoja pri različnih fiziološko zanimivih rastlinah. Njegov prvi odmeven članek v reviji Bulletin de la Societe Botanique de France je obravnaval vlogo avksinov in citokininov pri regeneraciji endivije (*Cichorium endivia*). Zanimiv je njegov prispevek o regulaciji zasuka plodov v obratno smer, kot jo imajo cvetovi zidnega poponca (*Linaria cymbalaria*), prav tako članek o giberelinih in citokininih v spomladanskem ksilemskem soku breze (*Betula pendula*), ali pa o regulaciji nastajanja epifilnih brstov pod vplivom kinetina pri rastlini *Bryophyllum daigremontianum*. Poleg naštetih tem je bila za dr. Vardjana prav gotovo najzanimivejša regulacija dormantnosti in kalitve semen. Iz te tematike je objavil največ razprav in o njih referiral na mnogih znanstvenih in strokovnih srečanjih. Glavni rastlinski vrsti, ki ju je izbral za svoje raziskave sta bili rumeni svišč (*Gentiana lutea* subsp. *symphyandra*) in jelka (*Abies alba*). Prva vrsta ima zelo globoko dormantna semena, druga plitvo dormanco, odvisno od rastišča in leta obroda. Zato so njegove študije o vlogi rastnih regulatorjev in encimov, o vlogi smol v semenski lupini, skarifikaciji, da jih naštejemo samo nekaj, pomembne za osvetlitev pomena in poteka dormance in kalitve semen. Njegov ameriško slovenski projekt, ki ga je dobil v sedemdesetih letih o kalitvi semen jelke, nam je pomagal do prve večje opreme. Mislim, da liofilizer, ki je bil kupljen takrat, še vedno deluje.

Dr. Miran Vardjan je pisal tudi učbenike, od katerih bi omenila snopiča, namenjena gimnazijskemu izobraževanju: Življenski procesi – asimilacija, disimilacija in Izvor življenja in razvoj življenjskih procesov. Njegovo ime najdemo tudi med pisci poljudno znanstvene revije Proteus. Serija člankov o kalitvi semen je še sedaj primerno branje za mlade naravoslovce, ki jih zanima fiziologija rastlin. Prav tako smo o zanimivostih iz življenja rastlin poslušali njegove prispevke na radiu in gledali na televiziji.

Prof. Miran Vardjan je bil eden od ustanoviteljev Jugoslovanskega društva za fiziologijo rastlin, skupaj s prof. Devidéjem iz Zagreba, prof. Saričem iz Novega Sada in prof. Neškovičevom iz Beograda. Nekaj časa je bil tudi njegov predsednik. Leta 1982 so se ustanovila republiška društva, tudi v Sloveniji. Leta 2002 je prof. Vardjan postal častni član Društva za rastlinsko fiziologijo Slovenije. Bil je tudi častni član društva za fiziologijo rastlin Hrvaške. Za svoje delo je prejel tudi več drugih priznanj. Tako je ob tridesetletnici Biotehniške fakultete leta 1977 prejel plaketo, leta 1977 častno priznanje mesta Ljubljane za udeležbo v osvobodilnem delovanju med NOB, ob šestdesetletnici biologije na Univerzi v Ljubljani zlato značko, leta 1979 red dela z zlatim vencem in leta 1981 Jesenkovo priznanje, ki ga podeljuje Biotehniška fakulteta. Ob štiridesetletnici Nacionalnega inštituta za biologijo je kot njegov bivši direktor dobil posebno priznanje.

Prof. Miran Vardjan se je upokojil leta 1982, vendar je še naprej sodeloval v stroki in ostal aktiven na pedagoškem področju. Njegova velika ljubezen je bila ves čas tudi umetnost. V intervjuju za revijo Proteus mi je ob njegovi sedemdesetletnici takole pripovedoval: »V dijaških letih se je moje zanimanje usmerilo na umetnostno področje. Bilo je čisto pasivno doživljanje lepega. Veliko sem bral, skoraj redno sem zahajal v dramo in opero – seveda na dijaško stojišče ali še pogosteje na še cenejši »oksenštand«, pogosto obiskoval slikarske razstave. Spominjam se s kakšnim navdušenjem sem prebiral obsežno zgodovino umetnosti zahodne Evrope Izidorja Cankarja. Takrat sem sklenil, da bom študiral umetnostno zgodovino«. Te kasneje seveda ni študiral, ostala pa je ljubezen do nje. Zanimala ga je tudi filatelistika in je tudi na tem področju postal priznan strokovnjak. Prof. Vardjan je preživel plodna leta prežeta s tisto dejavnostjo, ki človeka osrečuje v vsakem dnevu, ki prihaja.

Slava profesorjevemu spominu!

Nada Gogala

NAVODILA AVTORJEM

1. Vrste prispevkov

a) ZNANSTVENI ČLANEK je celovit opis originalne raziskave in vključuje teoretični pregled tematike, podrobno predstavljene rezultate z diskusijo in sklepe ter literaturni pregled: shema IMRAD (Introduction, Methods, Results And Discussion). Dolžina članka, vključno s tabelami, grafi in slikami, na sme presegati 15 strani; razmak med vrsticami je dvojen. Recenzirata ga dva recenzenta.

b) PREGLEDNI ČLANEK objavi revija po posvetu uredniškega odbora z avtorjem. Število strani je lahko večje od 15.

c) KRATKA NOTICA je originalni prispevek z različnih bioloških področij (sistematike, biokemije, genetike, mikrobiologije, ekologije itd.), ki ne vsebuje podrobnega teoretičnega pregleda. Njen namen je seznaniti bralca s preliminarimi ali delnimi rezultati raziskave. Dolžina na sme presegati 5 strani. Recenzira ga en recenzent.

d) KONGRESNA VEST seznaja bralce z vsebinami in sklepi pomembnih kongresov in posvetovanj doma in v tujini.

e) DRUŠTVENA VEST poroča o delovanju slovenskih bioloških društev.

2. Originalnost prispevka

Članek, objavljen v reviji Acta Biologica Slovenica, ne sme biti predhodno objavljen v drugih revijah ali kongresnih knjigah.

3. Jezik

Teksti naj bodo pisani v angleškem jeziku, izjemoma v slovenskem, če je tematika zelo lokalna. Kongresne in društvene vesti so praviloma v slovenskem jeziku.

4. Naslov prispevka

Naslov (v slovenskem in angleškem jeziku) mora biti kratek, informativen in razumljiv. Za naslovom sledijo imena avtorjev in njihovi polni naslovi (če je mogoče, tudi šte. faxa in e-mail).

5. Izvleček – Abstract

Podati mora jedrnat informacijo o namenu, uporabljenih metodah, dobljenih rezultatih in zaključkih. Primerna dolžina za znanstveni članek naj bo približno 250 besed, za kratko notico pa 100 besed.

6. Ključne besede – Keywords

Število naj ne presega 10 besed, predstavljati morajo področje raziskave, predstavljene v članku. Člankom v slovenskem jeziku morajo avtorji dodati ključne besede v angleškem jeziku.

7. Uvod

Nanašati se mora le na tematiko, ki je predstavljena v članku ali kratki notici.

8. Slike in tabele

Tabele in slike (grafi, dendrogrami, risbe, fotografije idr.) naj v članku ne presegajo števila 10, v članku naj bo njihovo mesto nedvoumno označeno. Ves slikovni material naj bo oddan kot fizični original (fotografija ali slika). Tabele in legende naj bodo tipkane na posebnih listih (v tabelah naj bodo le vodoravne črte). Naslove tabel pišemo nad njimi, naslove slik in fotografij pod njimi. Naslovi tabel in slik ter legenda so v slovenskem in angleškem jeziku. Pri citiranju tabel in slik v besedilu uporabljamo okrajšave (npr. Tab. 1 ali Tabs. 1-2, Fig. 1 ali Figs. 1-2; Tab. 1 in Sl. 1).

9. Zaključki

Članek končamo s povzetkom glavnih ugotovitev, ki jih lahko zapišemo tudi po točkah.

10. Povzetek – Summary

Članek, ki je pisan v slovenskem jeziku, mora vsebovati še obširnejši angleški povzetek. Velja tudi obratno.

11. Literatura

Uporabljene literaturne vire citiramo med tekstem. Če citiramo enega avtorja, pišemo ALLAN (1995) ali (ALLAN 1995), če sta dva avtorja (TRINAJSTIĆ & FRANJIĆ 1994), če je več avtorjev (PULLIN & al. 1995). Kadar navajamo citat iz večih del hkrati, pišemo (HONSIG-ERLENBURG & al. 1992, WARD 1994A, ALLAN 1995, PULLIN & al. 1995). V primeru, če citiramo več del istega avtorja, objavljenih v enem letu, posamezno del označimo s črkami a, b, c itd. (WARD 1994a,b). Če navajamo dobesedni citat, označimo dodatno še strani: TOMAN (1992: 5) ali (TOMAN 1992: 5-6). Literaturo uredimo po abecednem redu, začnemo s priimkom prvega avtorja, sledi leto izdaje in naslov članka, mednarodna kratica za revijo (časopis), volumen poudarjeno, številka v oklepaju in strani. Npr.:

HONSIG-ERLENBURG W., K. KRAINER, P. MILDNER & C. WIESER 1992: Zur Flora und Fauna des Webersees. Carinthia II **182/102** (1): 159-173.

TRINAJSTIĆ & J. FRANJIĆ 1994: Ass. *Salicetum elaeagno-daphnoides* (BR.-BL. et VOLK, 1940) M. MOOR 1958 (*Salicion elaeagni*) in the Vegetation in Croatia. Nat. Croat. **3** (2): 253-256.

WARD J. V. 1994a: Ecology of Alpine Streams. Freshwater Biology **32** (1): 10-15.

WARD J. V. 1994b: Ecology of Prealpine Streams. Freshwater Biology **32** (2): 10-15.

Knjige, poglavja iz knjig, poročila, kongresne povzetke citiramo sledeče:

ALLAN J. D. 1995: Stream Ecology. Structure and Function of Running Waters, 1st ed. Chapman & Hall, London, 388 pp.

PULLIN A. S., I. F. G. MCLEAN & M. R. WEBB 1995: Ecology and Conservation of *Lycaena dispar*: British and European Perspectives. In: PULLIN A. S. (ed.): Ecology and Conservation of Butterflies, 1st ed. Chapman & Hall, London, pp. 150-164.

TOMAN M. J. 1992: Mikrobiološke značilnosti bioloških čistilnih naprav. Zbornik referatov s posvetovanja DZVS, Gozd Martuljek, pp. 1-7.

12. Format in oblika članka

Članek naj bo poslan v obliki Word dokumenta (doc) ali kot obogateno besedilo (rtf) v pisavi "Times New Roman CE 12" z dvojnimi medvrstnim razmakom in levo poravnavo ter s 3 cm robovi na A4 formatu. Odstavki naj bodo med seboj ločeni s prazno vrstico. Naslov članka in poglavij naj bodo pisani krepko in v velikosti pisave 14. Vsja latinska imena morajo biti napisana ležeče. Uporabljene nomenklaturne vire navedemo v poglavju Metode. Tabele in slike so posebej priložene tekstu. Vse strani (vključno s tabelami in slikami) morajo biti oštevilčene. Glavnemu uredniku je potrebno oddati original, dve kopiji in elektronski zapis na disketi 3,5", na CD-romu ali kot priponko elektronske pošte (slednjega odda avtor po opravljenih strokovnih in jezikovnih popravkih).

13. Recenzije

Vsak znanstveni članek bosta recenzirala dva recenzenta (en domači in en tuji), kratko notico pa domači recenzent. Avtor lahko v spremnem dopisu predlaga tuje recenzente. Recenziran članek, ki bo sprejet v objavo, popravi avtor. Po objavi prejme 30 brezplačnih izvodov. V primeru zavrnitve se originalne materiale vrne avtorju skupaj z negativno odločitvijo glavnega urednika.

INSTRUCTIONS FOR AUTHORS

1. Types of Articles

a) SCIENTIFIC ARTICLES are comprehensive descriptions of original research and include a theoretical survey of the topic, a detailed presentation of results with discussion and conclusion, and a bibliography according to

the IMRAD outline (Introduction, Methods, Results, and Discussion). The length of an article including tables, graphs, and illustrations may not exceed fifteen (15) pages; lines must be double-spaced. Scientific articles shall be subject to peer review by two experts in the field.

b) REVIEW ARTICLES will be published in the journal after consultation between the editorial board and the author. Review articles may be longer than fifteen (15) pages.

c) BRIEF NOTES are original articles from various biological fields (systematics, biochemistry, genetics, microbiology, ecology, etc.) that do not include a detailed theoretical discussion. Their aim is to acquaint readers with preliminary or partial results of research. They should not be longer than five (5) pages. Brief note articles shall be subject to peer review by one expert in the field.

d) CONGRESS NEWS acquaints readers with the content and conclusions of important congresses and seminars at home and abroad.

e) ASSOCIATION NEWS reports on the work of Slovene biology associations.

2. Originality of Articles

Manuscripts submitted for publication in *Acta Biologica Slovenica* should not contain previously published material and should not be under consideration for publication elsewhere.

3. Language

Articles and notes should be submitted in English, or as an exception in Slovene if the topic is very local. As a rule, congress and association news will appear in Slovene.

4. Titles of Articles

Titles (in Slovene and English) must be short, informative, and understandable. The title should be followed by the name and full address of the author (and if possible, fax number and e-mail address).

5. Abstract

The abstract must give concise information about the objective, the methods used, the results obtained, and the conclusions. The suitable length for scientific articles is approximately 250 words, and for brief note articles, 100 words.

6. Keywords

There should be no more than ten (10) keywords; they must reflect the field of research covered in the article. Authors must add keywords in English to articles written in Slovene.

7. Introduction

The introduction must refer only to topics presented in the article or brief note.

8. Illustrations and Tables

Articles should not contain more than ten (10) illustrations (graphs, dendrograms, pictures, photos etc.) and tables, and their positions in the article should be clearly indicated. All illustrative material should be provided as physical originals (photographs or illustrations). Tables with their legends should be submitted on separate pages (only horizontal lines should be used in tables). Titles of tables should appear above the tables, and titles of photographs and illustrations below. Titles of tables and illustrations and their legends should be in both Slovene and English. Tables and illustrations should be cited shortly in the text (Tab. 1 or Tabs. 1-2, Fig. 1 or Figs. 1-2; Tab. 1 and Sl. 1).

9. Conclusions

Articles shall end with a summary of the main findings which may be written in point form.

10. Summary

Articles written in Slovene must contain a more extensive English summary. The reverse also applies.

11. Literature

References shall be cited in the text. If a reference work by one author is cited, we write Allan (1995) or (Allan 1995); if a work by two authors is cited, (Trinajstić & Franjić 1994); if a work by three or more authors is cited, (Pullin & al. 1995); and if the reference appears in several works, (Honsig-Erlenburg & al. 1992, Ward 1994a, Allan 1995, Pullin & al. 1995). If several works by the same author published in the same year are cited, the individual works are indicated with the added letters a, b, c, etc.: (Ward 1994a,b). If direct quotations are used, the page numbers should be included: Toman (1992: 5) or (Toman 1992: 5-6).

The bibliography shall be arranged in alphabetical order beginning with the surname of the first author followed by the year of publication, the title of the article, the international abbreviation for the journal (periodical), the volume (in bold print), the number in parenthesis, and the pages. Examples:

HONSIG-ERLENBURG W., K. KRÄINER, P. MILDNER & C. WIESER 1992: Zur Flora und Fauna des Webersees. *Carinthia* II **182/102** (1): 159-173.

TRINAJSTIĆ & J. FRANJIĆ 1994: Ass. *Salicetum elaeagno-daphnoides* (BR.-BL. et VOLK, 1940) M. MOOR 1958 (*Salicion elaeagni*) in the Vegetation in Croatia. *Nat. Croat.* **3** (2): 253-256.

WARD J. V. 1994a: Ecology of Alpine Streams. *Freshwater Biology* **32** (1): 10-15.

WARD J. V. 1994b: Ecology of Prealpine Streams. *Freshwater Biology* **32** (2): 10-15.

Books, chapters from books, reports, and congress anthologies use the following forms:

ALLAN J. D. 1995: Stream Ecology. Structure and Function of Running Waters, 1st ed. Chapman & Hall, London, 388 pp.

PULLIN A. S., I. F. G. MCLEAN & M. R. WEBB 1995: Ecology and Conservation of *Lycaena dispar*: British and European Perspectives. In: PULLIN A. S. (ed.): Ecology and Conservation of Butterflies, 1st ed. Chapman & Hall, London, pp. 150-164.

TOMAN M. J. 1992: Mikrobiološke značilnosti bioloških čistilnih naprav. Zbornik referatov s posvetovanja DZVS, Gozd Martuljek, pp. 1-7.

12. Format and Form of Articles

Articles should be sent as *Word document* (doc) or Rich text format (rtf) using "Times New Roman CE 12" font with double spacing, align left and margins of 3 cm on A4 pages. Paragraphs should be separated with an empty line. The title and chapters should be written bold in font size 14. All scientific names must be properly italicized. Used nomenclature source should be cited in the Methods section. Tables and illustrations shall accompany the texts separately. All pages including tables and figures should be numbered. The original manuscript, two copies, and an electronic copy (after all corrections) on a 3.5" computer diskette, on CD-ROM or by e-mail must be given to the editor-in-chief. All articles must be proofread for professional and language errors before submission.

13. Peer Review

All Scientific Articles shall be subject to peer review by two experts in the field (one Slovene and one foreign) and Brief Note articles by one Slovene expert in the field. Authors may nominate a foreign reviewer in an accompanying letter. Reviewed articles accepted for publication shall be corrected by the author. Authors shall receive thirty (30) free copies of the journal upon publication. In the event an article is rejected, the original material shall be returned to the author together with the negative determination of the editor-in-chief.