PHYTOSOCIOLOGICAL DESCRIPTION OF SPRING VEGETATION IN THE SUBALPINE AND ALPINE BELT OF THE JULIAN ALPS

FITOCENOLOŠKI OPIS RASTJA OB IZVIRIH V SUBALPINSKEM IN ALPINSKEM PASU V JULIJSKIH ALPAH

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http://dx.doi.org/10.3986/fbg0090

ABSTRACT

Phytosociological description of spring vegetation in the subalpine and alpine belt of the Julian Alps

Plant communities of several moss-rich calcareous water springs in the subalpine and alpine belt of the Julian Alps were phytosociologicaly investigated. Based on the comparison with similar communities in other parts of the Alps we classify them into the new association *Saxifrago robustae-Palustrielletum commutati* and in to two subassociations: *-violetosum biflorae* (mostly in the subalpine belt) and *-saxifragetosum sedoidis* (mostly in the alpine belt). Stands of described community belong to Natura 2000 habitat type Petrifying springs with tufa formation (*Cratoneurion*). For now they are mostly not directly threatened by man.

Key words: vegetation, *Cratoneurion*, Julian Alps, Triglav National Park, Slovenia, Italy

IZVLEČEK

Fitocenološki opis rastja ob izvirih v subalpinskem in alpinskem pasu v Julijskih Alpah

Fitocenološko smo preučili združbe nekaterih izvirov na karbonatni podlagi v subalpinskem in alpinskem pasu Julijskih Alp. Na podlagi primerjav s podobnimi združbami drugod v Alpah jih uvrščamo v novo asociacijo *Saxifrago robustae-Palustrielletum commutati* in v dve subasociaciji: *-violetosum biflorae* (v glavnem v subalpinskem pasu) in *-saxifragetosum sedoidis* (v glavnem v alpinskem pasu). Sestoji opisane združbe sodijo v Natura 2000 habitatni tip Lehnjakotvorni izviri (*Cratoneurion*) in jih za zdaj človek neposredno v glavnem ne ogroža.

Ključne besede: vegetacija, *Cratoneurion*, Julijske Alpe, Triglavski narodni park, Slovenija, Italija

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1 INTRODUCTION

Spring vegetation of the Julian Alps was studied already by Surina (2005a, b), mainly in the Krn Mountains and under Mt. Mangart. Our research was incidental, as it concerned the study of subalpine and alpine vegetation in different areas of the Julian Alps. As they are a key feature of this vegetation type we consistently collected the moss species. Once they were determined by our specialist, Andrej Martinčič, we prepared a phytosociological table with 25 relevés and ordered it using hierarchical classification. Finally, we arranged the studied communities into a syntaxonomic system.

2 METHODS

Our relevés were made using the Central-European (Braun-Blanquet 1964) phytosociological approach. They were entered into the FloVegSi database (T. Seliškar, Vreš & A. Seliškar 2003). The relevés were made across the entire wet spring area, not only on the surface covered by the moss layer (Figures 2a and 2b). We collected mosses and liverworts, which Andrej Martinčič, the co-author, determined in the laboratory. The relevés were processed using hierarchical classification, unweighted average linkage method – UPGMA and Wishart's similarity ratio. We transformed the combined cover-abundance values into ordinal scale (1–9) according to van der Maarel (1979). Numerical comparisons were performed with the SYN-TAX 2000 program package (Podani 2001). In the classification of species into phytosociological groups (groups of diagnostic species) we mainly refer to the Flora alpina (Aeschimann et al. 2004a, b), Zechmeister (1993), Tomaselli et al. (2011) and Hinterlang (2017), but rely also on our own experience.

Figure 1: Approximate localities of researched stands at springs in the subalpine and alpine belt of the Julian Alps.
Slika 1: Približna nahajališča preučenih sestojev ob izvirih v subalpinskem in alpinskem pasu Julijskih Alp.

The nomenclatural sources for the names of vascular plants were the Mala flora Slovenije (Martinčič et al. 2007) and FloVegSi database. For the taxon *Saxifraga stellaris* L. subsp. *alpigena* Temesy we use the earlier valid name *Saxifraga stellaris* L. subsp. *robusta* (Engl.) Gremli. Hodgetts et al. (2020) was the nomenclatural source for the names of mosses and liverworts. Zechmeister (1993), Tomaselli et al.

Figures 2a, b: Springs near Lake below Vršac (Jezero pod Vršacem) (above), and in the Mlinarica valley (below); the sample plot is limited with moist (spring) surface. Photo: I. Dakskobler.
Slika 2a,b: Izvira pri Jezeru pod Vršacem (zgoraj) in v povirju Mlinarice (spodaj), popisna ploskev je omejena z mokrotno (povirno) površino. Foto: I. Dakskobler.

(2011), Šilc & Čarni (2012), Mucina et al. (2016) and Hinterlang (2017) served as nomenclatural sources for the names of the syntaxa. The source for the parent material (geological bedrock) was Buser (2009). The researched springs have a predominantly calcareous bedrock (limestone, dolomite, limestone with marlstone, debris). The geographic coordinates of the relevés were determined based on the Slovenian geographic coordinate system D 48 (Zone 5) on the Bessel ellipsoid and with Gauss-Krüger projection.

3 RESULTS AND DISCUSION

3.1 Arrangement of relevés with hierarchical classification and comparison with similar communities elsewhere in the Alps.

Relevés in Table 1 grouped into two distinct clusters (Figure 3).

Some of the relevés in the first large cluster (the left side of the dendrogram in Figure 3) stood out from other relevés (relevé 1 on the extreme left side and relevés 14 and 18 on the extreme right side of this relevé cluster). The species that are common to all or least half of the relevés (and occur in both separate clusters of stands) include: *Palustriella commutata*, *Saxifraga stellaris* subsp. *robusta* (both with 100% constancy), *Poa alpina, Festuca nitida*, *Ptychostomum pseudotriquetrum* (*Bryum pseudotriquetrum*), *Achillea atrata, Cratoneuron filicinum* and *Epilobium alsinifolium*. The table published by Surina (2005a: 59) does not include *Cratoneuron filicinum*, *Ptychostomum pseudotriquetrum*, *Festuca nitida* and *Achillea atrata*. As the author mentions that some of the mosses in his table have not yet been determined, we believe that for the most part he recorded communities that are similar to ours, also in the subalpine and alpine belt, and that they probably belong to the same association as our relevés. Surina classified them into the association *Cratoneuretum falcati* Gams 1927 and justified his decision while also listing the problems regarding the evaluation and identification of the taxon *Cratoneuron commutatum* var. *falcatum* (= *Palustriella falcata*). Previously, Aichinger (1933) had described association *Cratoneuretum commutati* in the Karawanks. In classifying the surveyed spring areas Surina (ibid.) followed the concept described by Zechmeister (1993). Hinterlang

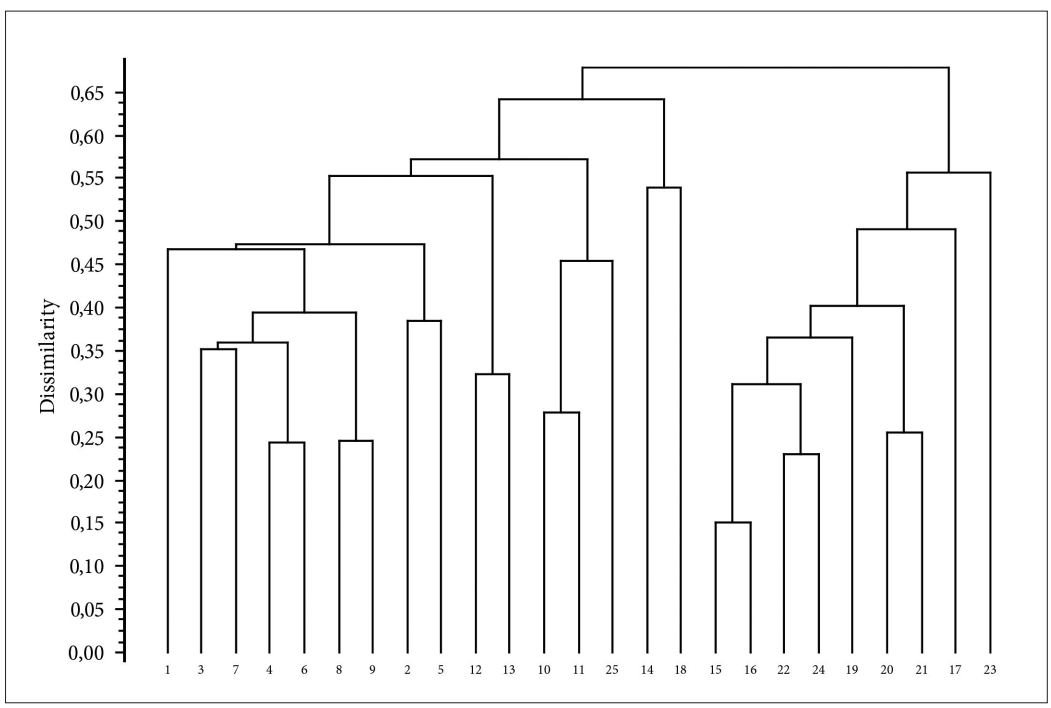

Figure 3: Dendrogram of stands at springs in the subalpine and alpine belt of the Julian Alps (UPGMA, 1-similarity ratio).
Slika 3: Dendrogram sestojev ob izvirih v subalpinskem in alpinskem pasu Julijskih Alp (UPGMA,1-similarity ratio).

(2017) lists the name *Cratoneuretum falcati* Gams 1927 p. p. as a synonym for the association *Arabido bellidifoliae-Cratoneuretum* Koch 1928 nom. inv. With regard to *Cratoneurion* he mentions also three other associations, but their floristic composition is less comparable with our stands. We compared the floristic composition of the association *Arabido bellidifoliae-Cratoneuretum* (documented with 105 relevés) and our community (documented with 25 relevés), and determined the value of Sørensen similarity coefficient (Sørensen 1948) at 27%. Both communities share certain dominant species, such as *Palustriella commutata*, *Saxifraga stellaris* s. lat. and *Heliosperma pusillum* (which is frequent and abundant only in a part of our relevés). *Arabis soyeri* is very rare in Slovenia, with only a few localities in the Julian Alps and Trnovski Gozd plateau (source: FloVegSi database), and is probably quite rare in the subalpine and alpine springs in the Julian Alps.

Geographically closer than the relevés collected in Hinterlang's synthetic table (ibid.) are the relevés of associations *Cratoneuretum commutati* Aichinger 1933 and *Cratoneuretum falcati* Gams 1927 from the Southeastern Alps in the province of Trentino, Italy (Tomaselli, Spitale & Petraglia 2011). Relevés of the association *Cratoneuretum commutati* are predominantly from the montane belt, whereas most of the relevés of the association *Cratoneuretum falcati* are from the subalpine belt. The species that occur both in these and our relevés are *Palustriella commutata* (inc. var. *falcata*), *Cratoneuron filicinum, Ptychostomum pseudotriquetrum* (*Bryum pseudotriquetrum*), *Palustriella decipiens, Hymenostylium recurvirostrum*, *Polygonum viviparum*, *Epilobium alsinifolium, Tofieldia calyculata, Carex frigida, Viola biflora, Poa alpina* as well as *Saxifraga stellaris* and *Heliosperma pusillum*, which occurred only in one of altogether 15 relevés. The floristic similarity between our relevés and theirs cannot be calculated because the authors did not include rare species in the table nor did they list them in the appendix.

E. Pignatti & S. Pignatti (2014, 2016) published tables for both associations, *Cratoneuretum commutati* and *Cratoneuretum falcati*, for the Dolomites. In our comparison we took into account the table of the association *Cratoneuretum falcati*, which is comparable with our relevés. The authors selected *Palustriella commutata* (incl. var. *falcata*), *Arabis soyeri* (*A. jacquinii*), *Saxifraga stellaris* (it has a 45% frequency in the table with 11 relevés), *Philonotis calcarea* and *Bryum schleicheri* (the latter two with constancy values below 20%). Frequent species with frequency values higher than 50% (or just below) include *Epilobium alsinifolium, Cardamine amara*, *Deschampsia cespitosa, Alchemilla glabra, Agrostis stolonifera*, *Viola biflora* and *Ptychostomum pseudotriquetrum* (*Bryum pseudotriquetrum*).

Figure 4: Stand of the association Saxifrago robustae-Palustrielletum commutati, detail. Photo: I. Dakskobler.
Slika 4: Sestoj asociacije Saxifrago robustae-Palustrielletum commutati, detajl. Foto: I. Dakskobler.

Figures 5a, b: Stands of the syntaxon Saxifrago robustae-Palustrielletum commutati violetosum biflorae var. Heliosperma pusillum, sources of the Mlinarica above the Trenta Valley. Photo: I. Dakskobler.
Sliki 5a,b: Sestoja sintaksona Saxifrago robustae-Palustrielletum commutati violetosum biflorae var. Heliosperma pusillum v povirju Mlinarice nad Trento. Foto: I. Dakskobler.

The value of Sørensen's similarity coefficient for the overall species composition (rare species are listed in the appendix to the table) is 26%. As our relevés are very comparable to the relevés by E. and S. Pignatti (ibd.), both in the size of the sample plot and the number of recorded species per plot, we assume that we also applied similar criteria in the selection of sample plots.

3.2 Classification of the researched communities into a syntaxonomical system and description of subassociations

According to Hinterlang's criteria (ibid.) the stands classified by E. and S. Pignatti (ibid.) into the association *Cratoneuretum falcati* could also be classified into the association *Arabido bellidifoliae-Cratoneuretum commutati*. As our communities and the compared communities share many species that characteristically occur in spring areas our stands could, despite low floristic similarity, be treated also as a special geographical race – *Arabido bellidifoliae-Cratoneuretum commutati* var. geogr. *Festuca nitida*, syn. *Cratoneuretum falcati* var. geogr. *Festuca nitida*. As the Code of Phytosociological Nomenclature (Theurillat et al. 2020) does not discuss the rank of geographical race (geographical variant), the low floristic similarity with the relevés from the Dolomites allows also for classification into the new association *Saxifrago robustae-Palustrielletum commutati*. It is named after two species that dominate and are almost invariably present in the herb and moss layer, namely *Palustriella commutata* and *Saxifraga stellaris* subsp. *robusta* (Figure 4).

Geographical differential species that distinguish our stands from the stands of the association *Arabido bellidifoliae-Cratoneuretum* are *Festuca nitida* and *Achillea atrata*, and the ecological differential species is *Cratoneuron filicinum*. Hintrelang's (ibid.) and Pignatti's (ibid.) tables do not comprise these species, and *Cratoneuron filicinum* is present only in the relevés of the association *Cratoneuretum falcati* in the province of Trentino (Tomaselli et al., ibid.). The nomenclatural type, *holotypus*, of the new association is relevé 2 in Table 1. This is also the nomenclatural type, *holotypus,* of the subassociation *violetosum biflorae,* in which we distinguish the typical variant (relevés 12–14 in Table 1, Figures 5a, b) and the variant with *Heliosperma pusillum* (relevés 2–11 in Table 1). The differential species of the subassociation *violetosum biflorae* are *Viola biflora, Heliosperma pusillum, Cerastium carinthiacum, Campanula cochleariifolia*, *Philonotis calcarea* and *Paederota lutea*. In terms of ecology, these are mainly stands of subalpine springs, in source areas and along small streams on slopes, even in rock walls, some of them slightly resembling hygrophilous chasmophytic communities from the alliance *Cystopteridion* (some of the diagnostic species of this alliance are also differential for this subassociation). In one of the relevés of this subassociation, in the spring area of the Mlinarica, we collected and determined also the subarctic-alpine species *Sciuro-hypnum latifolium* (*Brachythecium latifolium*), which has only a few known localities in Slovenia (Martinčič 2020: 48–49) and is red-listed as vulnerable (Martinčič 2016).

Relevés 17–25 in Table 1 (see also Figures 6 and 7a, b) are classified into the subassociation *Saxifrago robustae-Palustrielletum commutati saxifragetosum sedoidis*. Its differential species are *Saxifraga sedoides* and *Philonotis fontana*. These stands are ecologically different from the stands of the subassociation *violetosum biflorae*. They characterize the vegetation of alpine springs, often on gravelly and levelled terrain on the fringes of high-mountain hollows (lakes). Moss *Palustriella commutata* has a significantly lower medium coverage here than in the stands of the previous subassociation, which is mainly associated with the subalpine belt, but the moss *Cratoneuron filicinum* is constantly present in these stands with considerable medium coverage. Broadly speaking, the differential species of this subassociation include also several diagnostic species of the order *Arabidetalia caeruleae* (*Rumex nivalis, Carex parviflora, Salix retusa, Veronica alpina* and *Gnaphalium supinum / Omalotheca supina*) and certain diagnostic species of the class *Thlaspietea rotundifolii* (*Moehringia ciliata, Cirsium spinosissimum, Hutchinsia alpina* and *Arabis alpina*). The nomenclatural type, *holotypus*, of the new subassociation *Saxifrago robustae-Palustrielletum commutati saxifragetosum sedoidis* is relevé 24 in Table 1. In terms of floristic composition relevés 15 and 16 are transitional between the stands of both subassociations (Figure 3, 14 and 18), but taking into account certain ecological characteristics (alpine springs on gravelly material) they are classified within the subassociation *saxifragetosum sedoidis*. The only relevé classified to the rank of association is relevé 1.

Classification into the syntaxonomical system is therefore as follows:

Montio-Cardaminetea Br.-Bl. & Tx. ex Klika et Hadač 1944
 Montio-Cardaminetalia Pawłowski et al. 1928
  Cratoneurion commutati Koch 1928
   Saxifrago robustae-Palustrielletum commutati ass. nov. hoc loco
    violetosum biflorae subass. nov. hoc loco
     var. *Heliosperma pusillum*
    saxifragetosum sedoidis subass. nov. hoc loco

4. CONCLUSIONS

Phytosociological and syntaxonomic evaluation of subalpine-alpine spring communities on calcareous bedrock in the subalpine and alpine belt of the Julian Alps with predominating mosses *Palustriella commutata, Cratoneuron filicinum* and *Ptychostomum pseudotriquetrum* (*Bryum pseudotriquetrum*) allows for several alternatives. Elsewhere in the Alps they were until recently predominantly classified into the association *Cratoneuretum falcati*. Surina (2005a, b), who was the first to more closely analyse the vegetation of these springs, took the same approach. Our analysis allows for another alternative, classification at the rank of a new association *Saxifrago robustae-Palustrielletum commutati*, which we base on the overall species composition of the community which includes vascular plants from ecologically similar or contact communities of snow beds, screes or moist rock crevices. According to these criteria the studied stands are floristically very different from similar stands in the Dolomites, even though they share certain dominant species. Since the rank of geographical race is not recognized by modern syntaxonomy and rules of phytosociological nomenclature (Theurillat et al. 2020), the admissible alternative in such cases is to describe new associations, because this is the only way we can clearly point out the particularities and specifics of these stands.

The spring communities discussed in this article belong to Natura 2000 habitat type 7220* Petrifying springs with tufa formation (*Cratoneurion*). To date, they have not yet been subject to comprehensive research in the Slovenian Alps. Together with recently published relevés (Dakskobler & Martinčič 2021) our relevés fill a small gap in our knowledge of these communities. For the main part they are not directly threatened by human impact, even though some of these springs are situated near roads (Mangart) and areas that are very popular in the summer (Prehodavci, Mangart), whereas others (the Mlinarica, ledges of Mt. Kanjavec, Upper Kriško Lake / Zgornje Kriško Jezero) are found in very remote areas. The main threat factors are grazing of small ruminants, popular mountain trails in the vicinity, climate and hydrological change, and eutrophication (Dakskobler et al. 2021).

Figure 6: Large spring areas near Lake below Vršac (Jezero pod Vršacem), stands of the subassociation Saxifrago robustae-Palustrielletum commutati saxifragetosum sedoidis. Photo: I. Dakskobler.
Slika 6: Obsežna povirja pri Jezeru pod Vršacem, sestoji subasociacije Saxifrago robustae-Palustrielletum commutati saxifragetosum sedoidis. Foto: I. Dakskobler.

Figures 7a, b: Stands of the subassociation Saxifrago robustae-Palustrielletum commutati saxifragetosum sedoidis at Lake below Vršac (Jezero pod Vršacem). Photo: I. Dakskobler.
Slika 7a,b: Sestoja subasociacije Saxifrago robustae-Palustrielletum commutati saxifragetosum sedoidis pri Jezeru pod Vršacem. Foto: I. Dakskobler.

5. POVZETEK

Pri fitocenološko-sintaksonomskem vrednotenju subalpinsko-alpinskih združb izvirov na karbonatni podlagi v subalpinskem in alpinskem pasu Julijskih Alp s prevladujočimi mahovnimi vrstami *Palustriella commutata, Cratoneuron filicinum* in *Ptychostomum pseudotriquetrum* (*Bryum pseudotriquetrum*) je več možnosti. Prevladujoči pristop drugod v Alpah je do nedavna bil njihova uvrstitev v asociacijo *Cratoneuretum falcati*. Tej je sledil tudi Surina (2005a,b), prvi, ki se je vegetaciji teh izvirov v tem gorovju bolj posvetil. Naša obravnava dopušča tudi drugo možnost, vrednotenje na rangu nove asociacije *Saxifrago robustae-Palustrielletum commutati*, pri čemer izhajamo iz celotne vrstne sestave združbe, v kateri so tudi cevnice iz ekološko podobnih ali prostorsko stičnih združb snežnih dolinic, melišč ali vlažnih skalnih razpok. Po teh merilih so preučeni sestoji kljub nekaterim skupnim prevladujočim vrstam floristično precej drugačni od podobnih sestojev v Dolomitih. Ker sodobna sintaksonomija in pravila fitocenološke nomenklature (Theurillat et al. 2020) ranga geografske variante ne obravnavajo (vsebujejo), je v takih primerih dopusten tudi opis novih asociacij, ker lahko le na ta način jasno opozorimo na določeno svojskost in posebnosti teh sestojev.

V članku obravnavane združbe povirij sodijo v Natura 2000 habitatni tip 7220* Lehnjakotvorni izviri (*Cratoneurion*). V slovenskih Alpah zagotovo še niso celovito raziskane. Naši popisi, skupaj z nedavno objavljenimi popisi (Dakskobler & Martinčič 2021), nekoliko zapolnjujejo vrzel v njihovem poznavanju. Za zdaj jih človek večinoma neposredno ne ogroža, čeprav so nekateri od njih blizu poleti zelo obiskanih območij (Prehodavci, Mangart), ali celo blizu prometnic (Mangart), drugi (Mlinarica, police Kanjavca, Zgornje Kriško jezero) pa v precej odmaknjenih predelih. Glavni dejavniki ogrožanja zanje so paša drobnice, bližina obiskanih planinskih poti, podnebne in hidrološke spremembe, evtrofikacija (Dakskobler et al. 2021).

ACKNOWLEDGEMENTS

Branko Zupan, Dr. Aleš Poljanec and Lojze Hosner helped the younger author in field surveying of some of the springs. Iztok Sajko prepared Figure 1 for print

We also acknowledge the financial support from the Slovenian Research Agency (research core funding No. P1-0236). English translation by Andreja Šalamon Verbič.

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Table 1: Spring vegetation in the subalpine and alpine belt of the Julian Alps
Preglednica 1: Rastje izvirov v subalpinskem in alpinskem pasu Julijskih Alp

	Successive number of relevé (Zaporedna številka popisa)		1	2	3	4	5	6	7	8	9	10
	Database number of relevé (Delovna številka popisa)		219334	221183	282223	244923	268370	282224	282225	219354	245513	282687
	Elevation in m (Nadmorska višina v m)		1380	1680	1690	1630	1440	1680	1700	1360	1620	1820
	Aspect (Lega)		S	SW	SW	N	NW	SE	SW	N	NE	S
	Slope in degrees (Nagib v stopinjah)		25	25	70	40	30	45	60	15	30	80
	Parent material (Matična podlaga)		Gr	D	DA	D	D	DA	DA	D	DA	AL
	Soil (Tla)		Li	Li	Gl	Li	Gl	Li	Li	Li	Li	Li
	Stoniness in % (Kamnitost v %)		20	10	100	30	20	20	20	20	80	100
	Cover of herb layer in % (Zastiranje zeliščne plasti v %):		30	30	40	40	40	40	30	60	60	40
	Cover of moss layer in % (Zastiranje mahovne plasti v %):		80	80	80	30	80	80	80	70	50	70
	Number of species (Število vrst)		5	11	18	8	6	17	18	11	11	13
	Relevé area (Velikost popisne ploskve)	m^2	4	10	10	5	5	10	10	20	10	10
	Date of taking relevé (Datum popisa)		7/1/2008	8/6/2008	8/11/2020	9/7/2012	8/23/2017	8/11/2020	8/11/2020	7/1/2008	6/19/2012	8/20/2020
	Locality (Nahajališče)		Zapotok	Mlinarica	Mlinarica	Solna glava-Suha Pišnica	Zajzera-Žabniška krnica	Mlinarica	Mlinarica	Zapotok	Krma-Brda	Mangart-Prehod
	Quadrant (Kvadrant)		9648/1	9548/4	9548/4	9548/4	9547/3	9548/4	9548/4	9648/1	9649/2	9547/4
	Coordinate GK Y (D-48)	m	399014	406605	406636	404712	385904	406598	406618	399521	417894	395422
	Coordinate GK X (D-48)	m	5138231	5141839	5141831	5143478	5145310	5141839	5141868	5138687	5138806	5144730
	Diagnostic species of the association (Diagnostične vrste asociacije)											
MC	*Palustriella commutata*	E0	4	4	4	4	4	4	4	4	3	2
MC	*Saxifraga stellaris* subsp. *robusta*	E1	3	2	2	3	2	2	3	4	3	3
PaT	*Poa alpina*	E1	+	1	.	.	.	+	+	.	.	.
TR	*Festuca nitida*	E1	.	+	+	+	.	1	1	.	.	1
MC	*Ptychostomum pseudotriquetrum (Bryum pseudotriquetrum)*	E0	.	2	+	.	.	1	.	1	1	.
MC	*Cratoneuron filicinum*	E0	.	+	+	.	.	.	.	.	.	3
TR	*Achillea atrata*	E1	.	+	1	1	+	+	+	.	.	.
MC	*Epilobium alsinifolium*	E1	.	.	.	.	.	+	.	3	.	2
	Differential species of subassociations (Razlikovalnice subasociacij)											
MC	*Heliosperma pusillum*	E1	.	2	2	2	3	2	2	2	3	3
TR	*Cerastium carinthiacum*	E1	.	.	+	+	1	.	+	.	.	+
Cy	*Viola biflora*	E1	+	1	.	+	.	.	.	+	2	.
PC	*Campanula cochleariifolia*	E1	.	.	+	.	.	+	+	.	.	1
MC	*Philonotis calcarea*	E0	.	.	+	.	.	1	2	.	.	.
PC	*Paederota lutea*	E1	.	.	.	.	.	r	+	.	.	.
AC	*Saxifraga sedoides*	E1	.	.	.	.	.	.	.	.	.	.
MC	*Philonotis fontana*	E0	.	.	.	.	.	.	.	.	.	.
MC	***Montio-Cardaminetea***											
	Palustriella decipiens	E0	.	.	.	.	.	.	1	.	.	.
	Conocephalum conicum	E0	.	.	.	.	.	.	.	.	.	.
	Cardamine amara	E1	.	.	.	.	.	.	.	+	.	.
	Hymenostylium recurvirostrum	E0	.	.	.	.	.	.	.	.	.	.
	Sciuro-hypnum latifolium (Brachythecium latifolium)	E0	.	.	.	.	.	.	.	.	.	.
	Flexitrichum flexicaule (Ditrichum flexicaule)	E0	.	.	.	.	.	.	.	.	.	.

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
282688	282226	282227	286933	286813	286617	286810	286811	286823	286826	286814	286821	286822	286812	286825		
1830	1850	1890	1520	2005	2130	1990	1990	2000	1995	2010	2005	1995	2015	2000		
S	SW	SW	NW	N	NW	N	0	W	N	N	NW	NW	N	NE		
70	45	25	20	5	30	2	0	5	2	5	5	5	10	10		
AL	DA	DA	Gr	A	DA	A	A	A	A	A	A	A	A	A		
Li	Li	Gl	Gl	Gl	Gl	Gl	Gl	Gl	Gl	Gl	Gl	Gl	Gl	Gl		
100	40	30	40	10	30	10	10	10	10	10	10	10	10	10		
50	40	40	40	50	35	40	30	30	40	40	30	40	40	30		
60	50	50	60	70	80	90	80	80	90	80	80	90	70	80		
14	24	16	18	23	17	16	16	12	14	15	14	18	22	13		
10	10	10	3	5	10	5	5	10	5	5	5	10	10	10		
8/20/2020	8/11/2020	8/11/2020	7/28/2021	9/3/2021	8/9/2021	9/3/2021	9/3/2021	9/3/2021	9/3/2021	9/3/2021	9/3/2021	9/3/2021	9/3/2021	9/3/2021		
Mangart-Prehod	Mlinarica	Mlinarica	Ravni dol	Jezero pod Vršacem	Zgornje Kriško jezero	Jezero pod Vršacem	Jezero pod Vršacem	Jezero pod Vršacem	Jezero pod Vršacem	Jezero pod Vršacem	Jezero pod Vršacem	Jezero pod Vršacem	Jezero pod Vršacem	Jezero pod Vršacem		
9547/4	9548/4	9548/4	9648/4	9648/2	9548/4	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2		
395463	406824	406881	404443	407871	408562	407842	407840	407936	407854	407857	407927	407905	407907	407832		
5144744	5142084	5142104	5134614	5135644	5141178	5135722	5135725	5135770	5135715	5135643	5135687	5135713	5135612	5135695		
															Pr.	Fr.
3	4	4	2	4	5	1	1	2	2	1	2	2	2	2	25	100
4	2	2	3	1	1	2	2	2	2	3	2	2	2	1	25	100
1	2	2	+	1	+	2	2	1	1	+	1	1	+	1	19	76
+	2	1	+	1	+	+	.	1	1	1	+	1	1	2	20	80
1	.	.	3	+	+	3	3	2	3	3	2	2	1	.	17	68
3	+	.	.	.	+	3	3	2	2	3	2	2	2	3	15	60
.	1	1	+	1	+	.	.	.	.	.	.	+	1	+	14	56
+	.	.	.	+	.	1	+	.	1	+	1	.	+	3	12	48
2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	40
+	2	2	2	.	.	.	.	.	.	.	.	+	.	.	10	40
.	1	+	1	+	.	.	.	.	.	.	.	.	.	.	9	36
+	1	1	+	.	.	.	.	.	.	.	.	.	.	.	8	32
.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	5	20
.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	4	16
.	1	+	.	.	3	1	+	+	+	2	.	+	2	1	11	44
3	.	.	.	.	.	1	1	2	1	.	2	2	3	.	8	32
.	+	.	2	.	3	.	.	.	.	.	.	.	.	.	4	16
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	Successive number of relevé (Zaporedna številka popisa)		1	2	3	4	5	6	7	8	9	10
AC	***Arabidion caeruleae* (incl. *Salicetea herbaceae*)**											
	Rumex nivalis	E1	.	.	.	.	.	.	.	.	.	.
	Carex parviflora	E1	.	.	.	.	.	.	.	.	.	.
	Salix retusa	E1	.	.	.	.	.	.	.	.	.	.
	Veronica alpina	E1	.	.	.	.	.	.	.	.	.	.
	Gnaphalium supinum (Omalotheca supina)	E1	.	.	.	.	.	.	.	.	.	.
	Ranunculus traunfellneri	E1	.	.	.	.	.	.	.	.	+	.
	Soldanella minima	E1	.	.	.	.	.	.	.	.	.	.
	Taraxacum sect. Alpina	E1	.	.	.	.	.	.	.	.	.	.
	Soldanella pusilla	E1	.	.	+	.	.	.	.	.	.	.
	Soldanella alpina	E1	.	.	.	.	.	.	.	.	.	.
TR	***Thlaspietea rotundifolii***											
	Moehringia ciliata	E1	.	.	.	.	.	.	.	.	+	.
	Adenostyles glabra	E1	.	.	.	+	.	.	.	.	+	2
	Cirsium spinosissimum	E1	.	.	.	.	.	.	.	.	.	.
	Hutchinsia alpina	E1	.	.	.	.	.	.	.	.	.	.
	Arabis alpina	E1	.	.	.	.	.	.	.	.	.	.
	Leontodon hyoseroides	E1	.	.	.	.	.	.	.	.	.	+
	Silene vulgaris subsp. *glareosa*	E1	+	.	.	.	.	.	.	r	.	.
	Heliosperma alpestre	E1	.	.	+	.	.	.	.	.	.	+
	Festuca laxa	E1	.	.	.	.	.	+	+	.	.	.
	Rumex scutatus	E1	.	.	.	.	.	+	+	.	.	.
	Dryopteris villarii	E1	.	.	.	.	.	.	.	.	.	.
	Armeria alpina	E1	.	.	.	.	.	.	.	.	.	.
Cy	***Cystopteridion***											
	Cystopteris regia	E1	.	.	.	.	.	.	.	.	.	.
	Orthothecium rufescens	E0	.	.	.	.	2	.	.	.	.	.
	Cystopteris montana	E1	.	.	.	.	.	.	.	+	2	.
	Ptychostomum elegans (Bryum elegans)	E0	.	.	.	.	.	.	1	.	.	.
	Astrantia carniolica	E1	.	.	.	.	.	.	.	1	.	.
	Carex brachystachys	E1	.	.	1	.	.	.	.	.	.	.
	Fissidens dubius	E0	.	.	.	.	.	.	.	.	.	.
	Valeriana saxatilis	E1	.	.	.	.	.	.	.	.	.	.
	Asplenium viride	E1	.	.	.	.	.	.	.	.	.	.
PC	***Potentilletalia caulescentis***											
	Valeriana elongata	E1	.	.	.	.	.	.	.	.	1	.
CD	***Caricetalia davallianae, Scheuchzerio-Caricetea fuscae***											
	Parnassia palustris	E1	.	.	.	.	.	1	+	.	.	+
	Allium schoenoprasum subsp. *alpinum*	E1	.	.	.	.	.	.	.	.	.	.
	Carex frigida	E1	.	+	.	.	.	.	.	.	.	.
	Tofieldia calyculata	E1	.	.	+	.	.	.	.	.	.	.
ES	***Elyno-Seslerietea***											
	Polygonum viviparum	E1	.	.	.	.	.	.	.	.	.	.
	Carex ferruginea	E1	.	+	+	.	.	1	+	.	.	.
	Euphrasia minima	E1	.	.	.	.	.	r	+	.	.	.
	Aster bellidiastrum	E1	.	.	+	.	.	.	.	.	.	.
	Juncus monanthos	E1	.	.	+	.	.	.	1	.	.	.
	Sesleria sphaerocephala	E1	.	.	+	.	.	.	.	.	.	.
	Carex firma	E1	.	.	.	.	.	.	.	.	r	.
	Lloydia serotina	E1	.	.	.	.	.	.	.	.	.	.
	Homogyne discolor	E1	.	.	.	.	.	.	.	.	.	.
	Myosotis alpestris	E1	.	.	.	.	.	.	.	.	.	.
PaT	***Poo alpinae-Trisetetalia***											
	Leontodon hispidus	E1	.	.	.	.	.	.	.	.	.	.
MA	***Mulgedio-Aconitetea***											
	Veratrum album	E1	.	.	.	.	.	.	.	.	.	.
	Aconitum lycoctonum subsp. *ranunculifolium*	E1	.	.	.	.	.	.	.	.	.	.
	Adenostyles alliariae	E1	.	.	.	.	.	.	.	.	.	.
BA	***Betulo-Alnetea***											
	Salix waldsteiniana	E2a	.	.	.	.	.	.	.	.	.	.
	Salix appendiculata	E2a	.	.	.	.	.	.	.	.	.	.
	Salix glabra	E2a	.	.	.	.	.	.	.	.	.	.

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Pr.	Fr.
.	.	.	.	+	+	1	1	.	.	+	.	.	.	.	5	20
.	.	.	.	+	.	+	+	.	.	.	.	1	.	.	4	16
.	.	.	.	2	.	.	+	.	.	.	2	2	.	.	4	16
.	.	.	.	.	.	2	+	.	+	.	.	.	+	.	4	16
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.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	2	8
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.	.	.	.	1	+	.	.	+	.	.	.	+	+	.	5	20
.	.	.	.	.	+	.	.	+	+	.	.	+	.	.	4	16
+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	3	12
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.	+	.	.	.	.	.	.	.	.	+	.	.	1	.	4	16
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.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	4	16
.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	3	12
.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	3	12
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.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	3	12
.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	4
.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	4

	Successive number of relevé (Zaporedna številka popisa)		1	2	3	4	5	6	7	8	9	10
FS	***Fagetalia sylvaticae***											
	Fagus sylvatica	E1	.	.	.	.	.	.	.	r	.	.
ML	**Mosses (Mahovi)**											
	Bryum sp.	E0	.	.	.	.	.	.	.	.	.	1
	Lescuraea plicata	E0	.	.	.	.	.	+	.	.	.	.
	Fissidens taxifolius	E0	.	.	.	.	.	.	.	.	.	.
	Timmia norvegica	E0	.	.	.	.	.	.	.	.	.	.
	Scorpidium cossonii (Drepanocladus cossonii)	E0	.	.	.	.	.	.	.	.	.	.
	Mnium marginatum	E0	.	.	.	.	.	.	.	.	.	.
	Pohlia cruda	E0	.	.	.	.	.	.	.	.	.	.

Legend-Legenda
A Limestone - apnenec
D Dolomite - dolomit
L Marlstone - laporovec
Gr Debris - grušč
Li Lithosol - kamnišče
Gl Molic Gleysols - organsko-mineralna tla
Pr. Presence (number of relevés in which the species is presented) - število popisov, v katerih se pojavlja vrsta
Fr. Frequency in % - frekvenca v %

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Pr.	Fr.
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