

NEW LOCALITIES OF *ADIANTUM CAPILLUS-VENERIS* IN THE
RIVER-BASIN OF VOLARJA/VOLARNIK (THE JULIAN ALPS)
AND PHYTOSOCIOLOGICAL ANALYSIS OF ITS SITES
NOVA NAHAJALIŠČA VRSTE *ADIANTUM CAPILLUS-VENERIS* V
POREČJU VOLARJE/VOLARNIKA (JULIJSKE ALPE) IN
FITOCENOLOŠKA ANALIZA NJENIH RASTIŠČ

Igor DAKSKOBLER¹, Andrej MARTINČIČ² & Daniel ROJŠEK³

<http://dx.doi.org/10.3986/fbg0019>

ABSTRACT

New localities of *Adiantum capillus-veneris* in the river basin of the Volarja/Volarnik (the Julian Alps) and a phytosociological analysis of its sites

The article describes the localities, sites and communities of *Adiantum capillus-veneris* along the Volarja/Volarnik, the right tributary of the Soča River between Tolmin and Kobarid (9747/4). We classified its communities from three locations at elevations between 210 and 250 m into the subassociation *Eucladio-Adiantetum cratoneuretosum commutati*, a new variant *Eucladio-Adiantetum hymenostylietosum recurvirostri* var. *Pinguicula alpina* and into the new association *Adianto-Molinietum arundinaceae*.

Key words: phytosociology, synsystematics, *Eucladio-Adiantetum*, *Adianto-Molinietum arundinaceae*, Natura 2000, Upper Soča Valley, Julian Alps, Slovenia

IZVLEČEK

Nova nahajališča vrste *Adiantum capillus-veneris* v porečju Volarje/Volarnika (Julijske Alpe) in fitocenološka analiza njenih rastišč

V članku opisujemo nahajališča, rastišča in združbe vrste *Adiantum capillus-veneris* ob Volarji/Volarniku, desnem pritoku Soče med Tolminom in Kobaridom (9747/4). Njene združbe na treh krajih, na nadmorski višini od 210 m do 250 m, uvrščamo v subasociacijo *Eucladio-Adiantetum cratoneuretosum commutati*, v novo varianto *Eucladio-Adiantetum hymenostylietosum recurvirostri* var. *Pinguicula alpina* in v novo asociacijo *Adianto-Molinietum arundinaceae*.

Ključne besede: fitocenologija, sinsistematika, *Eucladio-Adiantetum*, *Adianto-Molinietum arundinaceae*, Natura 2000, Zgornje Posočje, Julijske Alpe, Slovenija

¹ Institute of Biology, Scientific Research Centre of the Slovenian Academy of Sciences and Arts, Regional unit Tolmin, Brunov drevored 13, SI-5220 Tolmin, and Biotechnical Faculty of the University in Ljubljana, Department of Forestry and Renewable Forest Resources, Večna pot 83, SI-1000 Ljubljana, igor.dakskobler@zrc-sazu.si

² Zaloška 78 a, SI-1000 Ljubljana, andrej.martincic@siol.net

³ The Institute of the Republic of Slovenia for Nature Conservation, Regional Unit Nova Gorica, Delpinova 16, SI-5000 Nova Gorica, dar@zrsvn.si

1 INTRODUCTION

The Mediterranean (subtropical, paleotemperate) fern *Adiantum capillus-veneris*, a character species of communities growing on permanently moist to wet rocks, is distributed in the hill belt across the entire southern stretch of the Alps (AESCHIMANN et al. 2004: 66). Two localities have been reported so far for the Alpine part of Slovenia, in the Brezna/Brizna Grapa gorge at the foothills of Mali Vrh above Grahovo ob Bači and in the river beds of the Mrzlica/Mrzli Potok brook under the village of Krn (at the elevation of 510 m, which makes it its highest locality in Slovenia). Both localities have recently been described by ROJŠEK (2015a). We examined them in terms of phytosociology as well and looked also into the localities of this fern in the Soča Valley between Ročinj and Solkan, in the Idrija Valley,

in the Karst region (Škocjan Caves) and on several other localities in Istria (DAKSKOBLER, MARTINČIČ & ROJŠEK 2014). On 24 July 2016 we discovered new localities of this fern on three spots on the right bank of the Volarja/Volarnik at the village of Selišče (DAKSKOBLER 2017 and Figures 1 and 2). They are situated in the basin of the same river (the Volarja) as the locality in the Mrzlica gorge, but are much more extensive and occupy a different quadrant of Central-European flora mapping (9747/4). In this article we provide a detailed description of these localities and present the species composition of the studied communities with a phytosociological table. Based on our comparison with relevés from other regions of Slovenia we will classify these communities into the syntaxonomic system.

2 METHODS

Vegetation on the localities of *Adiantum capillus-veneris* was researched applying the standard Central-European method (BRAUN-BLANQUET 1964). On 12 re-

corded plots we collected mosses and liverworts which one of the authors, Andrej Martinčič, determined in the laboratory. All relevés were entered into the

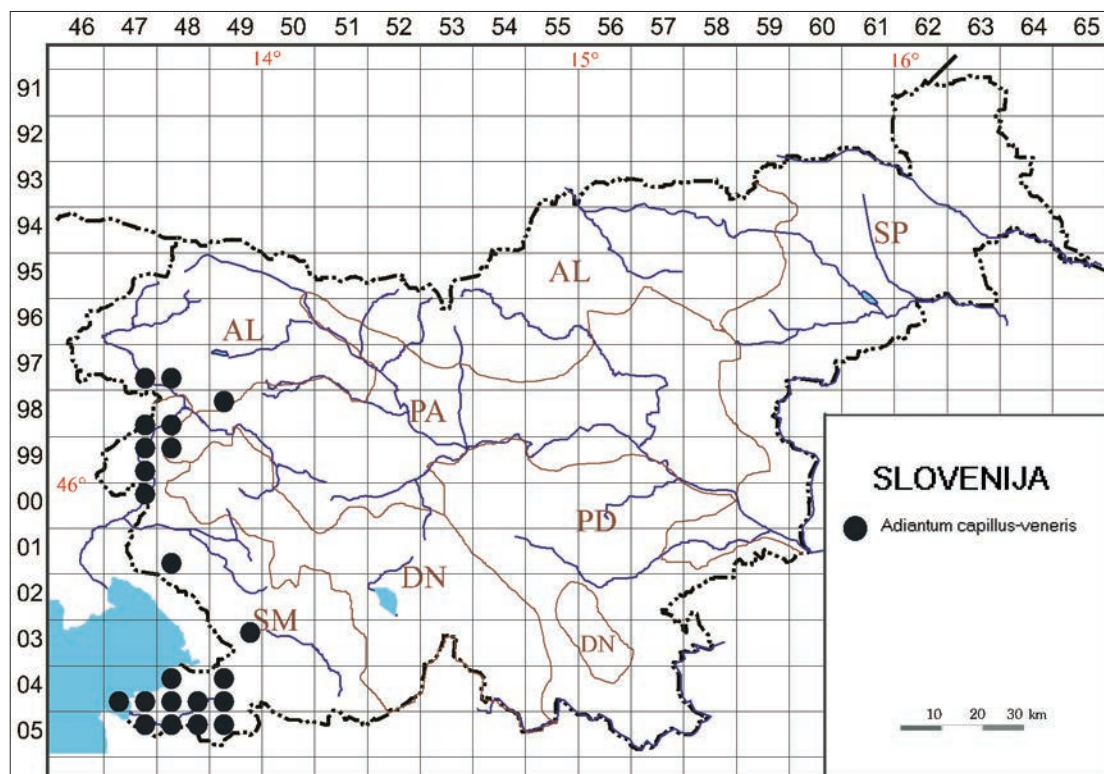


Figure 1: Distribution of *Adiantum capillus-veneris* in Slovenia
 Slika 1: Razširjenost vrste *Adiantum capillus-veneris* v Sloveniji

FloVegSi database (T. SELIŠKAR, VREŠ & A. SELIŠKAR 2003). Combined cover-abundance values were transformed into numerical values 1–9 (van der MAAREL 1979). Programme package SYN-TAX (PODANI 2001) was used in numerical comparisons. The relevés were mutually compared by means of hierarchical classification. We applied the (unweighted) pair group method with arithmetic mean (UPGMA) and Wishart's similarity ratio as a measure of dissimilarity. The nomenclature source for the names of vascular plants is

the Mala flora Slovenije (MARTINČIČ et al. 2007). Ros et al. (2007) is the nomenclature source for the names of liverworts (*Marcanthiophyta*) and Ros et al. (2013) for the names of mosses. The nomenclature sources for the names of syntaxa are THEURILLAT (2004), ŠILC & ČARNI (2012) and DAKSKOBLER, MARTINČIČ & ROJŠEK (2014). The source for geological bedrock data was BUSER (1986, 1987, 2009), and ZUPANČIČ (1995, 1998), MEKINDA-MAJARON (1995) and CEGNAR (1998) for climatic data.

3 RESULTS AND DISCUSSION

3.1 Description of new localities of *Adiantum capillus-veneris* in the gorge of the Volarja

The Volarja/Volarnik is the right tributary of the Soča River that originates from several distributaries on the southern slopes of the Krn Mountains and runs into

the Soča at Selišče. In the lower course, for about 1.6 km between the confluence with the Soča and the confluence with the left tributary Mrzlica/Mrzli Potok/Mrzuc/Zalazčenca, it has a relatively wide bed, whereas the beds above this section are narrow as they had been cut into troughs and ravines. The right (western)

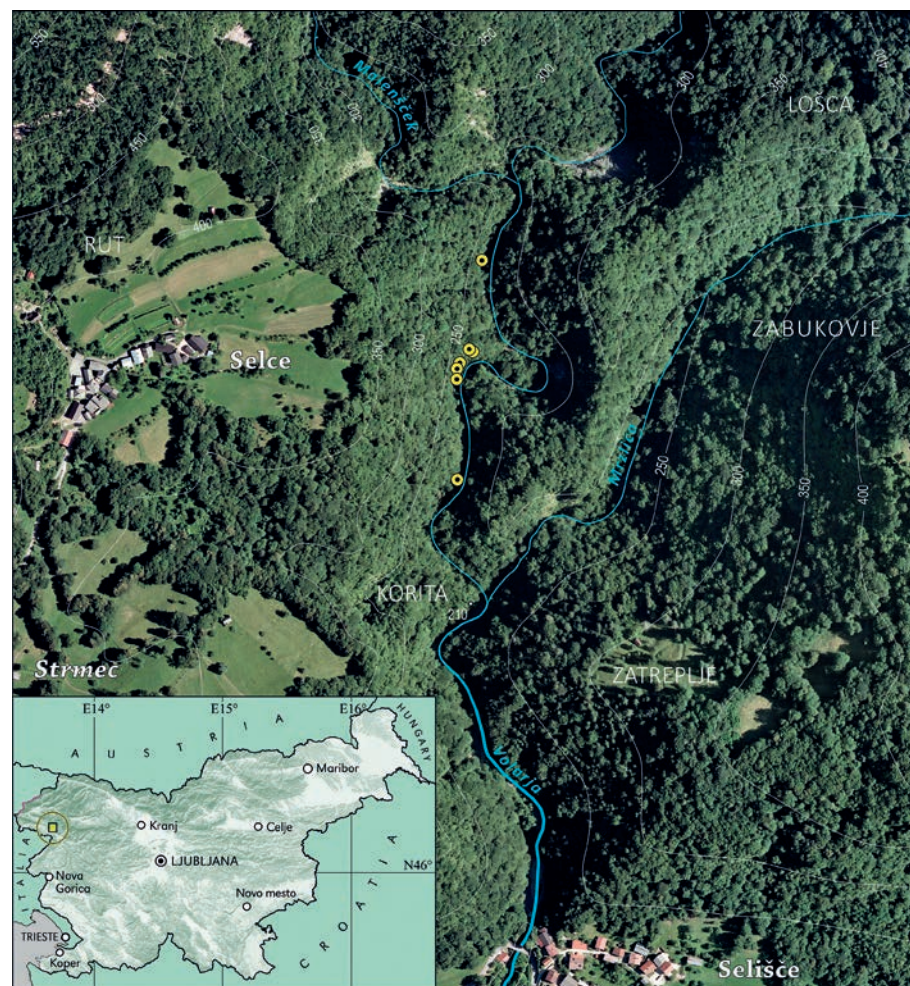


Figure 2: New localities of *Adiantum capillus-veneris* in the gorge of the Volarja near the village of Selišče
Slika 2: Nova nahajališča vrste *Adiantum capillus-veneris* v grapi Volarje pri vasi Selišče

branch of the Volarja, in the terms used by PODOBNIK (1983), has the same name, Volarja, even though it is marked as Malenšček on some of the older maps. This is also the name of the next right (western) tributary that joins the Volarja about 500 m upstream from the confluence with the Mrzlica. Its lower course as well as the section of the Volarja up until the confluence with the Mrzlica is known also as Brinta (MEDVEŠČEK & SKRT 2016: 34). The Volarja/Volarnik has a distinctly torrential outflow and in autumn and spring, when the river bed is full of water, it looks like a small river in its lower course, but turns into a brook with little water in summer and spring. All of the new maidenhair fern localities are on the right bank along the sources in the relatively short section of the Volarja/Volarnik river bed (spanning about 500 m) above the confluence with the Mrzlica, at elevations between 210 and 250 m (Figure 2). Heavily fractured and folded rock is formed by reddish platy limestone and marlstone interlayered with chert sheets and nodules (K21+2, Cenomanian and Turonian, between 90 and 105 million years old). The climate in this part of the Soča Valley is relatively warm and humid, with mean annual temperature be-

tween 8 and 10 °C and mean annual precipitation volume exceeding 2000 mm.

The first maidenhair fern locality (relevé 14 in Table 1) is situated about 100 m above the confluence with the Mrzlica at the elevation of about 210 m. More than one hundred maidenhair ferns grow here (a little more than 2 m high and 1.5 m wide) in tufa deposited by the seeping water in the lower part of a perpendicular and rather heavily overgrown, more than 10 m high rock level with distinct, heavily folded and fractured layers of limestone with intercalated marlstone (Figures 2 and 3).

The next locality is situated about 150 m upstream from the first, in a pronounced bend (Figures 2 and 4). The almost perpendicular right bank (slope break) is almost 80 metres high there and overgrown with open scrub communities. It is dominated by *Salix appendiculata*, *Ostrya carpinifolia*, *Ulmus glabra* and *Fraxinus ornus*, and by *Molinia caerulea* subsp. *arundinacea*, *Calamagrostis varia* and *Erica carnea* in the herb layer. Tufa is deposited from the seeping water. It is overgrown with maidenhair ferns that occur also on the moist parts of the parent material. The total surface



Figure 3: The first locality of *Adiantum capillus-veneris* in the gorge of the Volarja. Photo: I. Dakskobler
Slika 3: Prvo nahajališče vrste *Adiantum capillus-veneris* v grapi Volarje. Foto: I. Dakskobler



Figure 4: The second locality of *Adiantum capillus-veneris* in the gorge of the Volarja. Photo: I. Dakskobler
Slika 4: Drugo nahajališče vrste *Adiantum capillus-veneris* v grapi Volarje. Foto: I. Dakskobler

area extends over several areas at between 220 and 250 m a.s.l. It is estimated to comprise several thousand specimens of *Adiantum capillus-veneris* and is therefore its most prolific locality both in the Soča Valley and Slovenia. It is divided into two parts, the south and the north, by a 15-m-high and up to 7-m-wide, dry pillar of bare rock. The pillar is composed of striking limestone folds with marlstone intercalations. Five of our relevés (relevés 10, 11, 12, 13 and 20 in Table 1) were made on this locality.

The third locality is about 200 m above the second, at the elevation of ca. 235 m. While the bank here is also perpendicular it is not as high as on the previous localities as it ascends only about four metres above the stream. Water seeping through the bedrock forms tufa deposits. These and marlstone layers are overgrown with maidenhair fern, a total of 20 plants. This is a modest yet striking locality, with vertical limestone and marlstone layers that are overgrown with mosses and maidenhair ferns (relevé 15 in Table 1).

3.2 Phytosociological analysis of relevés with *Adiantum capillus-veneris* in the gorge of the Volarja

Our comparison was based on 39 previously published relevés (DAKSKOBLER, MARTINČIČ & ROJŠEK 2014) to which we added seven relevés from the gorge of the Volarja and three relevés from the Sopot gorge at Plave (ROJŠEK, 2015b). The new table comprises also the relevé from the small brecciated spring above the Brezna/Brizna gorge at Grahovo ob Bači (det. I. Dakskobler and D. Rojšek, 9. 12. 2014, relevé 19 in Table 1, mosses determined by A. Martinčič, 20. 2. 2017) and a relevé from the Piševac gorge (Šmarje pri Kopru, 0548/1, det. I. Dakskobler and Z. Sadar, 7. 5. 2014, mosses determined by A. Martinčič, 20. 2. 2017, relevé 18 in Table 1). A total of 51 relevés clustered into several groups that mainly correspond to the syntaxa we described in 2014 (Figure 6): *Eucladio-Adiantetum eucladietosum*, *-hymenostylietosum recurvirostri*, *-cratoneuretosum commutati*, *-conocephaletosum conici* and *Phyteumato columnae-Adiantetum capilli-veneris*. New relevés



Figure 5: The third locality of *Adiantum capillus-veneris* in the gorge of the Volarja. Photo: I. Dakskobler
 Slika 5: Tretje nahajališče vrste *Adiantum capillus-veneris* v grapi Volarje. Foto: I. Dakskobler

from the Volarja grouped mainly with the relevés from the Brezna Grapa gorge at Grahovo ob Bači and the nearby Mrzlica (subassociation *-hymenostylietosum recurvirostri*), while the relevés from the first and third locality grouped with the relevés of the subassociation *-cratoneuretosum commutati*.

Table 1 comprises new, previously unpublished relevés (12) as well as some already published relevés that show the greatest similarity to the new relevés. Based on the previously described comparison they are classified into the association *Eucladio-Adiantetum* Br.-Bl. 1931. Its subassociation *-hymenostylietosum recurvirostri* Dakskobler, Martinčič et Rojšek 2014 comprises the relevés from the Brezna/Brizna Grapa gorge at Grahovo ob Bači and the Mrzlica (which is the closest to the new locality in the nearby Volarja) as well as one relevé from the Sopot brook at Plave and four relevés from the Volarja gorge. The latter grouped separately and based on their species composition they can be classified into the new variant with *Pinguicula alpina*. Its differential species include *Calamagrostis varia* (mainly on account of higher coverage that it has here

compared to the relevés of other syntaxa compared), *Carex brachystachys*, *Campanula cespitosa* and *Saxifraga aizoides*. The last three species have not yet been recorded on other maidenhair fern localities in Slovenia. While T. Wraber reported *Campanula cespitosa* for the maidenhair fern locality at Grahovo ob Bači (field notes from 1984, Wraber's library at the Botanical Garden of the University of Ljubljana), he gave no mention of this species for this locality in the published article (WRABER 1986). Individual occurrences of these taxa, which are mainly distributed in the Alps, characterise the stands of the new variant both in terms of phytogeography and ecology. Such occurrence can be attributed to the proximity of mountains rising to 2,000 m and higher under which these gorges with their headwaters are situated as well as with special geological and geomorphological conditions and the local climate. An even more prominent example of co-occurrence of Mediterranean fern and hygrophilous subalpine-alpine chasmophytic species, grassland and headwaters species is known from Italy, where a new association *Himenostylium recurvirostri-Pinguiculetum*

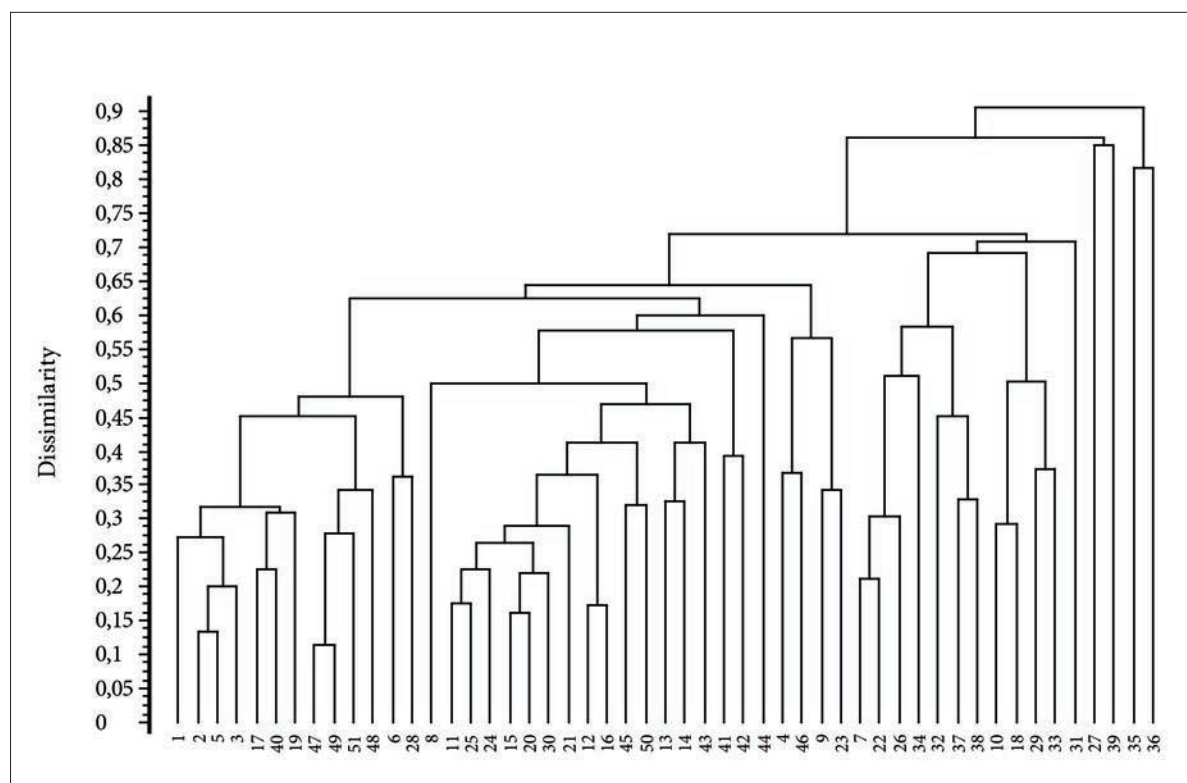


Figure 6: Dendrogram of relevés of communities with dominant *Adiantum capillus-veneris* in Slovenia (UPGMA, 1-similarity ratio). Stands of the subassociation *Eucladio-Adiantetum hymenostylietosum recurvirostri* are on the left side of the dendrogram, stands of the syntaxa *Eucladio-Adiantetum cratoneuretosum commutati*, -*eucladietosum* and *Adianto-Molinietum* are in the central part and stands of the syntaxa *Eucladio-Adiantetum conocephaletosum conici* and *Phyteumato columnae-Adiantetum* on the right.

Slika 6: Dendrogram popisov združb z vrsto *Adiantum capillus-veneris* v Sloveniji (UPGMA, komplement Wishartovega koeficienta podobnosti). V levem delu dendrograma so sestoji subasociacije *Eucladio-Adiantetum hymenostylietosum recurvirostri*, v srednjem delu sestoji sintaksonov *Eucladio-Adiantetum cratoneuretosum commutati*, -*eucladietosum* in *Adianto-Molinietum*, v desnem delu pa sestoji sintaksonov *Eucladio-Adiantetum conocephaletosum conici* in *Phyteumato columnae-Adiantetum*

poldinii (GIOVAGNOLI & TASINAZZO 2012) with *Pinguicula alpina* and *Carex brachystachys* was described several years ago in the ravines of the Venetian Prealps.

Two relevés from the Volarja gorge at Selišče and the Sopot at Plave as well as the relevé from Istria (Pišavec) show greater similarity with the relevés classified into the subassociation *Eucladio-Adiantetum cratoneuretosum commutati* (Pritivera & Lo Guidice) Deil 1996.

Four relevés stand out in Table 1, namely those that grouped separately also in the comparison of all relevés from Slovenia (relevés 44, 4, 46 and 9 in Figure 6 or relevés 20 to 23 in Table 1). They are classified into the new association *Adiantum capilli-veneris-Molinietum arundinaceae* ass. nov. that was provisionally described already in 2014. For now it is known on four very different localities situated far apart from each

other in the Alpine, pre-Alpine-sub-Mediterranean and sub-Mediterranean phytogeographical regions. The largest area that its stands occupy is in the gorge of the Volarja (Figure 7) and based also on these large surface areas it can be typified as new. Its nomenclature type, *holotypus*, is relevé 21 in Table 1. The stands of the new association are characterised by two herb layers. The upper, which is very distinct and conspicuous, is dominated by *Molinia caerulea* subsp. *arundinacea* (*M. arundinacea*), and the lower, which is less conspicuous and recognisable only close up, is dominated by *Adiantum capillus-veneris*. The Central-European nomenclature requires communities to be named after the dominating species of the highest stand layer, so the rank of the subassociation *Eucladio-Adiantetum molinietosum arundinaceae* would be less appropriate for these stands. Nevertheless, because of maidenhair



Figure 7: Stands of the syntaxa *Eucladio-Adiantetum hymenostylietosum recurvirostri* (the smaller area in the left part of the figure) and *Adianto-Molinietum arundinaceae* (the bigger area in the central part of the figure) in the gorge of the Volarja.

Photo: I. Dakskobler

Slika 7: Sestoja sintaksonov *Eucladio-Adiantetum hymenostylietosum recurvirostri* (manjša površina bolj v levem delu slike) in *Adianto-Molinietum arundinaceae* (večja površina v srednjem delu slike) v grapi Volarje. Foto: I. Dakskobler

fern and diagnostic moss species (*Eucladium verticillatum*, *Hymenostylium recurvirostre*, *Palustriella commutata*) the new association is classified into the alliance *Adiantion capilli-veneris* Br.-Bl. ex Horvatić 1934, order *Adiantetalia capilli-veneris* Br.-Bl. ex Horvatić 1934 and class *Adiantetea capilli-veneris* Br.-Bl. 1948.

Its stands on steep to very steep slopes with dolomite, limestone or flysch bedrock, where tufa is frequently deposited from, characterise a long-term successional stage in the gradual overgrowing of these extreme sites with shrub vegetation, in the case of the Volarja on the edges of the slope break.

4 CONCLUSIONS

On three locations in the gorge of the Volarja/Volarnik at Selišče (Krn Mountains, Julian Alps) we came across a rare and protected fern *Adiantum capillus-veneris*. Compared to the only known locality in the basin of the Volarja brook (in the Mrzlica gorge), the second new locality along the brook is very large (extending over several ares) and the richest in the number of specimens in the entire Soča Valley. In terms of the species composition the maidenhair communities

there are similar to the communities on other localities known so far in the Julian Alps and in the Central Soča Valley. Two relevés are classified into the subassociation *Eucladio-Adiantetum cratoneuretosum commutati* and four into the new variant of the subassociation *Eucladio-Adiantetum hymenostylietosum recurvirostri*, var. *Pinguicula alpina*. This montane headwaters species has been reported for maidenhair fern localities in the Alpine foothills of northeastern Italy, whereas in

Slovenia the Volarja is the only place where these two species occur together. One of the differential species of the new variant is also *Saxifraga aizoides*, a montane-alpine species of moist screes and headwaters, one of whose lowest localities in Slovenia is along the Volarja, at the elevation of only 230 m.

Maidenhair ferns along the Volarja occur on a very large area also in a community with tall moor grass (*Molinia caerulea* subsp. *arundinaceae*) and such stands, known on smaller areas also elsewhere in western and southwestern Slovenia, were classified into the new association *Adiantum capilli-veneris-Molinietum arundinaceae*.

The diverse basin of the Volarja/Volarnik under Mt. Krn with its numerous waterfalls and other fascinating geomorphological and geological phenomena (PODOBNIK 1983, ROJŠEK 1991) have been declared a natural monument and part of the Natura 2000 site named Soča with the Volarja. The new maidenhair fern localities are not endangered yet as they are not easily accessible, although they are in the vicinity of a popular path leading to the waterfalls. There are no other significant human interventions in these localities, but their populations nevertheless require careful monitoring in the future.

5 POVZETEK

V grapi Volarje/Volarnika pri Seliščih (Krnsko pogorje, Julijske Alpe) smo na treh krajih našli redko in zavarovano praprotnico *Adiantum capillus-veneris*. V primerjavi z do zdaj znanim edinim nahajališčem v porečju tega potoka (v soteski Mrzilce), je drugo novo nahajališče ob Volarji zelo obsežno (na površini več arov) in po številu primerkov najbogatejše v celotnem Posočju. Po vrstni sestavi so združbe venerinih laskov na njem podobne združbam na drugih do zdaj znanih nahajališčih v Julijskih Alpah in v Srednjem Posočju. Dva popisa uvrščamo v subasociacijo *Eucladio-Adiantetum cratoneuretosum commutati*, štiri pa v novo varianto *Eucladio-Adiantetum hymenostylietosum recurvirostri* var. *Pinguicula alpina*. To gorsko vrsto povirij že poznajo na nahajališčih venerinih laskov v alpskem prigorju severovzhodne Italije, v Sloveniji pa je Volarja za zdaj edini kraj, kjer rasteta skupaj. Ena izmed različnic nove variante je tudi (visoko)gorska vrsta vlažnih melišč in povirij *Saxifraga aizoides*, ki ima ob Vo-

larji na nadmorski višini le 230 m eno izmed svojih najnižje ležečih nahajališč v Sloveniji.

Ob Volarji venerini laski na precej veliki površini rastejo tudi v združbi s strtikasto stožko (*Molinia caerulea* subsp. *arundinaceae*) in take sestoje, ki jih na manjših površinah poznamo tudi drugod v zahodni in jugozahodni Sloveniji, smo uvrstili v novo asociacijo *Adiantum capilli-veneris-Molinietum arundinaceae*.

Razgibano porečje Volarje/Volarnika pod Krnom je zaradi številnih slapov in drugih zanimivih geomorfoloških in geoloških pojavov (PODOBNIK 1983, ROJŠEK 1991) razglašeno za naravni spomenik in sodi tudi v območje Natura 2000 z imenom Soča z Volarjo. Nova nahajališča venerinih laskov za zdaj še niso ogrožena, saj so razmeroma težko dostopna, vendar poteka blizu precej obiskana pot k slapovom. Drugih človekovih posegov na nahajališčih ni zaznati. Kljub vsemu bo v prihodnje potrebno pozorno spremljati njihove populacije.

ACKNOWLEDGEMENTS

We would like to thank the heirs of the late Tone Wraber for giving his manuscripts and professional literature to the safekeeping of the Botanical Garden of the University of Ljubljana, and to its director, Dr. Jože Bavcon, who allowed us to examine professor's legacy. Dr. Špela Goričan helped us to translate some of the

geological terms into English and Iztok Sajko prepared Figure 2 for print. The authors acknowledge the financial support from the Slovenian Research Agency (research core funding No. P1-0236). English translation by Andreja Šalamon Verbič.

REFERENCES – LITERATURA

- AESCHIMANN, D., K. LAUBER, D. M. MOSER & J.-P. THEURILLAT, 2004: *Flora alpina*. Bd. 1: *Lycopodiaceae-Apiaceae*. Haupt Verlag, Bern, Stuttgart, Wien.
- BRAUN-BLANQUET, J., 1964: *Pflanzensoziologie. Grundzüge der Vegetationskunde*. 3. Auflage. Springer, Wien – New York.
- BUSER, S., 1986: *Tolmač listov Tolmin in Videm (Udine) L 33-64 L 33-63. Osnovna geološka karta 1:100 000*. Beograd.
- BUSER, S., 1987: *Osnovna geološka karta SFRJ. Tolmin in Videm 1 : 100 000*. Zvezni geološki zavod, Beograd.
- BUSER, S., 2009: *Geološka karta Slovenije 1: 250.000. Geological map of Slovenia 1.250,000*. Geološki zavod Slovenije, Ljubljana.
- CEGNAR T., 1998: *Temperatura zraka*. In: J. Fridl, D. Kladnik, M., Orožen Adamič & D. Perko (eds.): *Geografski atlas Slovenije. Država v prostoru in času*. Državna založba Slovenije, Ljubljana, pp. 100–101.
- DAKSKOBLER, I., 2017: *Dve botanični opombi pod črto: plazeča sretena (Geum reptans) pod Triglavom in venerini laski (Adiantum capillus-veneris) v grapi Volarje pri Seliščih*. Proteus 79 (5): 216–223.
- DAKSKOBLER, I., A. MARTINČIČ, D. ROJŠEK, 2014: *Phytosociological analysis of communities with Adiantum capillus-veneris in the foothills of the Julian Alps (Western Slovenia)*. Hacquetia (Ljubljana) 13 (2): 235–258. <https://doi.org/10.2478/hacq-2014-0016>
- GIOVAGNOLI, L. & S. TASINAZZO, 2012: *Hymenostylio recurvirostri-Pinguiculetum poldinii* ass. nova in the Valbrenta ravines (Venetian Prealps): a new palaeoendemic plant association belonging to the class Adiantetea Br.-Bl. 1948. Plant Sociology 29 (2): 49–58. <https://doi.org/10.7338/pls2012492/03>
- MAAREL, van der E., 1979: *Transformation of cover-abundance values in phytosociology and its effects on community similarity*. Vegetatio 39 (2): 97–114. <https://doi.org/10.1007/BF00052021>
- MARTINČIČ, A., T. WRABER, N. JOGAN, A. PODOBNIK, B. TURK, B. VREŠ, V. RAVNIK, B. FRAJMAN, S. STRGULC KRAJŠEK, B. TRČAK, T. BAČIČ, M. A. FISCHER, K. ELER & B. SURINA, 2007: *Mala flora Slovenije. Ključ za določanje praprotnic in semenk*. Četrta, dopolnjena in spremenjena izdaja. Tehniška založba Slovenije, Ljubljana.
- MEDVEŠČEK, P. & D. SKRT, 2016: *Staroverstvo in straroverci. Katalog etnološke zbirke Pavla Medveščka 2*. Goriški muzej, Nova Gorica.
- MEKINDA-MAJARON, T., 1995: *Klimatografija Slovenije. Temperatura zraka 1961–1990*. Hidrometeorološki zavod Republike Slovenije, Ljubljana.
- PODANI, J., 2001: SYN-TAX 2000. *Computer Programs for Data Analysis in Ecology and Systematics*. User's Manual, Budapest.
- PODOBNIK, R., 1983: *Slapovi v okolici Vrsna in Krna*. In: A. Ramovš: *Slapovi v Sloveniji*. Slovenska matica, Ljubljana, pp. 110–118.
- ROJŠEK, D., 1991: *Naravne znamenitosti Posočja*. Državna založba Slovenije, Ljubljana.
- ROJŠEK, D., 2015a: *Venerini laski (Adiantum capillus-veneris L.) v Posočju*. Prvi del. Proteus (Ljubljana) 77 (9–10): 399–408.
- ROJŠEK, D., 2015b: *Venerini laski (Adiantum capillus-veneris L.) v Posočju*. Drugi del. Proteus (Ljubljana) 78 (1): 24–34.
- ROS, R. M., V. MAZIMPAKA, U. ABOU-SALAMA, M. ALEFFI, T. L. BLOCCKEEL, M. BRUGUÉS, M. J. CANO, R. M. CROS, M. G. DIA, G. M. DIRKSE, W. EL SAADAWI, A. ERDAĞ, A. GANEVA, J. M. GONZÁLEZ-MANCEBO, I. HERNSTADT, K. KHALIL, H. KÜRSCHNER, E. LANFRANCO, A. LOSADA-LIMA, M. S. REFAI, S. RODRÍGUEZ-NUNEZ, M. SABOVLEVIĆ, C. SÉRGIO, H. SHABBARA, M. SIM-SIM & M. SÖDERSTRÖM, 2007: *Hepatics and Anthocerotetes of the Mediterranean, an annotated checklist*. Cryptogamie, Bryologie 28 (4): 351–437.
- ROS, R. M., V. MAZIMPAKA, U. ABOU-SALAMA, M. ALEFFI, T. L. BLOCCKEEL, M. BRUGUÉS, R. M. CROS, M. G. DIA, G. M. DIRKSE, I. DRAPER, W. EL SAADAWI, A. ERDAĞ, A. GANEVA, R. GABRIEL, J. M. GONZÁLEZ-MANCEBO, I. HERNSTADT, V. HUGONNOT, K. KHALIL, H. KÜRSCHNER, A. LOSADA-LIMA, L. LUÍS, S. MIFSUD, M., PRIVITERA, M. PUGLISI, M. SABOVLEVIĆ, C. SÉRGIO, H. M. SHABBARA, M. SIM-SIM, A. SOTIAUX, R. TACCHI, A. VANDERPOORTEN & O. WERNER, 2013: *Mosses of the Mediterranean, an annotated checklist*. Cryptogamie, Bryologie 34 (2): 99–283.
- SELIŠKAR, T., B. VREŠ & A. SELIŠKAR, 2003: *FloVegSi 2.0. Fauna, Flora, Vegetation and Paleovegetation of Slovenia. Computer programme for arranging and analysis of biological data*. Biološki inštitut ZRC SAZU, Ljubljana.
- ŠILC, U. & A. ČARNI, 2012: *Conspectus of vegetation syntaxa in Slovenia*. Hacquetia (Ljubljana) 11 (1): 113–164. <https://doi.org/10.2478/v10028-012-0006-1>

- THEURILLAT, J.-P., 2004: *Pflanzensoziologisches System*. In: D. Aeschimann, K. Lauber, D. M. Moser & J.-P. Theurillat: *Flora alpina 3: Register*. Haupt Verlag, Bern, Stuttgart, Wien, pp. 301–313.
- WRABER, T., 1986: *Vsega po nekaj o venerinih laskih*. *Proteus* (Ljubljana) 48 (7): 259–263.
- ZUPANČIČ, B., 1995: *Klimatografija Slovenije. Padavine 1961–1990*. Hidrometeorološki zavod Republike Slovenije, Ljubljana.
- ZUPANČIČ, B., 1998: *Padavine*. In: J. Fridl, D. Kladnik, M. Orožen Adamič & D. Perko (eds.): *Geografski atlas Slovenije. Država v prostoru in času*. Državna založba Slovenije, Ljubljana, pp. 98–99.

Table 1: Communities with *Adiantum capillus-veneris* in western and southwestern Slovenia
Preglednica 1: Združbe z vrsto *Adiantum capillus-veneris* v zahodni in jugozahodni Sloveniji

Number of relevé (Zaporedna številka popisa)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21	22	23		
Database number of relevé (Delovna številka popisa)	245266	249922	245260	245261	245264	245262	247815	247819	262257	262259	262268	262258	262255	262260	251662	251663	251663	252436	255440	245263	262256	247658	249162	
Elevation in m (Nadmorska višina v m)	370	500	395	360	360	180	180	120	230	230	230	230	210	240	107	400	365	224	400	365	224	150	150	
Aspect (Lega)	SE	SE	SE	SE	S	SW	SW	S	SW	SEE	NEE	E	E	E	SW	SSW	NE	SE	S	SE	SW	SW	SW	
Slope in degrees (Nagib v stopinjah)	90	90	100	100	100	90	90	90	90	80	90	90	80	80	80	80	90	70	80	85-95	80	45	45	
Parent material (Matična podlaga)	D	Tu	B	D	D	D	Tu	Tu	Tu	Tu	LM	LM	LM	LM	Tu	Tu	Tu	B	D	D	LM	Tu	Tu	
Cover of herb layer in % (Zastiranje zeliščne plasti v %)	E1	40	20	70	70	80	70	60	80	60	70	60	70	70	20	30	60	30	80	80	90	70	70	
Cover of moss layer in % (Zastiranje mahovne plasti v %)	E0	70	100	40	60	40	90	60	80	70	80	50	60	60	90	80	70	80	20	60	60	90	50	
Number of species (Število vrst)	10	16	14	9	9	12	12	24	11	11	9	17	16	22	25	12	20	16	12	16	15	9	21	
Relevé area (Velikost popisne ploskve)	m ²	6	4	5	4	5	2	8	2	8	6	4	4	4	4	1	1	4	1	6	10	3	2	
Date of taking relevé (Datum popisa)	10/24/2012	9/12/2013	10/24/2012	10/24/2012	10/24/2012	10/24/2012	4/11/2013	1/29/2014	4/11/2013	7/24/2016	7/24/2016	7/24/2016	7/24/2016	7/24/2016	7/24/2016	7/24/2016	9/47/4	9/47/4	5/7/2014	12/9/2014	10/24/2012	3/22/2013	7/15/2013	
Locality (Nahajališče)	Brezna grapa	Mrzlica	Brezna grapa	Brezna grapa	Brezna grapa	Brezna grapa	Avče	Plave-Sopet	Ročinj-Ajba	Volartja	Volartja	Volartja	Volartja	Volartja	Volartja	Volartja	Plave-Sopet	Plave-Sopet	Istra-Piševac	Brezna grapa	Brezna grapa	Volartja	Trebež	Koštabona-Supt
Quadrant (Kvadrant)	9849/1	9748/3	9849/1	9849/1	9849/1	9849/1	9948/1	9947/4	9847/4	9747/4	9747/4	9747/4	9747/4	9747/4	9747/4	9747/4	9947/4	9947/4	0548/1	9849/1	9849/1	9747/4	9947/2	0548/1
Coordinate GK Y (D-48)	412756	397664	412714	412764	412768	412764	398588	390772	396806	396632	396629	396643	396629	396629	396655	390729	390737	399677	412770	412770	412770	396646	391703	402145
Coordinate GK X (D-48)	5113536	5120786	5113572	5113542	5113566	5113552	5106944	5100468	5107996	5120271	5120254	5120286	5120264	5120145	5120384	5100448	5100455	5039212	5113572	5113560	5120284	5120284	5102350	5038991
Diagnostic species of the association (Diagnostične vrste asociacije)	E1	2	1	4	4	5	4	4	4	4	3	3	3	3	3	1	2	4	2	2	3	4	3	3
<i>Adiantum capillus-veneris</i>																								
<i>Eucladium verticillatum</i>		+			+	+	+	+		+	+	+	+	r	+	+	+	+	+		+	+	+	+
<i>Molinia caerulea subsp. arundinacea</i>			r	1	+	+	+			1	1	1	2					+			5	3	4	4
Pr.		1		1	1	1	1	1	1	1	1	1	2					+			5	3	4	4
Fr.		23		23	23	23	23	23	23	23	23	23	23					+			23	23	23	100

		Number of relevé (Zaporedna številka popisa)																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Fr.
Differential species of the subsociation (Razlikovalnice subsociacij)																									
AD	<i>Hymenostylium recurvirostre</i>	4	5	3	4	4	3	4	4	3	4	4	3	2	2	1	+	1	.	.	1	2	2	.	20
TR	<i>Petasites paradoxus</i>	E1	.	.	+	+	1	.	.	.	+	+	+	+	+	.	.	.	.	.	+	1	.	.	10
ES	<i>Sesleria caerulea</i>	E1	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	4
CD	<i>Tofieldia calyculata</i>	E1	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	4
MC	<i>Palustris commutata</i>	E0	1	1	+	1	2	2	1	2	.	4	4	2	3	4	1	3	3	4	3	4	+	+	22
Differential species of the variant (Razlikovalnice variante)																									
EP	<i>Calamagrostis varia</i>	E1	+	+	.	.	.	1	.	.	3	2	4	1	+	1	.	.	.	.	+	+	.	.	13
CD	<i>Pringicula alpina</i>	E1	.	.	.	.	.	.	.	.	1	1	1	+	.	.	.	.	.	.	.	+	.	.	5
CF	<i>Carex brachystachys</i>	E1	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1
TR	<i>Campanula cespitosa</i>	E1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	4
MC	<i>Saxifraga aizoides</i>	E1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1
AD	Adiantum, Adiantetea																								
	<i>Pellia endiviifolia</i>	E0	.	+	1	.	.	+	1	+	1	+	+	1	1	1	+	+	3	.	.	.	+	+	17
	<i>Didymodon tophaceus</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2
MC	Montio-Cardaminetea																								
	<i>Conocephalum conicum</i>	E0	.	+	.	.	.	.	2	2	.	.	.	.	+	+	.	2	.	.	.	.	.	.	7
	<i>Campyllum stellatum</i>	E0	.	.	.	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	3
	<i>Cratoneuron filicinum</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1
CF	Cystopteridion fragilis																								
	<i>Orthothecium rufescens</i>	E0	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	4
	<i>Jungermannia atrovirens</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
AT	Asplenetea trichomanis																								
	<i>Phyteuma scheuchzeri</i> subsp. <i>columnae</i>	E1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
O	<i>Hieracium</i> cf. <i>pospichalii</i>	E1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	2
TR	Thlaspietea rotundifolii																								
	<i>Peucedanum verticillare</i>	E1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
	<i>Hieracium bifidum</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
FB	Festuco-Brometea																								
	<i>Blackstonia perfoliata</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1
	<i>Globularia punctata</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1
TG	Trifolio-Geranetea																								
	<i>Viola hirta</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2
	<i>Laserpitium latifolium</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
MA	Molinio, Molinio-Arrhenatheretea																								
	<i>Angelica sylvestris</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	4
	<i>Callitha palustris</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	2
	<i>Galium mollugo</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	4
	<i>Pulicaria dysenterica</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	4
MuA	Mulgedio-Aconitetea, Betulo-Adenostyletea																								
	<i>Senecio ovatus</i>	E1	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	2
	<i>Chaerophyllum hirsutum</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	2
	<i>Salix appendiculata</i>	E2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
EA	Epilobioetea angustifolii																								
	<i>Eupatorium cannabinum</i>	E1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	3

		Number of relevé (Zaporedna številka popisa)																									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Pr.	Fr.	
GU	Galio-Urticetea																										
	<i>Petasites hybridus</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	2	9
	<i>Equisetum arvense</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	2	9
RP	Rhamno-Prunetea																										
	<i>Ligustrum vulgare</i>	E2a	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	2	9
	<i>Rubus macrophyllus</i>	E2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
	<i>Rubus</i> sp.	E2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	1	4
EP	Erico-Pinetea																										
	<i>Bupthalamum salicifolium</i>	E1	.	.	.	.	.	.	.	.	r	.	r	.	.	r	.	.	.	.	.	.	.	.	.	4	17
VP	Vaccinio-Piceetea																										
	<i>Veronica urticifolia</i>	E1	.	r	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	4	17
	<i>Oxalis acetosella</i>	E1	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
	<i>Solidago virgaurea</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1	4
TA	Tilio-Acerion																										
	<i>Aruncus dioicus</i>	E1	.	r	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	4	17
	<i>Phyllitis scolopendrium</i>	E1	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	2	9
	<i>Geranium robertianum</i>	E1	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
AF	Arenonio-Fagion																										
	<i>Cyclamen purpurascens</i>	E1	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.	4	17
	<i>Lamium orvala</i>	E1	.	.	.	.	.	.	r	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.	3	13
	<i>Anemone trifolia</i>	E1	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
	<i>Cardamine trifolia</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
	<i>Epimedium alpinum</i>	E1	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
EC	Erythronio-Carpinion																										
	<i>Primula vulgaris</i>	E1	.	.	.	.	.	.	.	.	.	.	.	l	+	.	.	r	.	.	.	.	.	.	.	7	30
	<i>Galanthus nivalis</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	1	4
	<i>Lonicera caprifolium</i>	E2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
FS	Fagetalia sylvaticae																										
	<i>Galeobdolon flavidum</i>	E1	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	r	.	.	.	.	.	.	.	5	22
	<i>Pulmonaria officinalis</i>	E1	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	.	.	.	4	17
	<i>Brachypodium sylvaticum</i>	E1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	4	17
	<i>Mycelis muralis</i>	E1	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	13
	<i>Sambucus nigra</i>	E2a	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	2	9
	<i>Salvia glutinosa</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	2	9
	<i>Allium ursinum</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
	<i>Melica nutans</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
	<i>Lathyrus vernus</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
	<i>Asarum europaeum</i> subsp. <i>caucasicum</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	1	4
	<i>Fraxinus excelsior</i>	E2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	1	4
	<i>Viola reichenbachiana</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
QP	Quercetalia pubescenti-petraeae (inc. <i>Quercetea hlicis</i>)																										
	<i>Carex flacca</i>	E1	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	3	13
	<i>Ruscus aculeatus</i>	E1	.	.	.	.	.	.	.	r	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	3	13
	<i>Asparagus acutifolius</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	2	9

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Pr.	Fr.		
Number of relevé (Zaporedna številka popisa)																											
<i>Fraxinus ornus</i>	E2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	+	2	9	
<i>Quercus pubescens</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	4	
<i>Sesleria autumnalis</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	1	4	
QF																											
Quercus-Fagetea																											
<i>Hedera helix</i>	E1	.	.	+	+	.	+	+	.	.	.	.	.	+	+	.	1	.	1	r	+	.	.	+	14	61	
<i>Clematis vitalba</i>	E2a	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	3	13	
<i>Carex digitata</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	.	.	.	.	.	2	9	
<i>Vinca minor</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	2	9	
<i>Cephalanthera sp.</i>	E1	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	1	4	
<i>Viola riviniana</i>	E1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	4	
M																											
Mosses (Mahovi)																											
<i>Oxyrrhynchium schleicheri</i>	E0	.	.	.	.	+	.	r	+	.	.	.	r	.	.	+	.	.	.	.	.	.	.	.	.	6	26
<i>Oxyrrhynchium hians</i>	E0	.	.	.	.	.	1	+	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	6	26
<i>Jungermannia sp.</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	9
<i>Bryum pseudotriquetrum</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	9
<i>Preissia quadrata</i>	E0	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	2	9
<i>Ctenidium molluscum</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	9
<i>Pedinophyllum interruptum</i>	E0	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Fissidens taxifolius</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Seligeria trifaria</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Gymnostomum aeruginosum</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Brachythecium rutabulum</i>	E0	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Plagiommium rostratum</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Aneura pinguis</i>	E0	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Plagiommium undulatum</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Platyhypnidium riparioides</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Rhynchostegium murale</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Riccardia chamaedryfolia</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	1	4
<i>Fissidens dubius</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4
<i>Fissidens adianthoides</i>	E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	1	4

Legend - Legendia

Pr. Presence (number of relevés in which the species is presented) - število popisov, v katerih se pojavlja vrsta

Fr. Frequency in % - frekvenca v %

L Limestone - apnenec

M Marlstone - laporovec

Tu Tufa - lehnjak

D Dolomite - dolomit

B Breccia - breča

