PHYTOSOCIOLOGICAL ANALYSIS OF *CAREX BICOLOR* ALL. SITES IN THE JULIAN ALPS

FITOCENOLOŠKA OZNAKA RASTIŠČ VRSTE *CAREX BICOLOR* ALL. V JULIJSKIH ALPAH

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ABSTRACT

Phytosociological analysis of *Carex bicolor* All. sites in the Julian Alps

We conducted a phytosociological investigation of the sites of *Carex bicolor* on the only known localities of this species in the Julian Alps, in the upper part of the Triglav Lakes Valley. *Carex bicolor* was recorded in different alpine communities, most of which belong to the class *Scheuchzerio-Caricetea fuscae* and order *Caricetalia davallianae*. We described a new association *Caricetum bicolori-frigidae*, which is classified into the alliance *Caricion atrofusco-saxatilis* and is for now the only community of this alliance in Slovenia.

Key words: vegetation, alpine lake, snow beds, Triglav National Park, Slovenia

IZVLEČEK

Fitocenološka analiza rastišč vrste *Carex bicolor* All. v Julijskih Alpah

Fitocenološko smo raziskali rastišča vrste *Carex bicolor* na edinih do zdaj znanih nahajališčih v Julijskih Alpah, v zgornjem delu Dolini Triglavskih jezer. Popisali smo jo v različnih alpinskih združbah, ki večinoma sodijo v razred *Scheuchzerio-Caricetea fuscae* in v red *Caricetalia davallianae*. Kot novo smo opisali asociacijo *Caricetum bicolori-frigidae*, ki jo uvrščamo v zvezo *Caricion atrofusco-saxatilis* in je za zdaj edina združba iz te zveze v Sloveniji.

Ključne besede: vegetacija, alpinsko jezero, snežne dolinice, Triglavski narodni park, Slovenija

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1 INTRODUCTION

Carex bicolor (Figure 1) is an arctic-alpine species characteristic for calcareous springs and fens on mineral soils and gravelly substrates not accumulating peat (alliance *Caricion atrofusco-saxatilis* Nordhagen 1943) – Aeschimann et al. (2004b: 830). This sedge is rare in the Southern, Southeastern and Eastern Alps (see also Martini 2019). In Slovenia it has only two known localities, both in the Julian Alps, namely in the Triglav Lakes Valley and in the Triglav National Park, grid square 9648/2 (Figures 2, 3, 4 and 5). The first is in a snow bed situated approximately halfway between Lake under Vršac (Jezero pod Vršacem) and Pond in Ledges (Mlaka v Laštah), and the other on the rocky bank of Green Lake (Zeleno Jezero) (Novak 2010, Anderle & Leban 2014, Dakskobler & Martinčič 2021, Dakskobler et al. 2021). In the summer of 2020 and 2021 we made altogether 19 relevés of the stands with this sedge on both localities and arranged them into the phytosociological table (Table 1) with the aim to classify its communities into a syntaxonomic system.

Figure 1: Carex bicolor at Green Lake (Zeleno Jezero). Photo: I. Dakskobler.
Slika 1: Dvobarvni šaš (Carex bicolor) pri Zelenem jezeru. Foto: I. Dakskobler.

Figure 2: Snow bed between Pond in Ledges (Mlaka v Laštah) and Lake under Vršac (Jezero pod Vršacem). Photo: I. Dakskobler.
Slika 2: Snežna dolinica med Mlako v Laštah in Jezerom pod Vršacem. Foto: I. Dakskobler.

Figure 3: Rocky bank of Green Lake. Photo: I. Dakskobler.
Slika 3: Skalnata obala Zelenega jezera. Foto: I. Dakskobler.

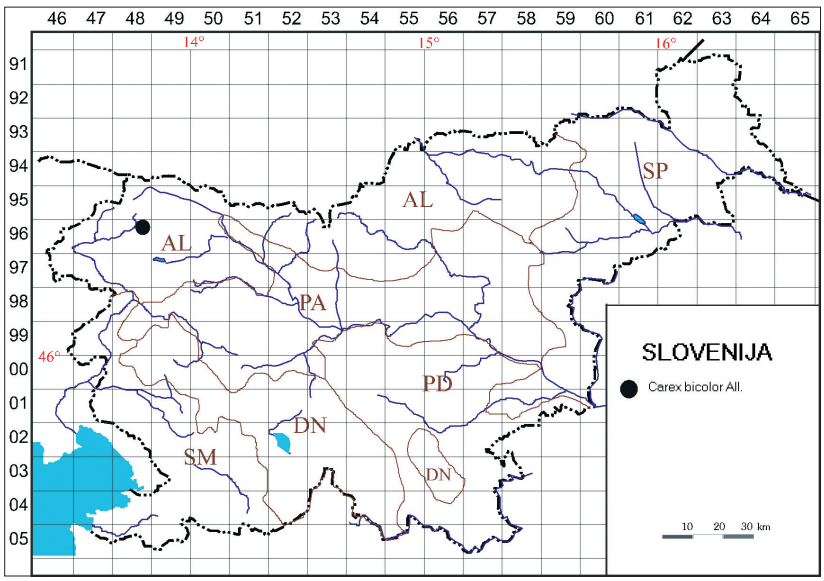

Figure 4: Distribution of Carex bicolor in Slovenia.
Slika 4: Razširjenost vrste Carex bicolor v Sloveniji.

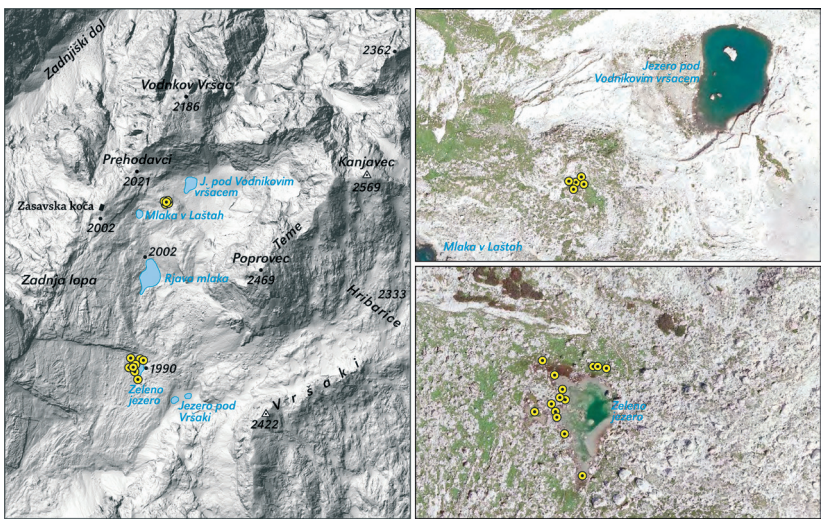

Figure 5: Localities of Carex bicolor in the Triglav Lakes Valley.
Slika 5: Nahajališča vrste Carex bicolor v Dolini Triglavskih jezer.

2 METHODS

Our analysis was based on the relevés recorded on the sites of *Carex bicolor* using the Central-European (Braun-Blanquet 1964) phytosociological approach. They were entered into the FloVegSi database (T. Seliškar, Vreš & A. Seliškar 2003) and 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), but use also our own experience. The nomenclatural source for the names of vascular plants were the Mala flora Slovenije (Martinčič et al. 2007) and the FloVeg-Si database. Hodgetts et al. (2020) was the nomenclatural source for the names of mosses and liverworts. Theurillat (2004), Šilc & Čarni (2012) and Dakskobler & Martinčič (2021) served as nomenclatural sources for the names of the syntaxa. Geological, climate, geographical and plant characteristics of the study area, i.e. the Triglav Lakes Valley, are described in more detail in two monographs (Brancelj 2002 and Zorn et al. 2015). 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

3.1 Communities on the bank of Green Lake

The relevés of the stands with *Carex bicolor* (Table 1) were arranged using hierarchical classification (Figure 6). The relevé that stands out the most with its species composition is relevé 3 in the dendrogram in Figure 6, i.e. relevé 1 in Table 1. Situated on a less rocky area just off the bank of Green Lake, this stand is completely dominated by *Eriophorum angustifolium*. It is provisionally classified into the association *Carici bicoloris-Eriophoretum angustifolii* nom. prov. (Figures 7 and 8).

Relevés of the stands clustered on the left side of the dendrogram in Figure 6 (numbers 1, 7, 14, 6, 4, 2, 13, 8, 10 and 11) were made at the bank of Green Lake, in a very rocky and wet riparian zone (Figures 2 and 5). The herbaceous layer is dominated by sedges *Carex frigida, C. capillaris, C. bicolor, C. flava*, on most relevés also by taxon *Allium schoenoprasum* subsp. *alpinum*, and the dominating moss species are *Palustriella commutata* and *Ptychostomum pseudotriquetrum* (*Bryum pseudotriquetrum*). The relevé of the stand with *Carex frigida* and *C. bicolor* from the bank of

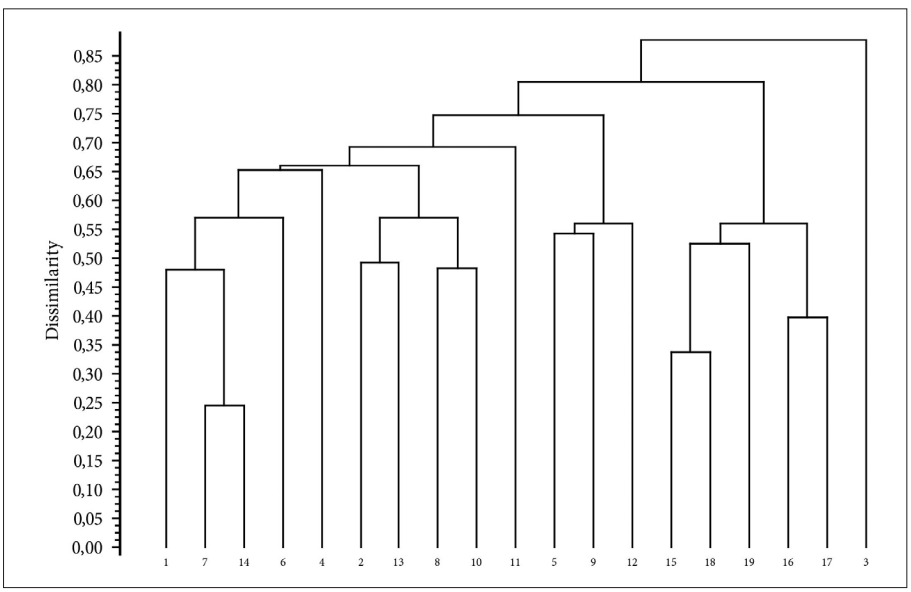

Figure 6: Dendrogram of the stands with Carex bicolor in the Triglav Lakes Valley (UPGMA, 1-similarity ratio).
Slika 6: Dendrogram sestojev z vrsto Carex bicolor v Dolini Triglavskih jezer (UPGMA, 1-similarity ratio).

Figures 7 and 8: Community of Eriophorum angustifolium and Carex bicolor (Carici bicoloris-Eriophoretum angustifolii nom. prov.). Photo: I. Dakskobler.
Sliki 7 in 8: Združba ozkolistnega munca in dvobarvnega šaša (Carici bicoloris-Eriophoretum angustifolii nom. prov.). Foto: I. Dakskobler.

Green Lake was recently (Dakskobler & Martinčič 2021, Table 1, relevé 20) classified into the association *Palustriello decipientis-Caricetum frigidae,* even though the diagnostic species of this association were poorly represented there and it differed from other relevés with the presence of *Allium schoenoprasum* subsp. *alpinum* and *Carex bicolor.* Now that we have more relevés from the bank of Green Lake available the difference between these stands with dominant *Carex frigida* and the stands of association *Palustriello decipientis-Caricetum frigidae* becomes even more obvious. *Palustriella decipens* was found only in the community with predominating *Eriophorum angustifolium* – relevé 1 in Table 1, whereas other diagnostic species of this association (*Festuca nitida, Paederota lutea* and *Achillea atrata*) occur only in individual relevés from Green Lake. When we removed the relevé from the bank of Green Lake from the table of association *Palustriello-Caricetum frigidae* and compared the stands of this community with relevés 2–11 in Table 1, the value of Sørensen (1948) similarity coefficient was only 41%, which indicates that it cannot be classified into the same association. Species that differentiate stands with *Carex frigida* at the bank of Green Lake from the stands in spring areas elsewhere in the Julian Alps are *Carex bicolor, Allium schoenoprasum* subsp. *alpinum*, *Pinguicula alpina, Agrostis stolonifera, Salix serpillifolia, Juncus alpinoarticulatus, Phyteuma sieberi, Soldanella minima*, *Tortella tortuosa* and *T. densa*. It therefore seems that of the two alternatives, namely

Figure 9: Stand of the association Caricetum bicolori-frigidae at the bank of Green Lake (Zeleno Jezero). Photo: I. Dakskobler.
Slika 9: Sestoj asociacije Caricetum bicolori-frigidae ob obali Zelenega jezera. Foto: I. Dakskobler.

Figure 10: Stand of the variant Caricetum bicolori-frigidae var. Juncus alpinoarticulatus at the bank of Green Lake (Zeleno Jezero). Photo: I. Dakskobler.
Slika 10: Sestoj variante Caricetum bicolori-frigidae var. Juncus alpinoarticulatus ob obali Zelenega jezera. Foto: I. Dakskobler.

that the studied stands be classified into the new subassociation *Palustriello decipientis-Caricetum frigidae caricetosum bicoloris* or into the new association *Caricetum bicolori-frigidae*, the latter makes more sense. Ecology plays an important part in this decision. Green Lake has no permanent surface inflows or outflows and the most important source of moisture other than precipitation is the fluctuating lake water level, whereas the source of moisture for the stands of association *Palustriello-Caricetum frigidae* comes mainly from springs. Association *Palustriello-Caricetum frigidae* was classified into the alliance *Cratoneurion* and class *Montio-Cardaminetea*, whereas association *Caricetum bicolori-frigidae* was classified into the alliance *Caricion atrofusco-saxatilis*, order *Caricetalia davallianae* and class *Scheuchzerio-Caricetea fuscae*. Our decision for the alliance *Caricion atrofusco-saxatilis* was based on the following consideration. This alliance comprises communities of low-sedge low-productivity calcareous fens on mineral soils and gravelly substrates not accumulating peat of the Alps, the Pyrenees, Scandinavia and the European Arctic archipelagos (Mucina et al. 2016) or small-sedge communities of calcareous fens in the subalpine and alpine belt (Steiner 1993). The only character species of this alliance present in our stands is *Carex bicolor*, which occurs with

Figure 11: Stand of the association Carici bicoloris-Juncetum alpinoarticulati at the bank of Green Lake (Zeleno Jezero). Photo: I. Dakskobler.
Slika 11: Sestoj asociacije Carici bicoloris-Juncetum alpinoarticulati ob obali Zelenega jezera. Foto: I. Dakskobler.

high constancy. The second alternative would be to classify our stands into the alliance *Caricion davalianae*, which comprises sedge-moss calcareous mineral-rich fen vegetation of Europe and Western Asia (Mucina et al. 2016) or small-sedge communities of calcareous fens from the lowland to the subalpine belt (Steiner 1993). Our stands do not comprise character species of this (Steiner, ibid.), and their altitudinal zone is the alpine belt.

Diagnostic species of the new association are *Carex frigida, C. bicolor, Allium schoenoprasum* susbp. *alpinum* and *Pinguicula alpina*. Its nomenclatural type, *holotypus,* is relevé 5 in Table 1.

Four relevés (relevés 8–11 in Table 1, or relevés 2, 13, 8 and 10 in Figure 6) show higher medium coverage of *Juncus alpinoarticulatus* and are classified into the variant with this name – Figure 10. These relevés indicate certain similarity with three stands (relevés 12–14 in Table 1 or relevés 5, 9 and 12 in Figure 6), which are usually dominated by *Juncus alpinoarticulatus* and are provisionally classified into association *Carici bicoloris-Juncetum alpinoarticulati* nom. prov. with diagnostic species *Juncus alpinoarticulatus, Carex flava* and *C. bicolor*. The lake's bank is less rocky and more finely gravelly in areas populated with this community (Figure 11).

Figure 12: Stand of the association Saxifrago aizoidis-Caricetum ferrugineae in the snow bed under Prehodavci. Photo: I. Dakskobler.
Slika 12: Sestoj asociacije Saxifrago aizoidis-Caricetum ferrugineae v snežni dolinici pod Prehodavci. Foto: I. Dakskobler.

Figure 13: Stand of the association Salici retusae-Eriophoretum scheuchzeri nom. prov. in the snow bed under Prehodavci. Photo: I. Dakskobler.
Slika 13: Sestoj asociacije Salici retusae-Eriophoretum scheuchzeri nom. prov. v snežni dolinici pod Prehodavci. Foto: I. Dakskobler.

3.2. Communities in the snow bed between Lake under Vršac and Pond in Ledges (under Prehodavci pass)

Relevés on the right side of the dendrogram (relevés 15–18 in Table 1 or relevés 15–19 in Figure 6) were made in the snow bed situated approximately halfway between Lake under Vršac (Jezero pod Vršacem) and Pond in Ledges (Mlaka v Laštah) – Figures 2 and 5, which is, at least in part, also a spring area (it seems there is an intermittent stream there, which was dry upon our visit). These stands are dominated by *Allium schoenoprasum* subsp. *alpinum, Eriophorum scheuchzeri, Carex ferruginea, Carex bicolor, C. capillaris, C. firma, Salix retusa* and *S. serpillifolia*, and the predominant mosses include *Ptychostomum pseudotriquetrum* (*Bryum pseudotriquetrum*), *Philonotis tomentella* and *Palustriella commutata*. These stands manifest a similarity with three communities – a moist alpine grassland (*Caricetum ferrugineae*), a snow-bed community (*Homogyno discoloris-Salicetum retusae*) and a fen community with Scheuchzer's cottongrass (*Eriophorum scheuchzeri*). Relevé 15 in Table 1 is provisionally classified into association *Saxifrago aizioidis-Caricetum ferrugineae*, relevés 16–18 into association *Salici retusae-Eriophoretum scheuchzeri* nom. prov., and relevé 19 into syntaxon *Homogyno discoloris-Salicetum retusae allietosum alpini* nom. prov. Evidently, this very small area boasts a mosaic of different communities that are not clearly distinguishable, but transitional.

3.3 Classification of the researched communities in the syntaxonomical system

The following is a provisional conspectus of the syntaxa described herein, ordered in a syntaxonomic scheme:

Scheuchzerio palustris-Caricetea nigrae Tx. 1937 nom. mut.
 Caricetalia davallianae Br.-Bl. 1950 nom. conserv. propos.
  Caricion davallianae Klika 1934
   Carici bicoloris-Juncetum alpinoarticulati nom. prov.
   Carici bicoloris-Eriophoretum angustifolii nom. prov.
   Salici retusae-Eriophoretum scheuchzeri nom., prov.
  Caricion atrofusco-saxatilis Nordhagen 1943
   Caricetum bicolori-frigidae ass. nov. hoc loco
    var. *Juncus alpinoarticulatus*
Elyno-Seslerietea Br.-Bl. 1948
 Seslerietalia coeruleae Br.-Bl. in Br.-Bl. et Jenny 1926
  Caricion ferrugineae Br.-Bl. 1931
   Saxifrago aizoidis-Caricetum ferrugineae Dakskobler 1996
Thlaspietea rotundifolii Br.-Bl. 1948
 Arabidetalia caeruleae Rübel ex Br.-Bl. 1948
  Arabidion caeruleae Br.-Bl. in Br.-Bl. et Jenny 1926
   Homogyno discoloris-Salicetum retusae Aichinger 1933
    allietosum alpini nom. prov.

Figure 14: Stand of the association Homogyno discoloris-Salicetum retusae in the snow bed under Prehodavci. Photo: I. Dakskobler.
Slika 14: Sestoj asociacije Homogyno discoloris-Salicetum retusae v snežni dolinici pod Prehodavci. Foto: I. Dakskobler.

4 CONCLUSIONS

Carex bicolor is a very rare species of Slovenian flora, with only two known localities. Both are situated in the Triglav Lakes Valley, in the alpine belt of the Triglav Mts. in the Julian Alps – at the bank of Green Lake at the elevation of around 1985 m, and in the snow bed between Lake under Vršac (Jezero pod Vršacem) and Pond in Ledges (Mlaka v Laštah) at around 2005 m a.s.l., – but have slightly different sites. The banks of Green Lake are very rocky, and in the absence of surface inflows to the lake the source of moisture is snow and water level fluctuation. Here, *Carex bicolor* occurs in communities with *Carex frigida*, *Allium schoenoprasum* subsp. *alpinum*, *Juncus alpinoarticulatus* and *Eriophorum angustifolium* (in stands of associations *Caricetum bicolori-frigidae*, *Carici bicoloris-Juncetum alpinoarticulati* nom. prov., *Carici bicoloris-Eriophoretum angustifolii* nom. prov.). In 2020 we observed more than 100 specimens. The surface area of the other locality is significantly smaller, measuring only about one are, and the number of observed specimens in the summer of 2021 was approximately 50. Here, *Carex bicolor* occurs in communities with *Eriophorum scheuchzeri, Allium schoenoprasum* subsp. *alpinum*, *Carex ferruginea* and *Salix retusa* (in stands of associations *Salici retusae-Eriophoretum scheuchzeri* nom. prov., *Saxifrago aizoidis-Caricetum ferrugineae*, *Homogyno discoloris-Salicetum retusae*); in addition to the long-lasting snow cover it is assumed that the source of moisture comes also from an intermittent water source (spring area). Green Lake is also the site of the macrophyte *Batrachium trichophyllum,* and we also recorded the amphibious species *Rorippa islandica*.

The snow bed between Lake under Vršac (Jezero pod Vršacem) and Pond in Ledges (Mlaka v Laštah) is quite remote, far from mountain trails and with no evident human impact. The most critical factor for the occurrence of *Carex bicolor* could be climate change, reduced precipitation levels and soil drainage – for now, the soil in most part of the snow bed is still hydromorphic.

The bank of Green Lake is in the immediate vicinity of a very popular mountain trail leading from the Hut of the Seven Lakes towards Prehodavci and Mt. Triglav, but the community of *Carex frigida* and *C. bicolor* is situated a good distance from the most visited parts of the lake's shoreline. On the whole, the Green Lake ecosystem is very vulnerable as it is unquestionably affected also by climate change, reduced snowfall and rising summer temperatures. Possibly, this might prove beneficial for *Carex bicolor,* as it is a species characteristic for pioneer sites such as glacier margins, banks of watercourses, and springs. Characteristically, such sites have disturbed marsh and alluvial soils flooded with cold, clean, gas-rich alkaline or slightly acidic water. The soil is therefore mineral, with running or percolating water (Novak 2010). In our case, this is the bank of an alpine lake whose circumference has changed in recent decades, however slightly. Older sources do not report *Carex bicolor* for the Triglav Lakes Valley, a popular destination of botanists.

5 POVZETEK

Carex bicolor je zelo redka vrsta v flori Slovenije, za zdaj zgolj z dvema znanima nahajališčema. Obe sta v Dolini Triglavskih jezer, v Triglavskem pogorju Julijskih Alp in v alpinskem pasu: ob obali Zelenega jezera na nadmorski višini okoli 1985 m in v snežni dolinici med Jezerom pod Vršacem in Mlako v Laštah na nadmorski višini okoli 2005 m. Po rastišču se nekoliko razlikujeta. Obala Zelenega jezera je zelo skalnata, vir mokrote je poleg snega nihanje gladine jezera, površinskega dotoka v jezero ni. Dvobarvni šaš (*Carex bicolor*) tukaj raste v združbah z vrstami *Carex frigida*, *Allium schoenoprasum* subsp. *alpinum*, *Juncus alpinoarticulatus* in *Eriophorum angustifolium*. Našli smo ga v sestojih asociacij *Caricetum bicolori-frigidae* (opisali smo jo kot novo, njene diagnostične vrste so *Carex frigida, C. bicolor, Allium schoenoprasum* subsp. *alpinum* in *Pinguicula alpina* in jo uvrščamo v zvezo *Caricion atrofusco-saxatilis*), *Carici bicoloris-Juncetum alpinoarticulati* nom. prov. in *Carici bicoloris-Eriophoretum angustifolii* nom. prov. Število opaženih primerkov je bilo leta 2020 več kot 100. Površina drugega nahajališča je precej manjša, le približno en ar, število opaženih primerkov pa poleti 2021 okoli 50. Tu dvobarvni šaš raste v združbah z vrstami *Eriophorum scheuchzeri, Allium schoenoprasum* subsp. *alpinum*, *Carex ferruginea* in *Salix retusa* (v sestojih asociacij *Salici retusae-Eriophoretum scheuchzeri* nom. prov., *Saxifrago aizoidis-Caricetum ferrugineae*, *Homogyno discoloris-Salicetum retusae*), poleg dolgotrajne snežne odeje je domnevni vir mokrote občasni izvir (povirje). V Zelenem jezeru raste tudi hidrofit *Batrachium trichophyllum,* popisali smo tudi amfibijsko vrsto *Rorippa islandica*.

Dolinica med Jezerom pod Vršacem in Mlako v Laštah je precej odmaknjena od planinskih poti, človekovih vplivov v njej nismo opazili. Na uspevanje dvobarvnega šaša bodo lahko vplivale predvsem spremenjene podnebne razmere, manjša količina padavin in izsuševanje tal – ta so za zdaj v večjem delu dolinice še hidromorfna.

Obala Zelenega jezera je v neposredni bližini zelo obiskane planinske poti od Koče pri Sedmerih jezerih proti Prehodavcem in Triglavu. Planinci se ob njej pogosto zadržujejo, vendar je združba mrzlega in dvobarvnega šaša proč od najbolj obiskanih delov obale. Celoten ekosistem Zelenega jezera je precej ranljiv, nanj zagotovo vplivajo tudi podnebne spremembe, manjša količina snežnih padavin in toplejše poletne temperature. Mogoče je, da je to celo v prid dvobarvnemu šašu, saj je značilen za pionirska mesta, kot so obrobja ledenikov, obrežja tekočih voda in izviri. Za ta rastišča so značilna motena močvirnata in aluvialna tla, ki jih preplavlja hladna, čista, s plini bogata bazična ali šibko kisla voda. Tla so torej mineralna, s tekočo ali pronicajočo vodo (Novak 2010). V našem primeru gre za obalo visokogorskega jezera, čigar obseg se v zadnjih desetletjih vsaj nekoliko spreminja. Starejši viri dvobarvni šaš za botanično pogosto obiskano Dolino Triglavskih jezer ne omenjajo.

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Table 1: Communities with *Carex bicolor* in the Julian Alps
Preglednica 1: Združbe z vrsto *Carex bicolor* v Julijskih Alpah

Successive number of relevé (Zaporedna številka popisa)		1	2	3	4	5	6	7
Database number of relevé (Delovna številka popisa)		282181	282195	217528	282191	282201	282190	282182
Elevation in m (Nadmorska višina v m)		1985	1985	1985	1985	1985	1985	1985
Aspect (Lega)		0	0	0	S	S	SW	0
Slope in degrees (Nagib v stopinjah)		0	0	0	5	5	10	0
Parent material (Matična podlaga)		A	A	A	A	A	A	A
Soil (Tla)		Gl	Li	Li	Li	Li	Li	Li
Stoniness in % (Kamnitost v %)		20	60	30	40	40	80	50
Cover of herb layer in % (Zastiranje zeliščne plasti v %):		80	40	70	60	50	40	40
Cover of moss layer in % (Zastiranje mahovne plasti v %):		10	20	10	15	20	10	20
Number of species (Število vrst)		14	14	15	23	24	16	26
Relevé area (Velikost popisne ploskve)	m^2	10	5	10	5	3	5	5
Date of taking relevé (Datum popisa)		8/10/2020	8/10/2020	7/26/2007	8/10/2020	8/10/2020	8/10/2020	8/10/2020
Locality (Nahajališče)		Zeleno jezero	Zeleno jezero	Zeleno jezero	Zeleno jezero	Zeleno jezero	Zeleno jezero	Zeleno jezero
Quadrant (Kvadrant)		9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2
Coordinate GK Y (D-48)	m	407624	407587	407590	407592	407594	407585	407620
Coordinate GK X (D-48)	m	5134884	5134838	5134856	5134863	5134854	5134876	5134884
Diagnostic species of the syntaxa (Diagnostične vrste sintaksonov)								
SCF *Eriophorum angustifolium*	E1	5	.	.	.	.	.	1
SCF *Carex frigida*	E1	.	2	3	1	2	+	3
CD *Carex bicolor*	E1	+	1	+	1	1	+	1
SCF *Allium schoenoprasum* subsp. *alpinum*	E1	+	.	3	1	1	1	+
CD *Pinguicula alpina*	E1	.	.	.	+	+	.	.
CD *Juncus alpinoarticulatus*	E1	.	.	.	+	.	.	.
CD *Carex flava* s.str. (incl. *C. flavella)*	E1	+	.	+	+	+	1	1
CF *Carex ferruginea*	E1	.	1	+	.	.	.	.
Cfir *Carex firma*	E1	.	.	.	.	.	.	.
SCF *Eriophorum scheuchzeri*	E1	.	.	.	.	.	.	.
AC *Salix retusa*	E1	.	.	.	+	1	1	.
AC *Salix serpillifolia*	E1	.	1	.	+	.	.	.
CD ***Caricetalia davallianae***								
CD *Carex capillaris*	E1	.	1	2	2	2	3	+
CD *Parnassia palustris*	E1	.	+	1	+	1	.	1
CD *Campylium stellatum*	E0	.	.	.	.	+	.	+
ML *Oncophorus virens*	E0	.	.	.	.	.	.	.
CD *Tofieldia calyculata*	E1	.	.	.	.	.	.	.
SCF ***Scheuchzerio-Caricetea fuscae***								
SCF *Brachythecium mildeanum*	E0	.	.	.	.	.	.	.
SCF *Calliergonella lindbergii*	E0	.	.	.	.	.	.	+
SCF *Meesia uliginosa*	E0	.	.	.	.	.	.	+
SCF *Juncus filiformis*	E1	.	.	.	.	.	.	.
SCF *Taraxacum* sect. *Palustria*	E1	.	.	.	.	.	.	.
MC ***Montio-Cardaminetea***								
Palustriella commutata	E0	+	+	1	1	1	+	1
Ptychostomum pseudotriquetrum (Bryum pseudotriquetrum)	E0	+	+	.	.	1	+	.
Epilobium alsinifolium	E1	+	.	+	.	.	.	.

8	9	10	11	12	13	14	15	16	17	18	19		
282180	282198	282192	282194	282193	282188	282197	286808	286804	286807	286805	286806		
1985	1985	1985	1985	1985	1985	1985	2005	2005	2005	2005	2005		
0	0	0	0	0	0	0	0	0	0	0	0		
0-5	0	0	0	0	0	0	0	0	0	0	0		
A	A	A	A	A	A	A	A	A	A	A	A		
Li	Li	Li	Li	Gl	Gl	Gl	Gl	Gl	Gl	Gl	Gl		
70	70	60	60	20	20	20	5	5	10	5	30		
40	50	50	50	80	80	80	90	90	90	80	70		
40	40	20	10	60	10	60	20	30	10	20	10		
57	34	24	35	17	17	11	31	18	27	15	18		
10	10	5	5	5	10	10	15	15	15	15	15		
8/10/2020	8/10/2020	8/10/2020	8/10/2020	8/10/2020	8/10/2020	8/10/2020	9/3/2021	9/3/2021	9/3/2021	9/3/2021	9/3/2021		
Zeleno jezero	Zeleno jezero	Zeleno jezero	Zeleno jezero	Zeleno jezero	Zeleno jezero	Zeleno jezero	Prehodavci-vzhod	Prehodavci-vzhod	Prehodavci-vzhod	Prehodavci-vzhod	Prehodavci-vzhod		
9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2	9648/2		
407632	407594	407582	407586	407567	407574	407610	407750	407747	407758	407756	407752		
5134882	5134823	5134850	5134843	5134843	5134889	5134785	5135669	5135675	5135673	5135678	5135674		
												Pr.	Fr.
.	.	.	.	.	+	.	.	.	.	.	.	3	16
2	1	3	3	.	r	.	.	.	.	.	.	11	58
1	+	1	+	3	1	1	1	1	1	1	2	19	100
1	2	1	3	1	1	1	1	4	3	2	3	18	95
+	1	.	+	.	.	.	1	.	1	.	+	8	42
3	2	1	2	+	2	5	.	.	.	.	.	8	42
+	2	.	+	3	4	1	.	.	.	.	.	12	63
1	2	.	.	.	.	.	2	4	2	1	2	9	47
+	.	.	.	.	.	.	3	.	2	1	1	5	26
.	.	.	.	.	.	.	.	3	3	2	.	3	16
2	1	.	.	.	.	.	2	2	3	1	2	10	53
.	+	+	+	.	.	.	2	.	1	4	3	9	47
1	1	1	2	+	.	.	+	.	1	3	1	15	79
+	.	1	1	2	1	.	.	+	.	.	.	11	58
+	.	.	+	+	.	.	+	+	+	+	+	10	53
.	.	.	.	.	.	.	1	.	+	.	.	2	11
.	.	.	.	.	.	.	+	.	+	.	.	2	11
.	.	.	.	.	.	.	+	+	+	.	.	3	16
.	.	.	.	.	.	.	.	.	.	.	.	1	5
.	.	.	.	.	.	.	.	.	.	.	.	1	5
.	.	.	.	.	.	2	.	.	.	.	.	1	5
.	.	.	.	.	.	+	.	.	.	.	.	1	5
2	3	2	1	3	1	4	.	.	.	2	1	16	84
1	.	1	1	3	.	1	+	2	1	.	1	13	68
+	1	1	+	+	.	.	.	+	.	.	.	8	42

	Successive number of relevé (Zaporedna številka popisa)		1	2	3	4	5	6	7
	Marchantia quadrata (Preissia quadrata)	E0	.	.	+	+	+	.	+
	Cratoneuron filicinum	E0	+	.	.	.	.	.	+
	Saxifraga aizoides	E1	.	.	.	.	.	1	.
	Apopellia endiviifolia (Pellia endiviifolia)	E0	.	.	.	.	.	.	+
	Philonotis tomentella	E0	.	.	.	.	.	.	.
	Flexitrichum flexicaule (Ditrichum flexicaule)	E0	.	.	.	.	.	.	.
	Palustriella decipiens	E0	+	.	.	.	.	.	.
	Sarmentypnum exannulatum (Warnstorfia exannulata)	E0	+	.	.	.	.	.	.
	Dichodontium pellucidum	E0	.	.	.	.	.	.	+
AC	***Arabidetalia caeruleae* (incl. *Salicetea herbaceae*)**								
	Soldanella alpina	E1	.	.	1	+	+	.	.
	Ranunculus traunfellneri	E1	.	+	.	.	.	.	.
	Taraxacum sect. *Alpina*	E1	.	.	.	.	.	.	+
	Veronica alpina	E1	.	.	.	.	.	.	.
	Carex parviflora	E1	.	.	.	.	.	.	.
	Alchemilla fissa	E1	.	.	.	.	.	.	.
	Rumex nivalis	E1	.	.	+	.	.	.	.
	Soldanella minima	E1	.	.	.	+	+	.	.
	Trifolium pallescens	E1	.	.	.	+	+	.	.
	Soldanella pusilla	E1	.	.	.	.	.	.	.
	Galium noricum	E1	.	.	.	.	.	.	.
TR	***Thlaspietea rotundifolii***								
	Festuca nitida	E1	.	.	.	.	+	.	.
	Armeria alpina	E1	.	.	.	.	.	.	.
	Achillea atrata	E1	.	.	.	.	.	.	.
	Dryopteris villarii	E1	.	.	.	.	.	.	.
	Arabis alpina	E1	.	.	.	.	.	.	.
Cy	***Cystopteridion***								
	Jungermannia atrovirens	E0	.	.	.	.	.	.	+
	Viola biflora	E1	.	.	.	.	.	.	.
	Cystopteris regia	E1	.	.	.	.	.	.	.
	Cyrtomnium hymenophylloides	E0	.	.	.	.	.	.	.
	Fissidens dubius	E0	.	.	.	.	.	.	.
PC	***Potentilletalia caulescentis***								
	Paederota lutea	E1	.	+	.	.	.	.	.
	Campanula cochleariifolia	E1	.	.	.	.	.	.	+
	Saxifraga paniculata	E1	.	.	.	.	.	.	.
	Valeriana elongata	E1	.	.	.	.	.	.	.
CF	***Caricion ferugineae***								
	Gentiana pumila	E1	.	.	.	.	.	.	.
Cfir	***Caricion firmae***								
	Silene acaulis	E1	.	+	.	+	+	1	.
	Phyteuma sieberi	E1	.	+	.	.	.	+	.
	Salix alpina	E1	.	.	.	.	.	1	.
SV	***Seslerietalia coeruleae***								
	Gentiana clusii	E1	.	.	.	.	.	.	.
	Achillea clavenae	E1	.	.	.	.	.	.	.
	Juncus monanthos	E1	.	.	.	.	.	.	.
	Erigeron glabratus	E1	.	.	.	.	.	.	.
ES	***Elyno-Seslerietea***								
	Polygonum viviparum	E1	.	.	.	1	1	1	.
	Agrostis alpina	E1	.	.	1	+	+	.	.
	Aster bellidiastrum	E1	.	+	.	.	.	.	.
	Sesleria caerulea	E1	.	.	.	+	+	+	.
	Selaginella selaginoides	E1	.	.	.	+	+	.	.
	Bartsia alpina	E1	.	.	.	.	+	.	.
	Astrantia bavarica	E1	.	.	.	.	.	.	.
	Myosotis alpestris	E1	.	.	.	.	.	.	.
NS	***Nardion strictae***								
	Euphrasia minima	E1	.	.	.	.	.	.	.
	Coeloglossum viride	E1	.	.	.	.	.	.	.
	Festuca nigrescens	E1	.	.	.	.	.	.	.

8	9	10	11	12	13	14	15	16	17	18	19	Pr.	Fr.
1	.	+	+	.	.	.	.	.	.	.	.	7	37
1	.	+	.	.	.	.	.	.	.	.	.	4	21
+	+	.	.	.	.	.	+	.	.	.	.	4	21
+	.	.	+	.	+	.	.	.	.	.	.	4	21
.	.	.	.	.	.	.	2	2	1	.	.	3	16
+	.	.	+	.	.	.	.	.	.	.	.	2	11
.	.	.	.	.	.	.	.	.	.	.	.	1	5
.	.	.	.	.	.	.	.	.	.	.	.	1	5
.	.	.	.	.	.	.	.	.	.	.	.	1	5
r	.	.	1	.	.	.	.	.	.	.	.	5	26
.	.	.	.	+	.	.	+	.	.	+	.	4	21
+	.	.	.	.	.	+	.	.	.	.	+	4	21
+	.	+	+	+	.	.	.	.	.	.	.	4	21
+	.	.	+	r	.	.	.	.	.	+	.	4	21
.	.	.	.	r	+	.	.	+	1	.	.	4	21
.	.	.	+	.	.	.	1	.	.	.	.	3	16
+	.	.	.	.	.	.	.	.	.	.	.	3	16
.	.	.	.	.	.	.	.	.	.	.	.	2	11
.	.	.	.	.	.	.	+	.	+	.	.	2	11
.	.	.	.	.	.	.	.	.	.	.	+	1	5
+	+	.	1	.	.	.	.	.	.	.	.	4	21
.	.	.	.	.	.	.	1	.	+	.	.	2	11
+	.	.	.	.	.	.	.	.	.	.	.	1	5
r	.	.	.	.	.	.	.	.	.	.	.	1	5
.	.	.	.	.	.	.	.	.	.	.	+	1	5
1	.	.	+	.	.	.	.	.	.	.	.	3	16
.	+	.	+	.	.	.	.	.	.	.	.	2	11
+	.	.	.	.	.	.	.	.	.	.	.	1	5
+	.	.	.	.	.	.	.	.	.	.	.	1	5
.	.	.	+	.	.	.	.	.	.	.	.	1	5
+	+	+	.	.	.	.	.	.	.	.	.	4	21
+	+	+	.	.	.	.	.	.	.	.	.	4	21
.	+	.	.	.	.	.	.	.	.	.	.	1	5
.	+	.	.	.	.	.	.	.	.	.	.	1	5
.	.	.	.	.	.	.	+	1	1	.	.	3	16
1	+	+	.	.	.	.	+	.	.	.	.	8	42
1	1	.	.	.	.	.	.	.	.	.	.	4	21
.	.	.	.	.	.	.	.	.	.	.	.	1	5
+	+	.	.	.	.	.	.	.	.	.	.	2	11
+	+	.	.	.	.	.	.	.	.	.	.	2	11
+	.	.	.	.	.	.	+	.	.	.	.	2	11
r	.	.	.	.	.	.	.	.	.	.	.	1	5
+	+	.	.	.	.	.	1	1	1	+	2	10	53
+	.	.	.	+	.	.	.	.	.	.	.	5	26
+	.	.	.	.	.	.	+	.	.	.	+	4	21
.	1	.	.	.	.	.	.	.	.	.	.	4	21
.	.	.	.	.	.	.	+	.	.	.	.	3	16
.	.	.	.	.	.	.	.	.	.	.	.	1	5
.	+	.	.	.	.	.	.	.	.	.	.	1	5
.	.	.	.	.	.	.	+	.	.	.	.	1	5
r	+	.	.	.	.	.	.	.	.	.	.	2	11
.	+	.	.	.	.	.	+	.	.	.	.	2	11
.	.	.	.	.	.	.	.	.	+	.	.	1	5

	Successive number of relevé (Zaporedna številka popisa)		1	2	3	4	5	6	7
JT	***Juncetea trifidi***								
	Campanula scheuchzeri	E1	.	.	.	+	+	.	1
	Scorzoneroides helvetica	E1	.	+	.	.	.	.	.
	Carex fuliginosa	E1	.	.	.	.	.	+	.
	Luzula spicata	E1	.	.	.	.	.	.	.
PaT	***Poo alpinae-Trisetetalia***								
	Poa alpina	E1	.	.	.	.	.	.	.
	Veronica serpyllifolia subsp. *humifusa*	E1	+	.	.	.	.	.	.
	Crepis aurea	E1	.	.	.	.	.	.	.
	Trifolium badium	E1	.	.	.	.	.	.	.
MA	***Molinio-Arrhenatheretea***								
	Agrostis stolonifera	E1	+	.	.	+	+	.	.
	Leontodon hispidus	E1	.	.	+	.	.	.	.
	Deschampsia cespitosa	E1	.	.	.	.	.	.	+
MuA	***Mulgedio-Aconitetea***								
	Veratrum album subsp. *lobelianum*	E1	+	.	.	.	.	.	+
	Rumex alpinus	E1	.	.	.	.	.	.	.
BA	***Betulo-Alnetea***								
	Salix waldsteiniana	E2a	.	.	.	.	.	.	.
LU	***Littorelletea uniflorae***								
	Rorippa islandica	E1	.	.	.	.	.	.	.
ML	**Mosses (Mahovi)**								
	Tortella tortuosa	E0	.	2	.	.	.	1	1
	Scorpidium cossonii (Drepanocladus cossonii)	E0	+	.	.	.	.	.	.
	Tortella densa	E0	.	.	1	1	.	.	1
	Plagiomnium rostratum	E0	.	.	.	.	.	.	+
	Lophozia sp.	E0	.	.	.	.	.	.	+
	Amblystegium serpens	E0	.	.	.	.	.	.	.
	Hygrohypnum luridum	E0	.	.	.	.	.	.	.
	Distichium inclinatum	E0	.	.	.	.	.	.	+
	Plagiochila porelloides	E0	.	.	.	.	.	.	.
	Didymodon sp.	E0	.	.	.	.	.	.	.
	Ctenidium molluscum	E0	.	.	.	.	.	.	.
	Timmia norvegica	E0	.	.	.	.	.	.	.
	Riccardia palmata	E0	.	.	.	.	.	.	.
	Sanionia uncinata	E0	.	.	.	.	.	.	.
	Tayloria froelichiana	E0	.	.	.	.	.	.	.
	Neoorthocaulis attenuatus (Barbilophozia attenuata)	E0	.	.	.	.	.	.	.

Legend-Legenda

1 *Carici bicoloris-Eriophoretum angustifolii* nom. prov.
2-7 *Caricetum bicolori-frigidae*
8-11 *Caricetum bicolori-frigidae* var. *Juncus alpinoarticulatus*
12-14 *Carici bicoloris-Juncetum alpinoarticulati* nom. prov.
15 *Saxifrago aizoidis-Caricetum ferugineae*
16-18 *Salici retusae-Eriophoretum scheuchzeri* nom. prov.
19 *Homogyno discoloris-Salicetum retusae*
A Limestone - apnenec
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 %

8	9	10	11	12	13	14	15	16	17	18	19	Pr.	Fr.
1	.	+	1	.	.	.	.	.	.	.	.	6	32
+	.	.	+	.	.	.	.	.	+	.	.	4	21
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.	.	.	.	.	.	.	+	.	.	.	.	1	5
2	1	1	2	2	1	1	+	+	+	.	+	11	58
.	.	.	.	.	+	1	.	.	.	.	.	3	16
.	.	.	.	.	+	.	.	.	.	.	.	1	5
.	.	.	.	.	.	.	.	+	.	.	.	1	5
2	1	1	.	.	+	.	.	.	.	.	.	7	37
+	.	.	.	.	.	.	.	.	.	.	.	2	11
.	.	.	.	.	1	.	.	.	.	.	.	2	11
+	+	.	.	.	+	.	.	.	+	.	.	6	32
+	.	.	.	.	.	.	.	.	.	.	.	1	5
+	+	2	.	.	.	.	+	1	+	+	.	7	37
r	.	.	.	.	.	.	.	.	.	.	.	1	5
+	1	1	+	.	.	.	.	.	.	.	.	7	37
+	.	.	+	.	1	.	.	+	.	1	.	6	32
.	.	.	.	.	.	.	.	.	.	.	.	3	16
1	.	.	+	.	.	.	.	.	.	.	.	3	16
.	.	+	+	.	.	.	.	.	.	.	.	3	16
+	.	.	+	1	.	.	.	.	.	.	.	3	16
.	+	+	.	.	.	.	.	.	.	.	.	2	11
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.	.	.	.	.	.	.	.	.	+	.	.	1	5
.	.	.	.	.	.	.	.	.	.	.	+	1	5