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Phytosociology and ecology of *Carex mucronata* on the Mt. Snežnik (SW Slovenia, Liburnian Karst)

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Summary: The phytosociology and ecology of *Carex mucronata* stands on the Snežnik plateau are discussed. Results are based on numerical analyses and a comprehensive synoptic table indicating an unique syntaxonomical position of Dinaric stands in comparison to Alpine ones. The differentiation of syntaxa is due to a significant number of Illyrian species in stands from the Liburnian Karst. The outcome of this is the description of a new association *Scabioso silenifoliae-Caricetum mucronatae*. The association is subdivided into two floristically and ecologically distinct sub-associations: *S. s.-C. m. edraianthetosum graminifolii*, restricted to the summit of Mt. Snežnik, and *S. s.-C. m. rhododendretosum hirsuti* on lower altitudes. The association is assigned to the Dinaric alliance *Seslerion juncifoliae* and it is restricted to the north-western part of the Liburnian Karst (Mts. Snežnik – SW Slovenia, Snježnik and Risnjak – NW Croatia).

Keywords: flora, vegetation, *Caricetum mucronatae*, *Seslerion juncifoliae, Elyno-Seslerietea*, phytogeography, Dinarides, Mt. Snežnik

The flora and vegetation of Mt. Snežnik (1796m, SW Slovenia, Liburnian Karst) is comparatively well known. From the very start, botanists were attracted by the phytogeographical peculiarities of the mountain's flora, because it is compared of a felicitous mixture of Alpine and Dinaric/ Illyrian species, as already pointed out by GINZBERGER (1909) and lately by WRABER (1971). Botanical research of Mt. Snežnik started early in the 19th century. H. Freyer was the first botanist to climb the mountain, in 1827, and his interesting floristical findings (e.g. *Edraianthus graminifolius, Ranunculus traunfellneri, Crepis kerneri* [sub *Geracium chondrilloides*], *Scabiosa silenifolia, Arabis scopoliana* [sub *Draba ciliata*], *Athamantha cretensis*…) have initiated more intensive botanical research (WRABER 2003). Several scientific papers have been published and many surveys have been provided (GINZBERGER 1909, WRABER 1997, 2000a). Nevertheless, new important novelties in the flora and vegetation are constantly reported (ZUPANČIČ & ACCETTO 1994; WRABER 1995; MARINČEK & ŠILC 1997; WRABER 2000b; ZUPANČIČ et al. 2004; WRABER 2004; SURINA & VREŠ 2004; SURINA 2004a).

The Snežnik plateau is a high-karst region in the north-westernmost part of the Liburnian Karst (sensu BECK 1901: 287), SW Slovenia (Fig. 1). The highest mountain of the plateau is Snežnik (1796m a.s.l.), which creates a distinct, orographic barrier between the northern and southern part of the plateau. In the period of 1960–1990, the southern part of the plateau, which is higher on average and has a more diversified relief, received considerably more rainfall (2738mm – Gomance, 937m a.s.l.) (ZUPANČIČ 1995: 59) than the northern part (2166mm – Leskova dolina, 806m a.s.l., 3142mm – Gomance, the period between 1928 and 1937) (MANOHIN 1957: 19–20). The entire region is one of the wettest in Slovenia. The Gomance rainfall regime, with peaks between November and January and lows in July and August, is obviously influenced by the Mediterranean Sea. Because of the higher altitude, karst relief, windiness and abundant rainfall, this climate is relatively cold. The mean annual temperature for Gomance between 1960 and 1990 was 6.7°C (MEKINDA-MAJARON 1995: 44).

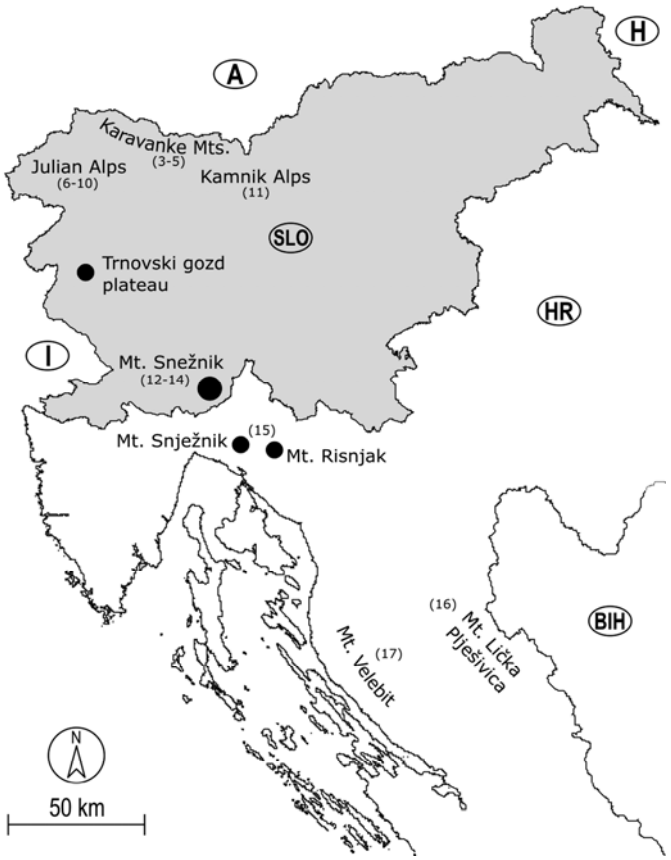

Figure 1: Research area. Numbers correspond to those in Fig. 2.

The geological bedrock consists of Jurassic and Cretaceous limestones, dolomitized limestones and their breccias (PLENIČAR 1956: 17; PAVLOVEC & PLENIČAR 2000). At the time of the last glacial period, the majority of the studied area was located above the perpetual snow line (ŠIFRER 1959: 31), and some of its regions were covered with ice, evidently in the moraine material at the bottom of the funnel-shaped sinkholes (ibid.: 29).

In general, the flora and vegetation of the Snežnik plateau could be considered to be Illyrian. Most of its altimontane vegetation belt is covered by climazonal Dinaric fir-beech forest (*Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora*). Altitudes between 1200–1400m a.s.l. are covered by subalpine beech stands with Large White Buttercup (*Ranunculo platanifolii-Fagetum* var. geogr. *Calamintha grandiflora*). Beech stands with Northern Holly Fern (*Polysticho lonchitis-Fagetum* var. geogr. *Allium victorialis*) and stands of Dinaric Mountain Pine association *Hyperico grisebachii-Pinetum mugo* var. geogr. *Rhododendron hirsuti* form the forest limit, as well as thriving on ridges exposed to strong winds. Due to the considerable number of Illyricoid species (sensu TRINAJSTIĆ 1997), beech and fir-beech woods are assigned to the Illyrian alliance *Aremonio-Fagion*. Spruce forest occurs only azonally and larger spruce stands thrive only on colder sites (shady slopes) or in hollows with a more (*Lonicero caeruleae-Piceetum* – closed, deeper freezing ravines in the altimontane and subalpine belt) or less (*Hacquetio-Piceetum* – larger and more open sinkholes in the montane belt) pronounced cold ravine character, where they represent the vegetational paraclimax.

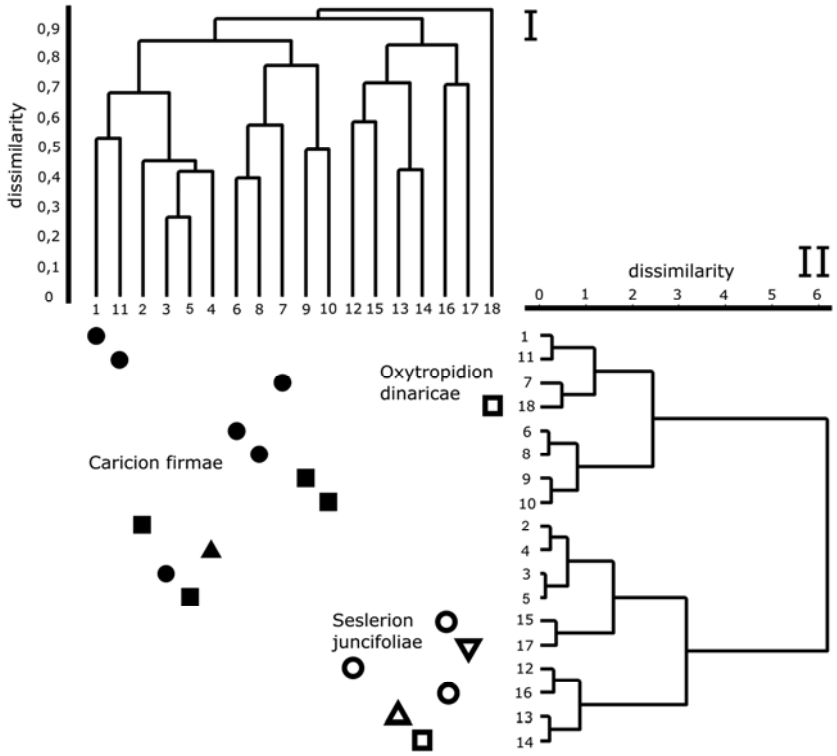

Figure 2: Dendrogram of syntaxa from the alliances *Caricion firmae* and *Seslerion juncifoliae* from the South-eastern Calcareous Alps (1–11) and Dinarides. (12–18); I – Complete Linkage, II – Minimal Sum of Squares in New Clusters. 1: *Gentiano-Caricetum firmae minuartietosum* (14 rel.), 2: *Gentiano-Caricetum firmae dryadetosum* (12 rel.) [Carnic Alps-Italy] (POLDINI & FEOLI 1976), 3: *Gentiano-Caricetum firmae* (10 rel.), 4: *Gentiano-Caricetum firmae caricetosum mucronatae* (8 rel.), 5: *Gentiano-Caricetum firmae dryadetosum* (5 rel.) [Karavanke Mts.-Slovenia] (AICHINGER 1933), 6: *Gentiano-Caricetum firmae* (6 rel.), 7: *Gentiano-Caricetum firmae potentilletosum nitidae* (5 rel.), 8: *Gentiano-Caricetum firmae drepanocladetosum uncinati* (7 rel.), 9: *Gentiano-Caricetum firmae dryadetosum* (10 rel.), 10: *Dryadetum octopetalae* (6 rel.) [Krn Mts., Julian Alps-Slovenia] (SURINA 2004b), 11: *Gentiano-Caricetum firmae* (26 rel.) [Kamnik Alps-Slovenia] (HADERLAPP 1982), 12: *Edraiantho-Caricetum firmae* (17 rel.) (WRABER 1967), 13. *Scabioso-Caricetum mucronatae* ass. nova (20 rel.), 14: *Scabioso-Dryadetum* (6 rel.) [Mt. Snežnik-Slovenia] (SURINA 2004a), 15: *Edraiantho-Caricetum firmae* (7 rel.) [Mts. Snježnik & Risnjak-Croatia], 16: *Edraiantho-Caricetum firmae potentilletosum clusianae* (13 rel.) [Mt. Lička Plješivica-Croatia], 17: *Helianthemo-Caricetum kitaibelianae* (6 rel.) [Mt. Velebit-Croatia] (HORVAT 1930), 18: *Edraiantho serpyllifolii-Dryadetum octopetalae* (10) [Mt. Kučki Kom & Mt. Vasojevički Kom-Montenegro] (LAKUŠIĆ 1968).

Dinaric calcareous open sedge swards (*Edraiantho graminifolii-Caricetum firmae*), tussock grasslands on wind-exposed habitats (*Scabioso silenifoliae-Dryadetum octopetalae, Helianthemo alpestris-Caricetum kitaibelianae* and *Caricetum mucronatae* s. lat.) as well as terraced subalpine grasslands on steep slopes (*Festucetum pungentis, Festucion pungentis, Seslerietalia juncifoliae*) and calcareous sedge swards on wet slopes in the Liburnian Karst (*Hyperico grisebachii-Caricetum ferrugineae, Caricion ferrugineae*) are found on the summit and extrazonally: on lower altitudes with extreme or specific ecological conditions (moist, cold and shaded sites or sites exposed to strong bora). Recent numerical analyses and comprehensive synoptic tables have proven that these stands, with predominating *Carex firma, C. mucronata, C. kitaibeliana* and *Dryas octopetala,* belong to the Dinaric alliance *Seslerion juncifoliae* (*Seslerietalia juncifoliae, Elyno-Seslerietea*), and they are in the north-westernmost area of distribution of the alliance (see SURINA 2004a; SURINA & DAKSKOBLER 2005).

Stands with predominating *Carex mucronata* were phytosociologically studied in detail by the second author in the 1990s, and more recently by the first author. On the basis of unpublished relevés, WRABER (1997: 414) proposed a new association *Edraiantho graminifolii-Caricetum mucronatae* prov. The results of the phytosociological studies have not been published until now. The aim of the paper is thus to present the phytosociological characteristics of *Carex mucronata* stands on the Snežnik plateau.

Methods

We studied stands with predominating *Carex mucronata*, applying the sigmatistic, phytosociological method (BRAUN-BLANQUET 1964). An analytical phytosociological table and also a comparison between similar syntaxa were made with the help of the computer programme SYN-TAX, using the method of hierarchical classification (PODANI 1993). The measure of dissimilarity was the complement of the coefficient »similarity ratio« (MISSQ, PCoA). The two indices were calculated for each taxon, after a linear transformation of coverage values had been performed for individual taxa (van der MAAREL 1979): (a) coverage index (I_c) according to LAUSI and co-workers (LAUSI et al. 1982), and (b) share of coverage ($D_{\%}$) according to SURINA (2004c). The nomenclature of ferns and flowering plants follows Mala flora Slovenije (MARTINČIČ et al. 1999). Complete names of syntaxa are listed in an appendix.

Results & discussion

An extensive synoptic table (available from the first author) and numerical analysis (Fig. 2) clearly indicate an unique syntaxonomical position of *Carex mucronata* stands from the Snežnik plateau within the class *Elyno-Seslerietea* and alliance *Seslerion juncifoliae* (see SURINA & DAKSKOBLER 2005) in the south-eastern Calcareous Alps and north-west Dinarides. Respective stands are well differentiated from the associations *Gentiano terglouensis-Caricetum firmae, Dryadetum octopetalae* s. lat. (*Caricion firmae*), as well as *Edraiantho-Caricetum firmae*, *Helianthemo-Caricetum kitaibelianae* and *Scabioso-Dryadetum* (*Seslerion juncifoliae*). We therefore assign these stands to a new association: *Scabioso silenifoliae-Caricetum mucronatae* ass. nova.

Scabioso silenifoliae-Caricetum mucronatae ass. nova

Floristical composition of the association

The most frequent species with the highest share of coverage ($D_{\%}$) in stands were: *Carex mucronata*$^{+\text{-}4}$ (16.3%), *Helianthemum alpestre*$^{+\text{-}1}$ (4.6%), *Leontopodium alpinum*$^{+\text{-}1}$ (4.7%), *Achillea clavenae*$^{+\text{-}2}$ (4.0%), *Scabiosa silenifolia*$^{+\text{-}2}$ (5.4%), *Edraianthus graminifolius*$^{+\text{-}2}$ (3.5%) and *Campanula cochleariifolia*$^{+\text{-}1}$ (2.9%) (Tab. 1).

A comparatively high share of coverage was also achieved by *Dryas octopetala*$^{+\text{-}3}$ (3.1%), *Crepis kerneri*$^{+\text{-}2}$ (2.9%), *Koeleria eriostachya*$^{+\text{-}1}$ (2.6%), *Gentiana clustii*$^{+\text{-}1}$ (2.6%), *Carex firma*$^{+\text{-}1}$ (2.4%), *Agrostis alpina*$^{+\text{-}1}$ (12.4%), *Rhododendron hirsutum*$^{+\text{-}1}$ (2.2%), *Trisetum argenteum*$^{+\text{-}1}$ (2.2%) and *Arabis scopoliana*$^{+\text{-}1}$ (2.2%).

The characteristic and differential species of the association are *Carex mucronata* and *Scabiosa silenifolia*. *C. mucronata* belongs to the SE-European-Caucasian geoelement (AESCHIMANN et al. 2004: 822) and exhibits fairly wide altitudinal and syntaxonomical amplitude. It frequently

occurs in syntaxa of classes *Festuco-Brometea, Asplenietea trichomanis* and *Elyno-Seslerietea*. In the submediterranean part of Slovenia (M. WRABER 1969) it thrives commonly at higher altitudes in rocky and wind-exposed grassland syntaxa of the alliance *Satureion subspicatae* (*Scorzoneretalia villosae, Festuco-Brometea*), e.g. in stands of *Carici humilis-Centaureetum rupestris* (*-globularietosum cordifoliae* and *-seslerietosum juncifoliae*) (KALIGARIČ 1997: 58), *Genisto sericeae-Seslerietum juncifoliae* (pers. observ.), and *Genisto holopetalae-Caricetum mucronatae* (see POLDINI 1989). In the Dinaric and Alpine region it is commonly observed in rock crevices (*Asplenietea trichomanis*): stands of *Potentilletum caulescentis* s. lat. (WRABER 2004: 7–8), as well as wind-exposed Alpine grasslands (*Elyno-Seslerietea*) of the alliances *Caricion firmae*: *Primulo carniolicae-Caricetum mucronatae* prov. (Dinarides-Trnovski gozd plateau; Dakskobler unpublished data), *Caricetum mucronatae* s. lat. and *Caricetum firmae* s. lat. (Alps), as well as *Seslerion juncifoliae* (Dinarides-Snežnik plateau): studied stands and within stands of *Scabioso-Dryadetum* and *Edraiantho-Caricetum firmae*. In the research area, the species achieved the highest constancy and coverage values in stands of *Scabioso-Caricetum mucronatae,* dominating and forming homogenous tussock grasslands of an area up to 100m^2.

Scabiosa silenifolia is a typical representative of the Illyrian geoelement with a disjunction in the Apennines (Abruzzi Mts.). It spreads from Mt. Snežnik at the north-westernmost extent of its distribution area to the mountains of Albania (Prokletije Mts.) in the southeast (HORVAT 1952: 204; WRABER 1990: 144 etc.). In Slovenia, it is found in the Dinaric phytogeographical region (PRAPROTNIK 1987: 120; ACCETTO 1995: 311; WRABER in MARTINČIČ et al. 1999: 432). It thrives well in stands of *Edraiantho-Caricetum firmae, Scabioso-Dryadetum*, *Helianthemo-Caricetum kitaibelianae*, *Scabioso-Caricetum mucronatae* and within phytocoenosis with *Scabiosa silenifolia*. The phytosociology, chorology and ecology of *S. silenifolia* were discussed in SURINA (2004a).

Carex mucronata and *Scabiosa silenifolia* frequently occur in different syntaxa within the studied area, but achieve the highest constancy in stands of *Scabioso-Caricetum mucronatae*. Due to their high presence and domination in stands, as well as the very specific ecological condition of their habitat, we think that they are good characteristic and differential species of the association.

Species of the class *Elyno-Seslerieta* were the most frequent (25 species) and achieved the highest coverage index (I_c= 4955.6; $D_{\%}$=53.4%) (Tab. 2). There were eight species from the class *Thlaspietea rotundifolii* (I_c= 1111.1; $D_{\%}$=12.0%) and the most frequent were *Campanula cochleariifolia, Crepis kerneri, Trisetum argenteum* (already mentioned) and *Athamantha cretensis*$^{+-1}$. From the syntaxonomical point of view, species of the alliance *Seslerion juncifoliae* s. lat. were of great importance and achieved the second highest coverage index (I_c= 1166.7; $D_{\%}$=12.6%): *Scabiosa silenifolia, Edraianthus graminifolius, Arabis scopoliana, Thymus balcanus*$^{+-1}$, *Gentianella liburnica*$^{+}$ and *Trinia glauca* subsp. *carniolica*$^{+}$. We noted eight species from the class *Erico-Pinetea* (I_c= 666.7; $D_{\%}$=7.2%) of which the most frequent were *Calamagrostis varia*$^{+-1}$, *Pinus mugo*$^{+-1}$ and *Erica carnea*$^{+-1}$, and ten from the group "Other species" (I_c=277.8; $D_{\%}$=3.0%) (Tabs. 1 & 2). The complete inventory of species and their coverage indices in the association are shown in Tables 1 & 2.

Table 1: Analytical table of the association *Scabioso silenifoliae-Caricetum mucronatae* ass. nova.

	Successive No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
	Altitude (m)		1510	1410	1410	1410	1410	1345	1345	1675	1680	1680	1700	1720	1700	1520	1770	1690	1680	1700	1680	1690		
	Exposition		SSW	S	NNE	NNE	NNE	NNW	NNW	N	W	S	SE	WSW	.	E	W	SW	WSW	NE	E	E		
	Inclination (°)		85	5	45	50	80	45	80	5	5	3	.	3	.	40	20	5	10	40	50	90		
	Relevé area (m²)		4	2	10	20	8	2	6	6	16	5	6	2	20	8	10	15	12	4	20	10		
	Coverness (%)		30	80	60	40	50	80	80	70	60	60	10	80	50	50	60	50	60	50	50	10		
	Number of taxa		16	10	9	18	12	20	13	16	14	10	8	12	15	21	22	18	18	7	31	10	fr	R
	Characteristic species of the assocoation																							
ES	*Carex mucronata*	C	3.2	4.2	3.2	3.2	3.2	3.2	3.2	4.3	4.3	3.3	+.3	3.3	2.3	3.3	3.4	3.3	3.3	3.3	3.3	3.2	20	V
SJ	*Scabiosa silenifolia*	C	+.2	2.2	2.2	2.2	1.2	2.2	.	.	+.2	.	+.2	2.2	.	1.2	.	+.2	1.2	.	1.2	.	13	III
	Differential species of subassociations		*rhododendretosum hirsuti*											*edraianthetosum graminifolii*										
EP	*Rhododendron hirsutum*	C	.	+	+.2	+.2	1.2	+.2	+.2	.	.	.	.	.	.	+.2	.	.	.	.	1.2	.	8	III
ES	*Hieracium villosum*	C	+.2	+	+	+	+	+.2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	7	II
EP	*Juniperus sibirica*	C	.	.	+.2	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	II
SJ	*Edraianthus graminifolius*	C	.	.	.	.	.	.	.	1.2	2.2	1.2	+.2	.	+.2	.	1.2	1.2	1.2	.	1.2	+.2	10	III
ES	*Carex firma*	C	.	.	.	.	.	.	.	+.3	1.3	+.3	.	+.2	.	+.2	1.2	+.2	+.2	.	+.2	.	9	III
ES	*Agrostis alpina*	C	.	.	.	.	.	.	.	+.2	1.2	1.2	.	.	.	.	1.2	+.2	+.2	1.2	+.2	.	8	III
SJ	***Seslerion juncifoliae***																							
	Arabis scopoliana	C	.	.	.	.	.	.	.	.	+.2	.	.	+	1.2	.	1.2	1.3	+.2	.	.	1.2	7	II
	Thymus balcanus	C	+.2	+.2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1.2	.	4	I
	Gentianella liburnica	C	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Trinia glauca subsp. *carniolica*	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	I
CA	***Caricion austroalpinae***																							
	Koeleria eriostachya	C	.	.	.	.	.	1.2	.	+.2	+.2	+.2	.	+.2	1.2	.	1.2	.	1.2	.	.	+.2	9	III
	Ranunculus hybridus	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1.2	.	2	I
	Laserpitium peucedanoides	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+.2	.	2	I
	Linum alpinum subsp. *julicum*	C	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	2.2	.	2	I
	Leucanthemum adustum	C	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+.2	.	2	I
ES	***Elyno-Seslerieta***																							
	Helianthemum alpestre	C	.	+.2	1.2	1.2	+	.	.	1.2	+.2	.	+.3	+.2	+.2	+.2	1.2	1.2	1.2	1.2	1.2	.	15	IV
	Leontopodium alpinum	C	1.2	+.2	1.2	1.2	+.2	.	.	1.2	+.2	1.2	1.2	+.2	.	.	1.2	+.2	1.2	.	1.2	+.2	15	IV
	Achillea clavenae	C	.	+	+.2	+.2	+	+.2	.	+.2	.	.	.	2.2	1.2	1.2	1.2	+	1.2	.	.	+.2	13	IV
	Gentiana clusii	C	.	.	.	.	.	.	.	1.2	+	+.2	.	+	.	+.2	1.2	1.2	+.2	.	1.2	.	9	III
	Crepis kerneri	C	.	.	.	.	.	.	.	1.1	2.2	+	.	.	1.1	+	.	1.2	1.2	.	1.1	.	8	III
	Dryas octopetala	C	.	.	.	.	2.2	+.3	+.3	1.3	.	.	.	.	3.3	2.3	.	+.3	.	.	.	.	7	II
	Aster bellidiastrum	C	.	.	.	+.2	+	1.2	1.2	+.2	.	.	.	.	.	.	.	.	.	.	+.2	.	6	II
	Anthyllis vulneraria subsp. *alpestris*	C	.	.	.	.	.	.	.	+.2	+.2	+.2	.	.	.	.	.	+	+.2	1.2	.	.	.	6	II
	Androsace villosa	C	.	.	.	.	.	.	.	+.2	+.2	.	.	.	.	.	1.2	1.3	1.3	.	.	.	5	II
	Festuca quadriflora	C	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	1.2	+.2	.	4	I
	Phyteuma orbiculare	C	.	.	.	.	.	.	.	.	.	.	.	.	+.2	+.2	.	.	.	.	1.2	.	3	I
	Heliosperma alpestre	C	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	+.2	.	.	+.2	3	I
	Bartsia alpina	C	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+.2	.	2	I
	Erigeron glabratus	C	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+.2	.	.	2	I
	Galium anisophyllum	C	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+.2	.	.	.	.	.	2	I
	Globularia nudicaulis	C	.	.	.	.	.	.	.	+.2	+.2	.	.	.	.	.	.	.	.	.	.	.	2	I
	Ranunculus carinthiacus	C	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	2	I
	Thesium alpinum	C	.	.	.	.	.	.	.	.	.	.	.	+.2	.	+.2	.	.	.	.	.	.	2	I

	Successive No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	fr	R
ES	cont.																							
	Euphrasia salisburgensis	C	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	1	I
	Aster alpinus	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	1	I
	Carex rupestris	C	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	.	1	I
	Pulsatilla alpina	C	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
EP	***Erico-Pinetea***																							
	Calamagrostis varia	C	+	.	.	+.2	.	1.2	.	.	.	.	.	.	.	+.2	.	.	.	.	+.2	.	5	II
	Pinus mugo	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	1.2	1.2	.	+	.	4	I
	Erica carnea	C	.	.	.	.	.	+	.	.	.	.	.	.	1.2	.	.	.	.	+.2	.	3	I
	Arctostaphylos uva-ursi	C	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Cotoneaster integerrimus	C	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Rubus saxailis	C	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
FB	***Festuco-Brometea***																							
	Globularia cordifolia	C	.	.	.	.	.	2.2	.	.	.	+.2	.	.	.	1.2	1.2	.	.	.	1.2	.	5	II
	Prunella grandiflora	C	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	2	I
	Leontodon incanus	C	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	+.2	.	2	I
	Thesium linophyllon	C	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
MA	***Mulgedio-Aconitetea***																							
	Salix appendiculata	C	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	I
	Allium ochroleucum	C	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1.2	.	2	I
	Viola biflora	C	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	2	I
TR	***Thlaspietea rotundifolii***																							
	Campanula cochlearifolia	C	.	+.2	.	1.2	+	1.2	+.2	.	.	.	1.2	.	+.2	.	.	.	+.2	+.2	.	1.2	10	III
	Trisetum argenteum	C	+.2	.	+.2	+.2	.	.	.	.	.	.	1.2	.	.	.	+.2	+.2	.	+.2	.	1.2	8	III
	Athamanta cretensis	C	.	1.2	.	+.2	+	.	.	.	.	.	.	.	.	.	1.2	.	.	.	+.2	.	5	II
	Biscutella laevigata	C	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	+.2	1.2	1.2	.	.	.	4	I
	Campanula cespitosa	C	.	.	.	.	.	1.2	1.2	.	.	.	.	.	.	+.2	.	.	.	.	.	.	3	I
	Hieracium porrifolium	C	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	.	.	.	.	.	1	I
	Ranunculus traunfellneri	C	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
AT	***Asplenietea trichomanis***																							
	Campanula justiniana	C	1.2	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	2	I
	Asplenium ruta-muraria	C	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Asplenium viride	C	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Carex brachystachys	C	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Kernera saxatilis	C	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Rhamnus pumila	C	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Other species																							
	Hieracium sp.	C	.	.	.	.	.	.	.	.	.	.	+.2	+.2	+.2	.	.	.	.	.	.	.	3	I
	Antennaria dioica	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	1	I
	Cyclamen purpurascens	C	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Festuca altissima	C	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Gentiana utriculosa	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	I
	Gentianella ciliata	C	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	I
	Gymnadenia conopsea	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	I
	Hieracium bifidum	C	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I
	Hieracium bupleuroides	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.2	.	1	I
	Tofieldia calyculata	C	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	.	.	.	1	I

Table 2: Phytosociological groups in the association *Scabioso silenifoliae-Caricetum mucronatae* ass. nova.

	rhododendretosum			*edraianthetosum*			*Scabioso-Caricetum* s. lat.		
	No. sp.	I_c	D%	No. sp.	I_c	D%	No. sp.	I_c	D%
Elyno-Seslerietea s. lat.	11	1377.8	46.9	23.0	3577.8	56.7	25.0	4955.6	53.4
Seslerion juncifoliae s. lat.	3	366.7	12.4	5.0	800.0	12.7	6.0	1166.7	12.6
Thlaspietea rotundifolii s. lat.	5	366.7	12.3	7.0	744.4	11.8	8.0	1111.1	12.0
Erico-Pinetea s. lat.	7	400.0	13.4	4.0	266.7	4.2	8.0	666.7	7.2
Caricion austroalpinae	1	33.3	1.1	5.0	444.4	7.0	5.0	477.8	5.1
Festuco-Brometea s. lat.	3	100.0	3.3	3.0	188.9	3.0	4.0	288.9	3.1
Other species	3	66.7	2.1	7.0	211.1	3.3	10.0	277.8	3.0
Asplenietea trichomanis s. lat.	6	166.7	5.4	0.0	0.0	0.0	6.0	166.7	1.8
Mulgedio-Aconitetea s. lat.	2	88.9	3.0	2.0	77.8	1.2	3.0	166.7	1.8
Total	41	2966.7	100.0	56.0	344.4	100.0	75.0	9277.8	100.0
Coefficient of variation (%)	28.0			42.7			38.4		

Ecology and variability of the association

The association *Scabioso-Caricetum mucronatae* is growing under extreme ecological conditions. The habitats are wind-exposed and rocky with shallow substrates, and a very high variation in air and ground temperature, as well as humidity. Very low winter temperatures due to strong bora, the absence of snow cover, and high air temperatures during the summer days, cause desiccation stress of plants in the studied stands. Stands of *Carex mucronata* take on a brownish overall appearance, particularly at the end of the season. It is clear that *Carex mucronata* turfs exhibit extreme tolerance to desiccation and low temperature. Nevertheless, as already deduced from observation of alpine *Carex curvula* stands (KÖRNER 1999: 145), dead and often distorted leaf ends of *C. mucronata* probably do not signal water shortage (drought), but reflect the recovery of nutrients before winter whereas in graminoids it is associated with terminal leaf dieback. Inclination (as well as exposition) of stands is highly variable and ranges from 0–90°.

We observed quite clear differentiation in certain phytosociological (Fig. 3) and, in some aspects, also ecological parameters of stands (Fig. 4): stands at the summit (1520–1720m) differed in ecological conditions and thus floristical composition from those on the plateau (1345–1510m). Although exposed to strong winds and locally cooler sites, homogenous stands from the plateau were restricted to a smaller area (median 6m^2) in comparison to those at the summit (10m^2), but they exhibited somewhat higher coverage, steeper inclination and lower variability of number of species per relevé area (Tabs. 1 & 2).

Mathematical analysis proved the floristical, ecological and syntaxonomical differentiation of stands into two subassociations: *Scabioso-Caricetum rhododendretosum hirsuti* subass. nova and *S. s.-C. m. edraianthetosum graminifolii* subass. nova (Fig. 3). The subassociation – *S. s.-C. m. rhododendretosum* is restricted to lower altitudes and longer duration of snow cover, whereas *S. s.-C. m. edraianthetosum* is exposed to higher altitudes and a shorter duration of snow cover (Fig. 4). Differential species of the subassociation *S. s.-C. m. rhododendretosum* are *Rhododendron hirsutum, Hieracium villosum* and *Juniperus sibirica*, and for the subassociation –*edraianthetosum*, *Edraianthus graminifolius, Carex firma* and *Agrostis alpina*. The subassociation *S. s.-C. m. edraianthetosum* hosted considerably higher coverage indices and numbers of species (Tab. 2) from the class *Elyno-Seslerietea*, alliances *Seslerion juncifoliae* and *Caricion austroalpinae*. On the other hand, species from the class *Erico-Pinetea, Mulgedio-Aconitetea* and *Asplenietea trichomanis* achieved much higher coverage indices in the subassociation *S. s.-C. m. rhododendretosum,* since they usually thrived on wind-exposed and rocky flanks within altimontane (*Ranunculo-Fagetum*) and subalpine beech stands (*Polysticho-Fagetum*).

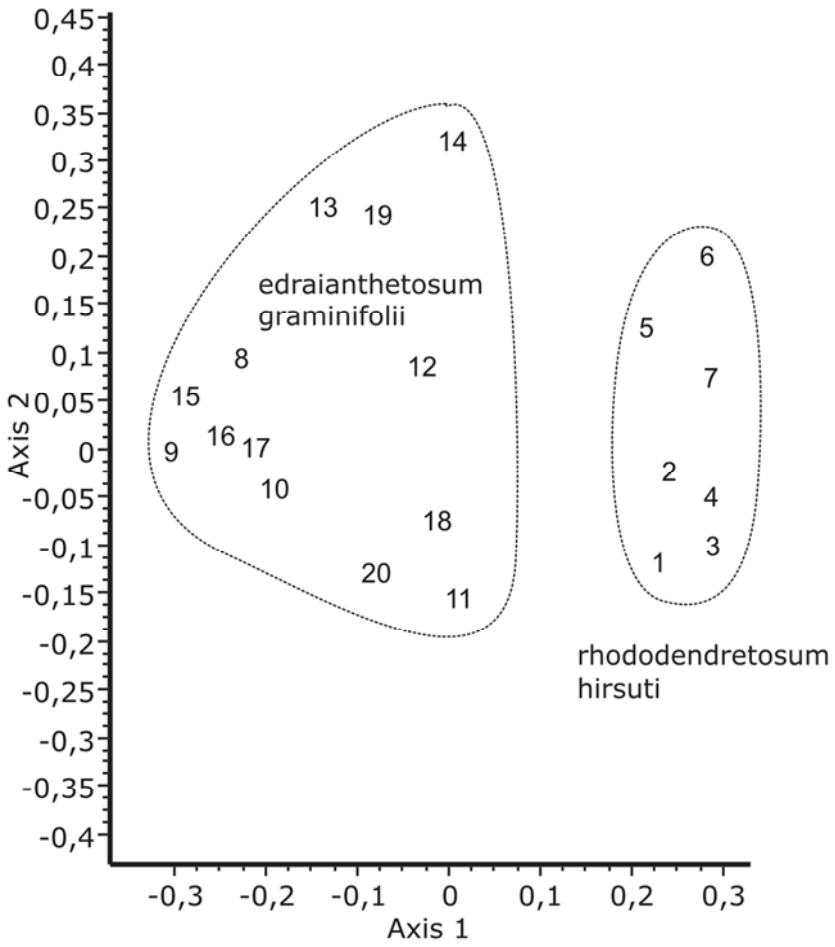

Figure 3: Two-dimensional scatter diagram of relevés of the association *Scabioso silenifoliae-Caricetum mucronatae* ass. nova on the Snežnik plateau (PCoA, similarity ratio).

Syntaxonomical position, syndynamics and distribution area of the association

Stands of the association *Scabioso-Caricetum mucronatae* were clearly distinguished from somewhat similar stands of the associations *Gentiano-Caricetum firmae*, *Dryadetum* s. lat. from the Alps, and *Edraiantho-Caricetum firmae*, *Helianthemo-Caricetum kitaibelianae*, *Scabioso-Dryadetum* from the Dinarides. Our analyses confirmed the placement of the association *Scabioso-Caricetum mucronatae* in the alliance *Seslerion juncifoliae* (Fig. 3; see SURINA 2004a; SURINA & DAKSKOBLER 2005).

There are different opinions about the syntaxonomical treatment of stands with *Carex mucronata* either because of their rather wide ecological amplitude or their possibly various, syndynamical origin. Several phytosociologists studying Alpine grasslands (*Elyno-Seslerietea*), have treated relevant stands within the association *Caricetum firmae* s. lat. (as a subassociation and/or variant) or as pioneer-stages anticipating either stands of *Caricetum firmae* s. lat. or *Seslerio coeruleae-Caricetum sempervirentis* s. lat. (incl. *Ranunculo hybridi-Caricetum sempervirentis*) (e.g. BRAUN-BLANQUET 1926: Tab. 7; AICHINGER 1933: Tabs. 26 & 29; WIKUS 1960: Tabs. 11, 12 & 15; LIPPERT 1966: Tabs. 20 & 21). We could find *C. mucronata* in wind-exposed habitats even within stands of the alliance *Satureion subspicatae* (*Festuco-Brometea*). POLDINI & KALIGARIČ (KALIGARIČ 1997: 58)

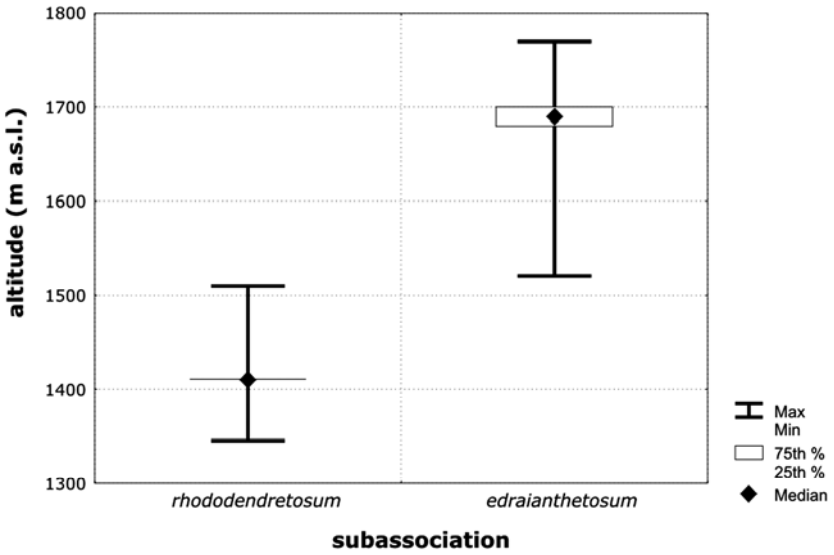

Figure 4: Altitude (m a.s.l.) of relevés of the two subassociations: *Scabioso silenifoliae-Caricetum mucronatae rhododendretosum hirsuti* (1) and *S. s.-C. m. edraianthetosum graminifolii* (2).

treated them as a subassociation *Carici-Centaureetum globularietosum*, as well as an association *Genisto-Caricetum mucronatae* (POLDINI 1978; KALIGARIČ 1997: 63) described by HORVAT (1962) in the Liburnian Karst. OBERDORFER (1994: 28) treated relevant stands as "*Carex mucronata* association" and he placed it in the rock-crevices alliance *Potentillion* (*Asplenietea trichomanis*). WIKUS (1959: Tab. 2) frequently observed stands with *C. mucronata* also in stands of *Potentilletum caulescentis* (see AICHINGER 1933: Tab. 1) and *Potentilletum nitidae* (l. cit. Tab. 3), whereas POLDINI (1978: 311) found it frequently in stands of *Phyteumato-Potentilletum caulescentis*. On Mt. Snežnik, WRABER (2004: 7–8) studied the vegetation of rock crevices and took four relevés with *C. mucronata*(2, 1, +,1). He placed them in *Potentilletum caulescentis* s. lat. On the other hand, GRABHERR and co-workers (1993: 410) accepted Thomaser's opinion that these stands should be treated separately from stands of *Caricetum firmae* s. lat., but within the alliance *Caricion firmae*. The opinion is derived from the fact that stands with predominating *C. mucronata* might be of various origin, not necessarily in syndynamical succession with syntaxa from the alliances *Caricion firmae, Satureion subspicatae* and/or *Potentillion caulescentis*. Nevertheless, the syntaxonomical position of *Carex mucronata* stands is confusing: these stands have specific habitats within at least three classes of vegetation: *Elyno-Seslerieta, Festuco-Brometea* and *Asplenietea*.

Syntaxonomic treatise of "*Caricetum mucronatae*" in the Dinarides is less complicated than that of the Alps, because stands of *Edraiantho-Caricetum firmae, Helianthemo-Caricetum kitaibelianae* and *Scabioso-Dryadetum* coincide much less or hardly at all in many aspects with stands of *Scabioso-Caricetum mucronatae*. The distribution area of *Carex firma* and *C. mucronata* is fairly congruent and in the Liburnian Karst they exceed their south-easternmost localities, whereas the distribution area of *Dryas octopetala* (HORVAT 1952: 202–203; SURINA 2004a) and *Carex kitaibeliana* spreads further towards southeast. The total absence of *Carex firma, C. kitaibeliana* and/or *Dryas octopetala* in many homogenous stands of *Scabioso-Caricetum mucronatae*, especially at lower altitudes (e.g. subass. *-rhododendretosum*), confirmed the unique syndynamical origin, distinct from other stands of the alliance *Seslerion juncifoliae*. On the other hand, syndynamical links between

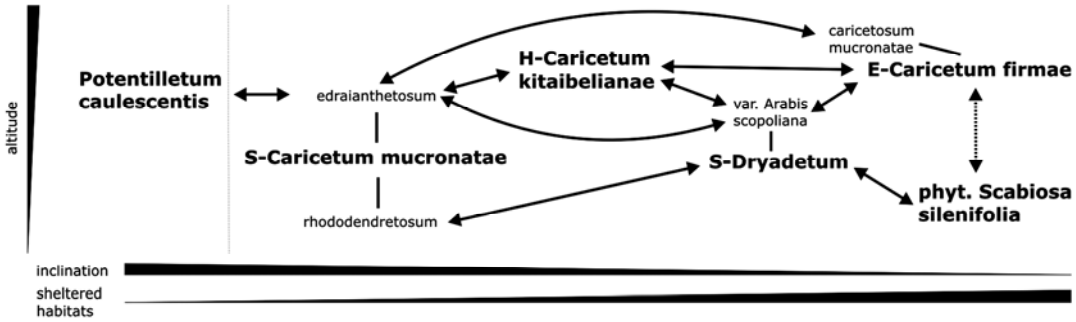

Figure 5: Succession dynamics of syntaxa from the alliance *Seslerion juncifoliae* in the Liburnian Karst.

the mentioned syntaxa are in many cases still recognised in nature, especially in stands at higher altitudes, since ecological conditions in extreme environments (and variable relief) significantly vary even over a short distance (Fig. 5). Thus HORVAT (1962: 97) treated stands with predominating *Carex mucronata* in NW-Croatia within the "*Caricetum firmae croaticum caricetosum mucronatae*" (=*Edraiantho-Caricetum firmae caricetosum mucronatae* p.p., *Scabioso-Caricetum mucronatae edraianthetosum* p.p.) with the remark: "on rocky and exposed ridges of Mts. Risnjak and Snježnik", but without further ecological data and relevés. Stands of *Edraiantho-Caricetum firmae* can be found in less exposed, colder and wetter habitats than *Scabioso-Caricetum mucronatae*, with longer snow cover particularly at higher altitudes, whereas stands of *Scabioso-Dryadetum* prefer exposed, but wetter and more gently rising habitats. North-western Liburnian stands of *Scabioso-Caricetum mucronatae* ecologically and syntaxonomically vicariate stands of *Helianthemo-Caricetum kitaibelianae* from the central Dinarides, which are restricted to small areas on Mt. Snežnik, as well as the Liburnian Karst, and are at their north-westernmost extent of distribution (see HORVAT 1930: 36–37). Until now, no syndynamical connections between stands of those two associations on Mt. Snežnik have been observed, while HORVAT (1952: 207) observed *C. mucronata* in stands of *Helianthemo-Caricetum kitaibelianae* on Mt. Velebit.

Stands of *Scabioso-Caricetum mucronatae* have been observed on mountains of the Liburnian Karst, e.g. Mts. Snežnik (SW Slovenia), Risnjak and Snježnik (NW Croatia). Stands from the Trnovski gozd plateau (W Slovenia) floristically (and phytogeographically) clearly differ from our stands due to the close proximity to the Julian Alps. Dakskobler has provisionally placed them in the association *Primulo carniolicae-Caricetum mucronatae* prov. Therefore, not only floristical but also phytogeographical and thus syntaxonomical differentiation of "*Caricetum mucronatae*" has proved to be meaningful (Fig. 2; SURINA 2004a; SURINA & DAKSKOBLER 2005). We disagree with the claim of GRABHERR and co-workers (1993: 411) that the reduced floristical composition of the association *Caricetum mucronatae*, due to extreme environmental conditions, does not allow any phytogeographical differentiation like the central- and eastern-Alpine association *Caricetum firmae* and its south-eastern-Alpine vicariant *Gentiano-Caricetum firmae*. Two relevés of *Caricetum mucronatae* from the Julian Alps (Krn Mts., South-eastern Calcareous Alps) host a significant number of E-, SE-Alpine, SE-Alpine-Illyrian and endemic species, which distinguish phytogeographically clearly SE-Alpine stands from central- and E-Alpine ones, e.g. *Achillea clavenae, Campanula zoysii, Cerastium subtriflorum, Oxytropis jacquinii, Paederota lutea, Pedicularis rostrato-capitata, Ranunculus hybridus, Rhodothamnus chamaecistus, Saxifraga crustata* and *Valeriana saxatilis* (SURINA 2004b: 85–87). For precise syntaxonomical treatment of SE-Alpine stands further phytosociological research will be needed.

The nomenclature type for the *Scabioso silenifoliae-Caricetum mucronatae* ass. nova and subassociation *S. s.-C. m. edraianthetosum graminifolii* subass. nova is relevé no. 15, holotypus hoc loco, and for subassociation *S. s.-C. m. rhododendretosum hirsuti* subass. nova relevé no. 4 in Table 1, holotypus hoc loco.

Conclusions

Stands of *Caricetum mucronatae* s. lat., due to the very specific ecological conditions of their habitats, are either of unique origin or in syndynamical transition with stands of rock-crevices (*Potentillion caulescentis, Asplenietea trichomanis*), SE-European/Illyrian dry grasslands (*Satureion subspicatae, Festuco-Brometea*) or subalpine and alpine grasslands (*Elyno-Seslerietea*) in the Alps (*Caricion firmae*: *Caricetum firmae* s. lat. & *Dryadetum octopetalae* s. lat., *Seslerion coeruleae*: *Seslerio-Caricetum sempervirentis* s. lat.; *Seslerietalia coeruleae*) and Dinarides (*Seslerion juncifoliae*: *Helianthemo-Caricetum kitaibelianae, Scabioso-Dryadetum, Edraiantho-Caricetum firmae*; *Seslerietalia juncifoliae*) (Fig. 5).

The syntaxonomical position of *Scabioso-Caricetum mucronatae* in the Dinarides is less complicated, since the distribution areas of edificatory species of other syntaxa, e.g. *Carex firma, C. mucronata, C. kitaibeliana* and *Dryas octopetala*, are not necessarily congruent. From the syntaxonomical point of view, the phytogeographical delimitation of the association *Caricetum mucronatae* s. lat. is not questionable. Stands from the Liburnian Karst (alliance *Seslerion juncifoliae*) show significant floristical differences from stands from the Alps (*Caricion firmae*), due to the presence of Illyrian and absence of Alpine and SE-Alpine species. Therefore it seems to be correct to consider *Carex mucronata* stands in the Liburnian Karst as a floristically, syntaxonomically and phytogeographically well defined association (*Scabioso-Caricetum mucronatae* ass. nova) within the alliance *Seslerion juncifoliae*.

Appendix

Nomenclature and synsystematics of the syntaxa mentioned (The complete list of syntaxa mentioned in the paper is intended to facilitate survey of syntaxonomical nomenclature.)

Elyno-Seslerietea Br.-Bl. 1948
- *Seslerietalia coeruleae* Br.-Bl. in Br.-Bl. & Jenny 1926
  - *Caricion austroalpinae* Sutter 1962
    - *Ranunculo hybridi-Caricetum sempervirentis* Poldini & Feoli Chiapella in Feoli Chiapella & Poldini 1993
  - *Seslerion coeruleae* Br.-Bl. in Br.-Bl. & Jenny 1926
    - *Seslerio coeruleae-Caricetum sempervirentis* Br.-Bl. in Br.-Bl. & Jenny 1926
  - *Caricion firmae* Gams 1936
    - *Caricetum firmae* Rübel 1911
    - *Gentiano terglouensis-Caricetum firmae* (Br.-Bl. 1933) T. Wraber 1970
      - *dryadetosum* Poldini & Feoli 1976
      - *minuartietosum* Poldini & Feoli 1976
      - *potentilletosum nitidae* Surina 2004
      - *drepanocladetosum uncinati* Surina 2004
    - *Caricetum mucronatae* (Br.-Bl. in Br.-Bl. & Jenny 1926) Thomaser 1977
    - *Primulo carniolicae-Caricetum mucronatae* Dakskobler prov. (in Surina & Dakskobler 2005 in press.)
    - *Dryadetum octopetalae* Rübel 1911
  - *Caricion ferrugineae* G. & J. Br.-Bl. 1931
    - *Hyperico grisebachii-Caricetum ferrugineae* T. Wraber 1971

Seslerietalia juncifoliae Horvat 1930
Seslerion juncifoliae Horvat 1930
Edraiantho graminifolii-Caricetum firmae Horvat (1930) 1934 (=*Caricetum firmae croaticum* Horvat 1930)
potentilletosum clusianae Horvat 1930
caricetosum mucronatae Horvat 1962 nom. prov.
Scabioso silenifoliae-Caricetum mucronatae Surina & Wraber 2005 (=*Caricetum firmae croaticum* Horvat 1930 *caricetosum mucronatae* Horvat 1962 nom. prov. p. max. p.)
edraianthetosum graminifolii Surina & Wraber 2005 (=*Edraiantho graminifolii-Caricetum mucronatae* Wraber 1997 prov.)
rhododendretosum hirsuti Surina & Wraber 2005
Helianthemo alpestris-Caricetum kitaibelianae Horvat 1930
Scabioso silenifoliae-Dryadetum octopetalae Surina 2004 var. *Arabis scopoliana* Surina 2004
Festucion pungentis Horvat 1930
Festucetum pungentis Horvat 1930
Crepidetalia dinaricae Lakušić 1966
Oxytropidion dinaricae Lakušić 1966
Edraiantho serpyllifolii-Dryadetum octopetalae Lakušić 1968
Festuco-Brometea Br.-Bl. & Tüxen 1943
Scorzoneretalia villosae Horvatić 1934
Satureion subspicatae Horvat 1962
Genisto holopetalae-Caricetum mucronatae Horvat 1956
Carici humilis-Centaureetum rupestris Horvat 1931
globularietosum cordifoliae Kaligarič & Poldini 1997
seslerietosum juncifoliae Horvat 1962
Genisto sericeae-Seslerietum juncifoliae Poldini 1980
Querco-Fagetea Br.-Bl. & Vlieg. 1937
Fagetalia sylvaticae Pawlowski in Pawlowski & al. 1928
Aremonio-Fagion (Horvat 1938) Borhidi in Török & al. 1989
Omphalodo-Fagetum (Tregubov 1957 corr. Puncer 1980) Marinček & al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002
Ranunculo platanifolii-Fagetum Marinček & al. 1993 var. geogr. *Calamintha grandiflora* Marinček 1996
Polysticho lonchitis-Fagetum (Horvat 1938) Marinček in Poldini & Nardini 1993 var. geogr. *Allium victorialis* Marinček 1996
Vaccinio-Piceetea Br.-Bl. 1930 em. Zupančič 1976
Vaccinio-Piceetalia Br.-Bl. in Br.-Bl. & al. 1939 em. Lund. 1967
Vaccinio-Piceion Br.-Bl. 1938
Hacquetio-Piceetum Zupančič (1980) 1999
Lonicero caeruleae-Piceetum Zupančič (1980) 1999
Pinion mugo Pawlowski 1928
Hyperico grisebachii-Pinetum mugo Wraber in Zupančič & al. 2004
Asplenietea trichomanis Br.-Bl. in Meier & Br.-Bl. corr. Oberdorfer 1977
Potentilletalia caulescentis Br.-Bl. in Br.-Bl. & Jenny 1926
Potentillion caulescentis Br.-Bl. in Br.-Bl. & Jenny 1926
Potentillenion caulescentis Theurillat in Theurillat & al. 1995
Potentilletum nitidae Wikus 1959
Physoplexido comosae-Potentillenion caulescentis Theurillat in Theurillat & al. 1995
Potentilletum caulescentis Aichinger 1933 s. lat.
Phyteumato-Potentilletum caulescentis Poldini 1978
Thlaspietea rotundifolii Br.-Bl. 1948 s. lat.
Erico-Pinetea Horvat 1959
Mulgedio-Aconitetea Hadač & Klika in Klika 1944 (=*Betulo-Adenostyletea* Br.-Bl. & Tüxen 1943)

Localities of relevés

Slovenia, Dinarides, NW Liburnian Karst, Snežnik plateau:
1 Gorge above Grčovec valley. 27.7.2003, leg. & det.: D. Stešević & B. Surina. **2–4** Mt. Planinc, top of the rocky ridge (Belveder) above Črna draga valley. 27.7.2003, leg. & det.: D. Stešević & B. Surina. **5** Mt. Planinc, top of the rocky ridge (Belveder) above Črna draga valley, western-most part of the ridge. 27.7.2003, leg. & det.: D. Stešević & B. Surina. *Ctenidium molluscum* +.2, *Ditrichium capillaceum* +.3. **6–7** Mt. Zatrep, edge of a sinkhole by the path between Mt. Zatrep and Grdobe. 14.8.2003, leg. & det.: U. Abram & B. Surina. (7) *Ctenidium molluscum* +.2, *Ditrichium capillaceum* 1.3, *Orthothecium rufescens* 1.3. **8–10** Mt. Snežnik, Grčovski vrh hill. 16.8.2003, leg. & det.: M. Blokar & B. Surina. (10) 14.7.1994, leg. & det.: T. Wraber. **11–12** Mt. Snežnik, rocky ridge between Mts. Veliki & Mali Snežnik. 2.8.1994, leg. & det.: T. Wraber. **13** Mt. Snežnik, rocky ridge between Mts. Veliki & Mali Snežnik, 100m towards W from the group of rocks. 2.8.1994, leg. & det.: T. Wraber. **14** Mt. Snežnik, Vzhodni dol valley (Sršajeva dolina valley). 10.8.1994, leg. & det.: T. Wraber. **15** Mt. Snežnik, summit above the Grčovec valley. 27.7.1996, leg. & det.: T. Wraber & B. Rozman. **16** Mt. Snežnik, Mt. Mali Snežnik, top of the rocky summit. 27.7.1996, leg. & det.: T. Wraber & B. Rozman. **17** Mt. Snežnik, Mt. Mali Snežnik, top of the rocky summit within the stands of *Hyperico-Pinetum mugo*, by the paths beside the stack of rocks. 27.7.1996, leg. & det.: T. Wraber & B. Rozman. **18** Mt. Snežnik, Karolinov vrh hill, rocky habitat within stand of *Hyperico-Pinetum mugo* at the north of the hill. 2.8.1996, leg. & det.: T. Wraber. **19** Mt. Snežnik, height 1680 in the ridge of Kindlerjev vrh hill. 21.8.1996, leg. & det.: T. Wraber. **20** Mt. Snežnik, rocky terrace on the eastern slope of the summit. 24.8.1997, leg. & det.: T. Wraber.

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