

Some novelties in the flora and vegetation of Mt Snežnik (SW Slovenia, Liburnian karst)

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The first records for *Scabiosa graminifolia*, *Potentilla clusiana* and *Seseli gouanii* are presented for the Mt Snežnik Plateau. One new association, *Scabioso silenifoliae-Dryadetum octopetalae* ass. nova, and a phytocoenon with *Scabiosa silenifolia* are described.

Key words: flora, vegetation, community Snežnik, Dinaric Mountains, *Seslerion juncifoliae*, *Dryadetum octopetalae*, *Elyno-Seslerietea*, *Scabiosa graminifolia*, *Potentilla clusiana*, *Seseli gouanii*

Introduction

Due to the distinct geographical position of Mt Snežnik (1796 m, SW Slovenia, Liburnian Karst, Fig. 1), its flora, which is composed of Alpine and Dinaric/Illyrian species, is comparatively well known. The first botanist who climbed the mountain and pointed out the floristic and thus phytogeographic peculiarities of the area was H. Freyer in 1827, and several treatises related to the flora and vegetation of Mt Snežnik have been published to date (WRABER 2000b). Nevertheless, important floristic and phytosociological novelties of the flora of Mt Snežnik and Slovenia are constantly being reported (e.g. WRABER 2000a, 2004, SURINA 2004a). In the paper some new findings of phanerogams worthy of mention are reported and the phytosociological characteristics of *Dryas octopetala* stands on the Snežnik Plateau are given.

Methods

Phytosociological research of stands with *Dryas octopetala* was conducted applying the sigmatistic method (BRAUN-BLANQUET 1964). With the aid of the computer programme SYN-TAX (PODANI 2001) and synoptic phytosociological table (available at the author), extensive comparisons with similar stands from the Alps and Dinaric Mts were made, and we performed a first linear transformation of cover values for individual taxa (VAN DER MAAREL 1979). The measure of dissimilarity was the complement of the coefficient »similarity ratio«. We used the Furthest Neighbour – Complete Linkage clustering method (CL),

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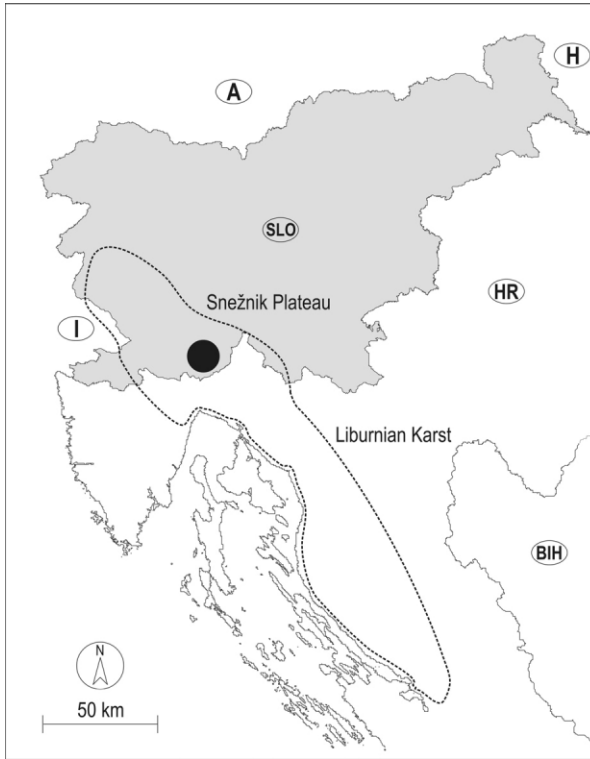


Fig. 1. The Snežnik Plateau (SW Slovenia) in the Liburnian Karst.

Minimization of Increase of Error Sum of Squares (MISSQ) and the ordination method of Principal Coordinates Analysis (PCoA). Mosses and lichens were excluded in the use of methods of hierarchical classification and ordination since several authors have not included cryptogams in phytosociological tables. A coverage index (I_c) (LAUSI et al. 1982) was calculated for individual taxa as follows:

$$\sum_{i=1}^n \frac{c_i}{nc_{\max}} \cdot 100$$

n – number of relevés in the table
 c_i – coverage value of registered taxa
 c_{\max} – max. coverage value (9)

Nomenclature source for phanerogams was the Register of the Flora of Slovenia (TRPIN and VREŠ 1995).

Results and Discussion

Scabiosa graminifolia L. [*Lomelosia graminifolia* (L.) Greuter et Burdet]

This Mediterranean-montane species is relatively rare in Slovenia and restricted to the western part of the country. It thrives on warm and sunny slopes between the Trnovski gozd Plateau (Čaven) (POLDINI 1978; Mt Mala Gora, Tab. 3, rel. 6–10) and the Nanos Plateau

(e.g. FLEISCHMANN 1844: 139, POLDINI 1978: Tab. 2, rel. 18–20, DAKSKOBLER 1996: 392). It is also known from the left bank of the Soča River in the vicinity of Solkan (e.g. WULFEN 1858: 191, POSPICAL 1899: 731, ZIRNICH in MEZZENA 1986: 143). From the Alpine phytogeographical region it is known from the screes of Mt Pršivec just above Bohinj lake (PLEMEL 1862: 156), the Tolminka valley (DAKSKOBLER 1996: 392) and Breginjski kot (ČUŠIN 2001: 13). Several herbarium specimens (LJU) confirm these localities. Other localities in central and eastern Slovenia given by JOGAN et al. (2001: 341) are most likely false.

New localities of the species are on the southern foothills of the Snežnik Plateau above the Reka valley (0451/2, 0451/4, 0452/3). It occurs fairly sparsely on the summit of Mt Kozlek (998 m a.s.l.) while it is very abundant on the eastern slope of the mountain along the path towards the village of Kuteževo in stands of the association *Genisto sericeae-Seslerietum juncifoliae* Poldini 1980, at the edges of *Pinus nigra* stands and on screes of the alliance *Peltarion alliaceae* Horvatić 1957. The phytosociological characteristics of the two sites are given by relevés:

Relevé No. 1: Slovenia, Submediterranean region, Snežnik plateau, Kozlek above the Reka valley, rocky brow of the summit (MTB: 0451/4); 997 m a.s.l, aspect S, slope 20°, herb layer cover 80 %, stoniness 20 %, relevé area 4 m², *Genisto-Seslerietum*, 20. 7. 2003, leg. B. Surina:

Sesleria juncifolia 4.2, *Globularia cordifolia* 2.2, *Anthyllis montana* subsp. *jacquinii* 1.2, *Carex humilis* 1.2, *Chamaecytisus purpureus* 1.2, *Satureja subspicata* subsp. *liburnica* 1.2, *Teucrium montanum* 1.2, *Anthericum ramosum* 1.1, *Carex mucronata* +.2, *Chamaecytisus hirsutus* +.2, *Dorycnium germanicum* +.2, *Genista sericea* +.2, *Helianthemum ovatum* +.2, *Peucedanum oreoselinum* +.2, ***Scabiosa graminifolia* +.2**, *Amelanchier ovalis* +, *Anthyllis vulneraria* subsp. *carpatica* +, *Bupthalmum salicifolium* +, *Carlina acaulis* +, *Centaurea rupestris* +, *Cuscuta epithymum* +, *Galium lucidum* +, *Inula hirta* +, *Knautia illyrica* +, *Linum tenuifolium* +, *Lotus corniculatus* +, *Peucedanum cervaria* +, *Pinus nigra* +, *Quercus pubescens* +, *Seseli gouanii* +, *Stachys subcrenata* +.

Relevé No. 2: only a few meters SE from relevé No. 1, ledge, aspect E, slope 10°, herb layer cover 50 %, stoniness 50 %, relevé area 1 m², 20. 7. 2003, leg. B. Surina:

Shrub layer (20 %): *Amelanchier ovalis* +, *Fraxinus ornus* +; herb layer (30 %): *Sesleria juncifolia* 3.2, *Chamaecytisus purpureus* 1.2, ***Scabiosa graminifolia* 1.2**, *Anthyllis montana* subsp. *jacquinii* +.2, *Carex mucronata* +.2, *Globularia cordifolia* +.2, *Satureja subspicata* subsp. *liburnica* +.2, *Anthericum ramosum* +, *Frangula rupestris* +, *Seseli gouanii* +.

***Seseli gouanii* Koch [S. *elatum* L. subsp. *gouanii* (Koch) P. W. Ball]**

The species thrives in the Alpine (e.g. WRABER 1964: 134), sub-Mediterranean and Dinaric regions (e.g. PLEMEL 1862: 158, KRAŠAN 1880: 282, POSPICAL 1898: 161) in Slovenia. The first map of its area of distribution was made by PRAPROTNIK (1987: 66) and is based mostly upon herbarium material (LJU). Several new localities have since been reported (DAKSKOBLER 1994: 27–28, KALIGARIČ 1997, DAKSKOBLER 1998: 64). We found *S. gouanii* on the stony ridge of the Snežnik Plateau above the Reka valley between the hills Sv. Ahac and Katalin (0451/2, 0451/4, 0452/3). It inhabits rocky and grassy slopes in stands of the association *Genisto-Seslerietum* (see phytosociological remarks on previous

species). The accompanying flora on the hill Srednji vrh (0451/4) is composed of *Iris pallida* subsp. *illyrica*, *Melica ciliata*, *Dictamnus albus*, *Cotinus coggygia*, *Amelanchier ovalis*, *Cottoneaster integerrima*, *Satureja subspicata* ssp. *liburnica*, *Coronilla emeroides* ssp. *emeroides*, *Sesleria juncifolia*, *Genista sericea* etc. Other new localities of *S. gouanii* in SW Slovenia are on a stony scarp by the Novokračine – Jelšane road (NE Istrian Peninsula, vicinity of Ilirska Bistrica: 0551/2) and on the stony ridge of the Nanos Plateau between the summits of Pleša (1414 m a.s.l.) and Gradiška Tura (793 m a.s.l.; 0150/3, 0149/2, 0149/1).

***Potentilla clusiana* Jacq.**

Although it is a common species in the Alps and Dinaric Mts, the locality in »Veliki Dolčiči« dolina is the first record of *P. clusiana* for the Snežnik Plateau (0452/4). Phytosociological characteristics of the site:

1250 m a.s.l., aspect S, slope 30°, herb layer cover 30 %, stoniness 70 %, relevé area 2 m²:

Sesleria juncifolia 2.2., *Antennaria dioica* 1.2, *Anthyllis vulneraria* subsp. *alpestris* 1.2, *Bupthalmum salicifolium* 1.2, *Campanula cespitosa* 1.2, *Coronilla vaginalis* 1.2, *Gentianella ciliata* 1.2, *Juniperus sibirica* 1.2, *Rhinanthus glacialis* 1.2, *Hippocrepis comosa* +.2, *Polygala croatica* +.2, *Aster bellidiastrum* +, *Gentiana lutea* subsp. *symphiandra* +, *Gymnadenia conopsea* +, *Leucanthemum liburnicum* +, *Phyteuma orbiculare* +, *Gentiana cruciata* r.

***Scrophularia laciniata* Waldst. et Kit. [*S. heterophylla* Willd. subsp. *laciniata* (Waldst. et Kit.) Maire et Petitm.]**

The distribution area of *Scrophularia laciniata* in Slovenia is limited to the Dinaric phytogeographical region. It is known from screes and rock-crevices of the summit of Mt Snežnik and from Mt Nanos (PRAPROTNIK 1987: 185). POSPICHAL (1899: 619–620) found it quite frequently on screes of the Nanos Plateau all the way from the church of Sv. Bric to the east and the castle ruins above Vipava to the west. The screes in the vicinity of Čaven above the Vipava valley are, according to the data (POLDINI 1978: Tab. 2, rel. 13–17), at most north-western extent of the species' distribution area. The first record for the Snežnik Plateau is that of BIASOLETTO (1846: 71), who mistakenly identified it as *S. juratensis* Schleich. He spotted the specimens on the southern slopes of Snežnik Plateau (Mt Orlovica and Mt Zatrep; 0452/3). More than a hundred years later, MAYER (1954: 95) noticed it on Mt Snežnik (0452/2) and thought it the first recording for the Snežnik Plateau, overlooking Biasoletto's false identification. During extensive research on the flora and vegetation of Mt Snežnik, Wraber mentioned *S. laciniata* for the summit again in many of his treatises. New localities for the Snežnik Plateau are: Mts Planinc, Travica, Zatrep, Paka, Katalin, Veliki Razbor, Oslica, screes in the vicinity of the village Zabiče (0452/3), Mt Gomanaška (0452/4), Mts Cifre, Medvedova glavica (0452/2), Mts Lunjevica, Devin and Bele ovce (0451/2). It usually thrives on screes (stands from the alliance *Peltarion alliaceae*) and rock-crevices (stands of the association *Moehringio muscosae-Corydaletum ochroleuca* Horvat 1962, *Asplenietum fissi* Horvat 1931 and *Neckero crispae-Campanuletum justiniana* Accetto 1995, alliance *Cystopteridion* Richard 1972) and on stony grasslands (atypical stands of the subassociation *Carici humilis-Centaureetum rupestris* Horvat 1931

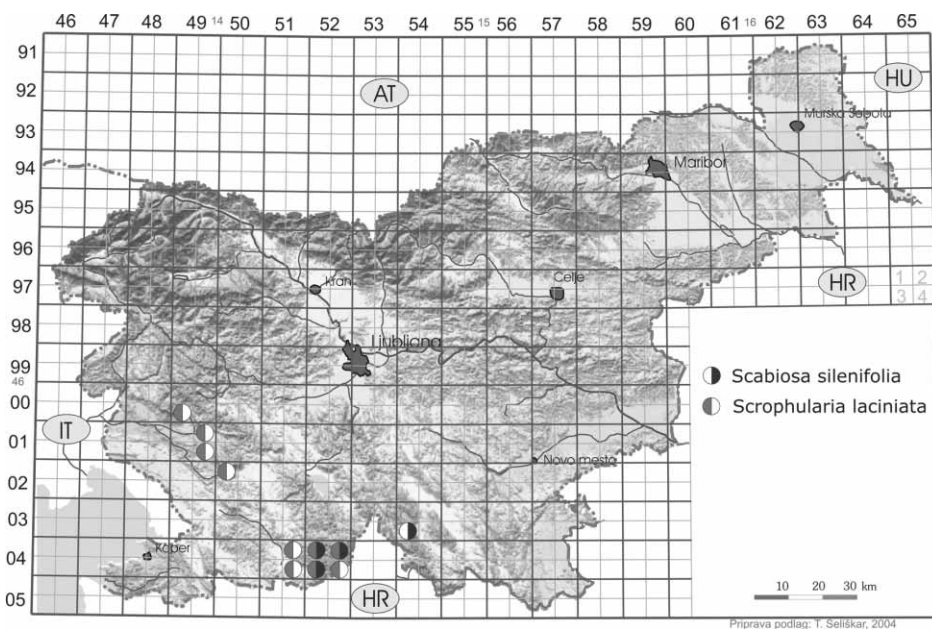


Fig. 2. Distribution map of *Scrophularia laciniata* Wald. et Kit. and *Scabiosa silenifolia* Waldst. & Kit. in Slovenia (supplemented after PRAPROTNİK 1987: 127,185)

seslerietosum juncifoliae Horvat 1962, alliance *Satureion subspicatae* Horvat 1962). The distribution area of *S. laciniata* in Slovenia is shown on Fig. 2.

***Nigritella rubra* (Wettst.) K. Richter s str. [*N. miniata* (Crantz) Janchen p. p.]**

According to Ravnik, the species occurs in Slovenia most frequently in the Julian Alps. Perko found, it among other localities in Carinthia, and also in the Karavanke Alps (PERKO 2004: 186). The only locality outside the Alps is Mt Snežnik, which was actually considered to be the only locality in Slovenia for a long time (MAYER 1952: 384, RAVNIK in MARTINČIČ et al. 1999: 690, RAVNIK 2002: 34). The first record of *N. rubra* for Mt Snežnik was probably given by BIASOLETTO (1846: 81) as *Nigritella suaveolens* Koch: »Sugli ultimi ripani pascolivi dello Schneeberg« (0452/2), and lately again by CZOERNIG (see WRABER 2000b: 17). A hundred years later, Avčín saw many specimens north of the summit at »Tri kaliči« (AVČIN 1946: 31; 0352/4). In the fifties, Mayer and Ravnik observed it in large quantities on southern and south-western slopes between Mts Mali and Veliki Snežnik (MAYER, pers. comm.). Nowadays, the species is very rare on the Snežnik Plateau mainly due to stands of the association *Hyperico grisebachii-Pinetum mugo* (HORVAT 1938) which constantly overgrow *Nigritella's* actual and potential growth sites. We found it on the pass Grčovsko sedlo (0452/2, 1664 m a.s.l.; field excursion with T. Wraber on 12.7.1997), Mt Sleme (0452/2; grassland within stands of the association *Ranunculo platanifolii-Fagetum* [Horvat 1938] Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Marinček 1996) and Zatrep (0452/3). It is worth mentioning some recent records from the Julian Alps (RAVNIK 2002: 34, SURINA and VREŠ 2003: 90, SURINA 2004b: phytosoc. tab. 23, rel. 3) and

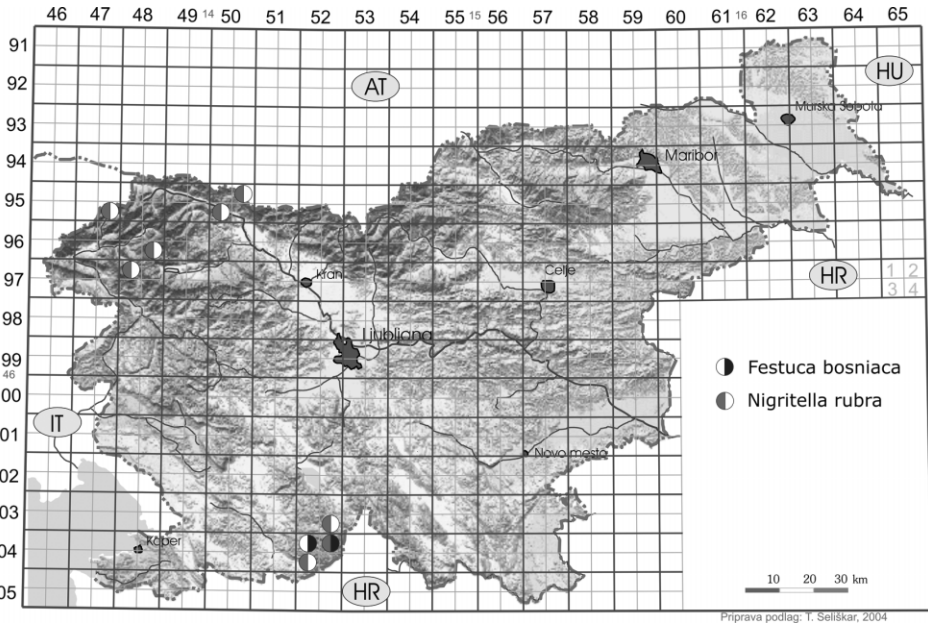


Fig. 3. Distribution map of *Festuca bosniaca* Kumm. et Sendtn. and *Nigritella rubra* (Wettst.) K. Richter s. str. in Slovenia (supplemented after PRAPROTNIK 1987: 125 and RAVNIK 2002: 34)

the Karavanke Mts (PERKO 2004: 186). The distribution of *Nigritella rubra* in Slovenia is shown in figure 3.

***Festuca bosniaca* Kumm. et Sendt. [*F. pungens* Kit. ex J. A. Schult.]**

Janchen and Ginzberger came across the taxonomical problem of identifying specimens of the *Festuca varia* complex collected during their expedition to Mt Snežnik. Specimens that were found in the vicinity of Grčovsko sedlo (0452/2) were later identified as *Festuca varia* var. *calva* by S. Belli (GINZBERGER 1909: 433). It was subsequently ascertained that specimens from Mt Snežnik belong to *Festuca bosniaca* and they are at most north-western extent of the species' distribution area (e.g. WRABER 1965: 192). We found them beside the path from Kapetanova bajta-Mt Snežnik, Velika Kolobarnica, Grčovsko and Holarinsko sedlo (0452/2, field excursion with Wraber, 12.–13.7.1997). Other new localities are: Grčovec, Žlebina (above Grčovec), Andrejev studenec (0452/2) and Mt Planinc (0452/3). It forms stands of the association *Festucetum pungentis* Horvat 1930 and may develop on sheltered sites with long lasting snow cover above the forest line but most often in the altimontane/subalpine belt in the clearings of stands of *Pinus mugo* (*Hyperico-Pinetum mugo*) and *Fagus sylvatica* (*Ranunculo-Fagetum* var. geogr. *Calamintha grandiflora* and *Polysticho lonchitis-Fagetum* [Horvat 1938] Marinček in Poldini et Nardini 1993 var. geogr. *Allium victorialis* Marinček 1996; =*Fagetum croaticum australe subalpinum* Horvat 1938 p. p.). The phytosociological characteristics of sites are given by two relevés:

Relevé No 1: Slovenija, Dinaric Mts, Snežnik Plateau, southern slope of Mt Snežnik above Žlebina, by the abandoned mountain track from Obračališče to Grčovec (0452/2);

1510 m a.s.l, aspect S, slope 30°, herb layer cover 100 %, relevé area 15 m², *Festucetum pungentis*, 27.7.2003, leg. D. Stešević et B. Surina:

Festuca bosniaca 5.3, *Cirsium erisithales* 1.2, *Phyteuma orbiculare* 1.2, *Achillea distans* +.2, *Buphthalmum salicifolium* +.2, *Calamagrostis varia* +.2, *Clinopodium vulgare* +.2, *Dactylis glomerata* +.2, *Digitalis grandiflora* +.2, *Galium anisophyllum* +.2, *Gentiana liburnica* +.2, *Heliosperma alpestre* +.2, *Hypericum richeri* subsp. *grisebachii* +.2, *Knautia drymeia* subsp. *intermedia* +.2, *Lotus corniculatus* +.2, *Luzula multiflora* +.2, *Luzula sylvatica* +.2, *Ranunculus carinthiacus* +.2, *Senecio ovatus* +.2, *Trifolium pratense* +.2, *Trollius europaeus* +.2, *Aconitum ranunculifolium* +, *Biscutella laevigata* +, *Bupleurum falcatum* subsp. *cernuum* +, *Campanula scheuchzeri* +, *Carlina acaulis* +, *Gentiana lutea* subsp. *symphyandra* +, *Geranium sylvaticum* +, *Gymnadenia conopsea* +, *Heracleum sphondylium* +, *Juniperus sibirica* +, *Lilium martagon* +, *Potentilla crantzii* +, *Senecio doronicum* +, *Silene vulgaris* subsp. *antelopum* +, *Thymus balcanus* +.

Releve No 2: Slovenija, Dinaric Mts, Snežnik Plateau, Mt Planinc, grassy saddle east of the summit (0452/3); 1420 m a.s.l, aspect SSW, slope 25°, herb layer cover 95 %, stoniness 5 %, relevé area 15 m², *Festucetum pungentis*, 27.7.2003, leg. D. Stešević et B. Surina:

Festuca bosniaca 5.3, *Euphorbia cyparissias* 2.2, *Buphthalmum salicifolium* 1.2, *Cirsium erisithales* 1.2, *Achillea millefolium* +.2, *Anthyllis vulneraria* subsp. *alpestris* +.2, *Aster bellidiastrum* +.2, *Calamagrostis varia* +.2, *Centaurea pannonica* +.2, *Dactylis glomerata* +.2, *Galium anisophyllum* +.2, *Hypericum maculatum* +.2, *Koeleria eriostachya* +.2, *Laserpitium peucedanoides* +.2, *Lathyrus pratensis* +.2, *Luzula sylvatica* +.2, *Phyteuma orbiculare* +.2, *Potentilla crantzii* +.2, *Ranunculus carinthiacus* +.2, *Scabiosa silenifolia* +.2, *Thymus balcanus* +.2, *Trifolium pratense* +.2, *Vicia cracca* +.2, *Achillea clavенаe* +, *Gentiana lutea* subsp. *symphyandra* +, *Heracleum sphondylium* +, *Lotus corniculatus* +, *Serratula macrocephala*, *Silene vulgaris* subsp. *antelopum* +, *Trifolium montanum* +.

The distribution of *Festuca bosniaca* in Slovenia is shown in figure 3.

***Scabiosa silenifolia* Waldst. et Kit.**

The species belongs to an Illyrian geoelement with a disjunction in the Appenines (Abruzzi Mts). It spreads from Mt Snežnik at the north-westernmost extent of its distribution area to the mountains of Albania (Prokletije Mountains) in the southeast (see HORVAT 1952: 204, WRABER 1990: 144). In Slovenia it is found in the Dinaric phytogeographical region (PRAPROTNİK 1987: 120, WRABER in MARTINČIČ et al. 1999: 432). In 1843 Biasoletto and Tommasini were the first to record it on Mt Snežnik (BIASOLETTO 1846: 61) and for a long time this was thought to be the only locality in Slovenia. More than 150 years later, Accetto found a second locality in Slovenia on the stony ridge of Goteniška planina (ACCETTO 1995: 311) and thus confirmed an old record of FLEISCHMANN (1844: 139). New localities on the Snežnik Plateau are Planinc (Belveder – stony ridge above the Črna draga valley, 0452/1) and Grdobe (east of Mt Zatrep, 0452/3). The distribution of *Scabiosa silenifolia* in Slovenia is shown on Fig. 2.

On the summit of Mt Snežnik *S. silenifolia* thrives in stands of *Edraiantho graminifolii-Caricetum firmae* Horvat (1930) 1934 (WRABER 1967) but most often and with the highest coverage index (I_c) in stands with *Dryas octopetala* (*Scabioso silenifoliae-Drya-*

detum octopetalae ass. nova, see Phytosociological Table 1), *Carex mucronata* (SURINA and WRABER 2005) and in stands of phytocoenon with *Scabiosa silenifolia*.

***Scabioso silenifoliae-Dryadetum octopetalae* ass. nova**

Floristic composition and synmorphology of stands

The highest constancy (100 %) and coverage index ($I_c=94$) in the stands are attained by *Dryas octopetala*³⁻⁵, which forms 1–10 m² homogenous, carpets adhering tightly to the ground. The second highest coverage index in stands is attained by *Scabiosa silenifolia*⁺² ($I_c=35$). Most species with high constancy were placed in the class *Elyno-Seslerietea* Br.-Bl. 1948, e.g. *Hieracium villosum*⁺¹, *Aster bellidiastrum*⁺¹, *Achillea clavennae*⁺, *Leontopodium alpinum*⁺, *Helianthemum alpestre*⁺¹, *Carex mucronata*⁺ and *C. firma*⁺. From the class *Erico-Pinetea* Horvat 1959, *Rhododendron hirsutum*⁺¹, *Calamagrostis varia*⁺, *Erica carnea*⁺ and *Juniperus sibirica*⁺ and from the class *Thlaspietea rotundifoliae* *Carex atrata*⁺ and *Campanula cochlearifolia*⁺ occur in at least 50 % of relevés. Of great syntaxonomical importance is the presence of species from the alliance *Seslerion juncifoliae* Horvat 1930 (order *Seslerietalia juncifoliae* Horvat 1930), e.g. *Scabiosa silenifolia*⁺², *Arabis scopoliiana*⁺, *Edraianthus graminifolius*², *Carex kitaibeliana*¹, *Trinia glauca* ssp. *carniolica*⁺, *Polygala croatica*⁺ and *Thymus balcanus*⁺ which clearly differentiate stands on the Snežnik Plateau from similar stands in the Alps. The moss layer is only sparsely developed. Characteristic and differential species of the association are *Scabiosa silenifolia* and *Dryas octopetala*. The latter is also its edicator. The total floristic composition and structure of stands is shown in Phytosociological Table 1.

The occurrence of *Arctostaphylos uva-ursi*¹ (*Erico-Pinetea*) in stands on Mt Planinc (see relevé No. 2 in Phytosociological Table 1) is of floristic importance for the flora of Snežnik Plateau since the species occurs very rarely in the research area.

Synecology

Stands of the association *Scabioso silenifoliae-Dryadetum octopetalae* ass. nova prefer northern slopes (inclination 5–25°), exposed ridges, summits and moderately dry or cool zones. During the winter period, stands on ridges are exposed to freezing stress due to a strong NE wind (Bora) which blows off the snow cover. On the other hand, stands were also observed in more or less sheltered localities, e.g. on the edge of abysses with permanent snow at the bottom, which cools down the surroundings (within beech stands of the association *Ranunculo platanifoliae-Fagetum* [Horvat 193] Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Marinček 1996) and on calcareous scree (stands of the association *Drepanoclado uncinati-Heliospermetum pusilli* Surina et Vreš 2004, *Arabidetalia caeruleae* Rübél ex Br.-Bl. 1949) with long-lasting snow in certain freezing ravines (SURINA and VREŠ 2004). Although the most typical carpets of the stands are developed in the sub-alpine belt above the tree line, in general they were observed between 1350–1796 m a.s.l.

Syntaxonomical position of stands

Phytosociologists do not agree on the syntaxonomical treatment of stands with *Dryas octopetala* in the Alps (*Elyno-Seslerieta*). The differences in the views derive from the fact that *Dryas octopetala* has a rather wide ecological amplitude and that stands where *Dryas*

Tab. 1. Analytical table of the association *Scabioso silenifoliae-Dryadetum octopetalae* ass. nova (relevés 1–6) and a phytocoenon with *Scabiosa silenifolia* (relevés 7–9).

Number of relevé	1	2	3	4	5	6	fr I _c	7	8	9	fr I _c			
Altitude (m)	1345	1345	1410	1410	1675	1670		1425	1425	1650				
Aspect	NW	NE	NW	NE	N	NW		.	.	SE				
Slope (°)	10	5	10	25	10	15		.	.	10				
Relevé area (m ²)	2	1	6	2	2	2		2	2	2				
Herb layer cover (%)	80	95	90	95	100	100		90	80	95				
Moss layer cover (%)	1	.	.	.	.	.		.	5	.				
Number of species	12	15	23	19	28	15		16	22	22				
Character and differential species of the association and phytocoenon														
ES <i>Dryas octopetala</i>	C	4	3	5	5	5	5	6	94	.	.	.		
SJ <i>Scabiosa silenifolia</i>	C	2	2	+	2	+	.	5	35	5	5	4	3	96
Differential species of the variant														
SJ <i>Arabis scopoliana</i>	C	.	.	.	.	+	+	2	7	.	.	.		
ES <i>Agrostis alpina</i>	C	.	.	.	.	+	+	2	7	.	.	.		
ES <i>Linum julicum</i>	C	.	.	.	.	1	+	2	9	.	.	.		
ES <i>Androsace villosa</i>	C	.	.	.	.	1	1	2	11	.	.	.		
TR <i>Crepis kernerii</i>	C	.	.	.	.	.	1	1	6	.	.	.		
SJ <i>Edraianthus graminifolius</i>	C	.	.	.	.	.	2	1	9	.	.	.		
SJ <i>Carex kitaibeliana</i>	C	.	.	.	.	1	.	1	6	.	.	.		
SJ Seslerietalia juncifoliae														
<i>Thymus balcanus</i>	C	.	.	+	.	.	.	1	4	1	1	+	3	30
<i>Polygala croatica</i>	C	.	.	.	.	+	.	1	4					
<i>Trinia galuca / carniolica</i>	C	.	.	.	.	.	+	1	4	.	.	.		
<i>Gentiana liburnica</i>	C	.	.	.	.	.	.			+	+	+	3	22
<i>Euphrasia liburnica</i>	C	.	.	.	.	.	.			.	+	.	1	7
ES Elyno-Seslerietea albicantis														
<i>Hieracium villosum</i>	C	1	+	+	+	+	.	5	20	.	.	+	1	7
<i>Aster bellidiastrum</i>	C	+	1	+	+	+	.	5	20	.	.	.		
<i>Achillea clavенае</i>	C	.	+	+	+	+	+	5	19	+	+	2	3	33
<i>Leontopodium alpinum</i>	C	.	.	+	+	+	+	4	15	.	+	.	1	7
<i>Helianthemum alpestre</i>	C	.	.	+	+	1	1	4	19	.	+	+	2	15
<i>Carex mucronata</i>	C	.	+	+	+	.	.	3	11	.	.	.		
<i>Carex firma</i>	C	.	+	.	.	+	+	3	11	+	.	+	2	15
<i>Thesium linophyllum</i>	C	.	+	.	+	.	.	2	7	.	.	.		
<i>Galium anisophyllum</i>	C	.	.	+	.	+	.	2	7	+	+	+	3	22
<i>Laserpitium peucedanoides</i>	C	.	.	.	+	+	.	2	7	+	+	.	2	15
<i>Koeleria eriostachya</i>	C	.	.	.	.	+	+	2	7	+	1	1	3	30
<i>Anthyllis vulneraria / alpestris</i>	C	.	.	.	.	+	+	2	7	1	+	.	2	19
<i>Tofieldia calyculata</i>	C	.	.	+	.	.	.	1	4	.	.	.		
<i>Pinguicula alpina</i>	C	.	.	+	.	.	.	1	4	.	.	.		
<i>Ranunculus carinthiacus</i>	C	.	.	.	+	.	.	1	4	+	+	.	2	15
<i>Bartsia alpina</i>	C	.	.	.	.	+	.	1	4	.	.	.		
<i>Gentiana clusii</i>	C	.	.	.	.	.	+	1	4	.	.	.		
<i>Potentilla crantzii</i>	C	.	.	.	.	.	.			+	.	+	2	15
<i>Erigeron polymorphus</i>	C	.	.	.	.	.	.			.	.	1	1	11

Tab. 1. – continued

Number of relevé	1	2	3	4	5	6	fr I _c	7	8	9	fr I _c
<i>Campanula scheuchzeri</i>	C	.	.	.	.	.	.	.	.	+	1 7
<i>Thesium alpinum</i>	C	.	.	.	.	.	.	.	.	+	1 7
TR Thlaspietea rotundifolii											
<i>Carex atrata</i>	C	.	+	+	+	.	3 11	.	.	.	
<i>Campanula cochleariifolia</i>	C	.	.	+	+	+	3 11	.	.	.	
<i>Campanula cespitosa</i>	C	1	+	.	.	.	2 9	.	.	.	
<i>Athamanta cretensis</i>	C	.	.	+	+	.	2 7	.	.	.	
<i>Trisetum argenteum</i>	C	.	.	+	.	.	1 4	.	.	.	
<i>Biscutella laevigata</i>	C	.	.	.	.	+	1 4	.	.	.	
AT Asplenietea trichomanis											
<i>Carex brachystachys</i>	C	.	.	+	.	.	1 4	.	.	.	
<i>Kernera saxatilis</i>	C	.	.	.	.	.	.	+	.	.	1 7
EP Erico-Pinetea											
<i>Rhododendron hirsutum</i>	C	+	+	1	+	+	5 20	.	.	.	
<i>Calamagrostis varia</i>	C	+	+	+	+	.	4 15	.	+	.	1 7
<i>Erica carnea</i>	C	+	.	.	+	+	3 11	.	.	.	
<i>Juniperus sibirica</i>	C	+	+	.	+	.	3 11	.	.	.	
<i>Buphthalmum salicifolium</i>	C	.	.	+	.	.	1 4	.	.	.	
<i>Arctostaphylos uva-ursi</i>	C	.	1	.	.	.	1 6	.	.	.	
VP Vaccinio-Piceetea											
<i>Hieracium bifidum</i>	C	+	.	+	.	.	2 7	.	.	.	
<i>Clematis alpina</i>	C	.	.	+	.	.	1 4	.	.	.	
<i>Rosa pendulina</i>	C	.	.	.	+	.	1 4	.	.	.	
<i>Vaccinium vitis-idaea</i>	C	.	.	.	.	+	1 4	.	.	.	
Other species											
<i>Globularia cordifolia</i>	C	+	+	.	.	1	3 13	.	.	.	
<i>Viola biflora</i>	C	+	.	.	.	.	1 4	.	.	.	
<i>Luzula multiflora</i>	C	.	.	+	.	.	1 4	.	.	.	
<i>Phyteuma orbiculare</i>	C	.	.	.	.	+	1 4	.	.	.	
<i>Gentiana utriculosa</i>	C	.	.	.	.	+	1 4	+	+	+	3 22
<i>Polygonum viviparum</i>	C	.	.	.	.	+	1 4	.	+	+	2 15
<i>Trifolium pratense</i>	C	.	.	.	.	.	.	+	+	+	3 22
<i>Parnassia palustris</i>	C	.	.	.	.	.	.	+	+	.	2 15
<i>Trifolium montanum</i>	C	.	.	.	.	.	.	+	.	.	1 7
<i>Carex capillaris</i>	C	.	.	.	.	.	.	.	+	.	1 7
<i>Trifolium repens</i>	C	.	.	.	.	.	.	.	+	.	1 7
<i>Lotus corniculatus</i>	C	.	.	.	.	.	.	.	.	1	1 11
<i>Plantago holosteum</i>	C	.	.	.	.	.	.	.	.	+	1 7
<i>Rhinanthus aristatus / aristatus</i>	C	.	.	.	.	.	.	.	.	+	1 7
<i>Euphrasia salisburgensis</i>	C	.	.	.	.	.	.	.	.	+	1 7
<i>Festuca</i> sp.	C	.	.	.	.	.	.	.	.	1	1 11
<i>Heliosperma alpestre</i>	C	.	.	.	.	.	.	.	.	+	1 7
Moss species											
<i>Brachythecium</i> sp.	D	.	.	.	.	.	.	.	+	.	1 7
<i>Schistidium apocarpum</i>	D	.	.	.	.	.	.	.	+	.	1 7
<i>Tortella tortuosa</i>	D	.	.	.	.	.	.	.	1	.	1 11

octopetala dominates might be of various syndynamical origins. Many phytosociologists who have studied the Alpine grasslands from the alliance *Caricion firmae* Gams 1927 in the Alps, have treated relevant stands within the association *Caricetum firmae* Rübél 1911 s. lat. (subassociation, variant or facies) or as pioneer stages anticipating either stands of *Caricetum firmae* s. lat. or *Seslerio albicantis-Caricetum sempervirentis* Br.-Bl. in Br.-Bl. et Jenny 1926 s. lat. (e.g. BRAUN-BLANQUET 1926, AICHINGER 1933, WIKUS 1960, LIPPERT 1966). However, Poldini and Feoli reported that the stage with *Dryas octopetala* does not coincide with synchronological dynamism at least in the Carnic Alps and that it rather characterises the peculiar ecological situation of *Caricetum firmae* (POLDINI and FEOLI 1976: 4–5). On the other hand, RÜBEL first distinguished homogenous stands with dominating *Dryas octopetala* from stands of the association *Caricetum firmae* s. lat. and described the association *Dryadetum octopetalae* Rübél 1911. Since then, several phytosociologists have treated stands with *Dryas octopetala* in the Alps as a distinct association (e.g. THIMM 1953, HAUPT 1987, GRABHERR et al. 1993, SURINA 2004b).

Syntaxonomical treatment of stands with *Dryas octopetala* in the Dinaric Mts and partly also in the Carpathian Mountains (see HADAČ et al. in GRABHERR et al. 1993) is much less complicated, since stands of the association *Caricetum firmae* s. lat. do not coincide in any aspect with stands of the association *Dryadetum octopetalae* s. lat., at least not south of the Liburnian Karst since, according to HORVAT (1930, 1952: 208), the most southeasterly extent of the distribution area of *Carex firma* (ant thus its stands) is on Lička Plješivica. For that reason, it is obvious that stands with *Dryas octopetala* (*Dryadetum octopetalae* s. lat.) from the Dinaric Mts are of quite unique syndynamical origin, distinct from stands with *Carex firma*. Such stands has been described in the mountains of the southeastern part of the Illyrian floral province (Zelengora, Maglić, Volujak, Bioč, Durmitor, Komovi and Prokletije), as *Edraiantho serpyllifolii-Dryadetum octopetalae* LAKUŠIĆ 1968 (*Oxytropidion dinaricae* LAKUŠIĆ 1964, *Crepidetalia dinaricae* LAKUŠIĆ 1964) (LAKUŠIĆ 1968, LAKUŠIĆ et al. 1969, BLEČIĆ and LAKUŠIĆ 1976).

Our comparison (Fig. 4) shows that stands with *Dryas octopetala* from the Snežnik Plateau clearly differ from similar stands described in the Southeastern Calcareous Alps and Dinaric Mts We therefore place them in a new association *Scabioso silenifoliae-Dryadetum octopetalae* ass. nova.

Gentiano tergluensis-Caricetum firmae (1–2: Carnic Alps – POLDINI and FEOLI 1976, 3–5: Karavanke Mountains – AICHINGER 1933, 6–9: Julian Alps – SURINA 2004, 11: Kamnik Alps – AICHINGER 1933, HADERLAPP 1982),

Dryadetum octopetalae (10: Julian Alps – SURINA 2004),

Edraiantho graminifolii-Caricetum firmae (12: Mt Snežnik – WRABER 1967, 15: Velebit, 16: Mt Lička Plješivica – HORVAT 1930),

Helianthemo alpestris-Caricetum kitaibelianae (17: Velebit – HORVAT 1930),

Edraiantho serpyllifolii-Dryadetum octopetalae (18: Montenegro – LAKUŠIĆ 1968),

Scabioso silenifoliae-Dryadetum octopetalae ass. nova (14: Mt Snežnik),

Scabioso silenifoliae-Caricetum mucronatae prov. (13: Mt Snežnik – SURINA and WRABER 2005).

We can also clearly distinguish between associations of alliances *Caricion firmae* (*Seslerietalia albicantis* Oberd. 1978 corr. Oberd. 1990) from the Alps, and *Seslerion*

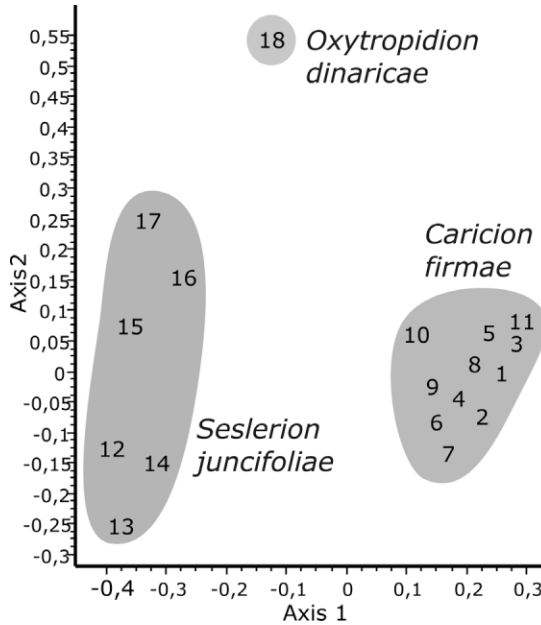


Fig 4. Two-dimensional scatter diagram of selected syntaxa from the alliances *Caricion firmae*, *Seslerion juncifoliae* and *Oxytropidion dinaricae* from the Southeastern Calcareous Alps and Dinaric Mts (PCoA, similarity ratio).

juncifoliae (*Seslerietalia juncifoliae*) and *Oxytropidion dinaricae* (*Crepidetalia dinaricae*) from the Dinaric Mts (Fig. 4).

Within the association, we can easily differentiate the variant *Arabis scopoliانا* var. nova (Fig. 5), which is developed at higher altitudes (e.g. 1500 m a.s.l.), such as on the summits of Mts Snežnik, Snježnik and Risnjak. Its differential species are *Arabis scopoliانا*, *Agrostis alpina*, *Androsace villosa*, *Carex kitaibeliana*, *Crepis kernerii*, *Edraianthus graminifolius* and *Linum julicum*.

From the syndynamical point of view, stands of the association *Scabioso-Dryadetum* are in contact with stands of the associations *Edraiantho graminifolii-Caricetum firmae* Horvat (1930) 1934 and *Scabioso-Caricetum mucronatae* Wraber et Surina in prep. Although the stands of the association *Scabioso-Dryadetum* are physiognomically clearly distinguished from neighbouring stands, several transitional stages between the aforementioned syntaxa can be recognised.

We placed relevés 7–9 (Phytosoc. Tab. 1, Fig. 5) in a phytocoenon with *Scabiosa silenifolia*. These stands are found on ridges of any exposition and slope but they thrive best on horizontal or slightly inclined growth sites (in our case 0–5°) which is in agreement with the comments of HORVAT (1930: 42–45). Stands of the phytocoenon with *Scabiosa silenifolia* are characterised by a high production of mild humus and are of great importance for further syndynamical succession of vegetation on bare calcareous soil. This is indicated by the lack of characteristic and differential species of these stands, as well as the high proportion of incidental species. Homogeneous and distinct stands dominated by *Scabiosa*

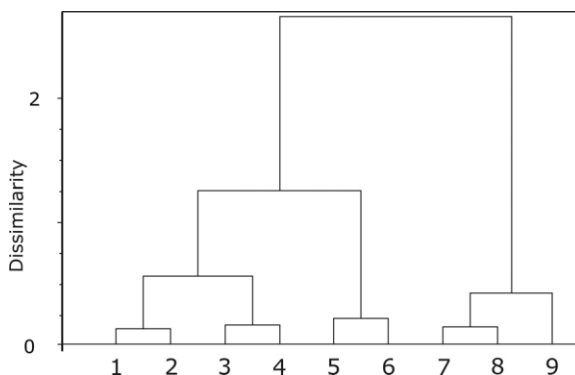


Fig. 5. Dendrogram of relevés of the association *Scabioso silenifoliae-Dryadetum octopetalae* ass. nova (1–6) and phytocoenon with *Scabiosa silenifolia* (7–9) (MISSQ, similarity ratio).

silenifolia were already observed on Mts Velebit and Velika Plješivica and their ecology discussed in detail by HORVAT (1930: phytosoc. tab. II). He treated them as *Helianthemo alpestris-Caricetum kitaibeliana*e Horvat 1930 facies *Scabiosa silenifolia*. In contrast, it seems that LAKUŠIĆ et al. (1979) managed to find some characteristic and differential species of selective stands on the basis of only three relevés and named the association *Scabiosetum silenifoliae* LAKUŠIĆ et al 1979. These stands were observed on the summit of Mt Vranica (Bosnia and Hercegovina) within an altitudinal belt between 1900–2000 m a.s.l. (LAKUŠIĆ and ABADŽIĆ 1982: 61). Only additional relevés could resolve the syntaxonomical problem of these stands for certain.

Syntaxonomical position of the association *Scabioso silenifoliae-Dryadetum octopetalae* ass. nova:

Elyno-Seslerietea Br.-Bl. 1948

Seslerietalia juncifoliae Horvat 1930

Seslerion juncifoliae Horvat 1930

Scabioso silenifoliae-Dryadetum octopetalae ass. nova.

var. *Arabis scopoliana* var. nova

phytocoenon with *Scabiosa silenifolia*

Nomenclature type for the association *Scabioso silenifoliae-Dryadetum octopetalae* ass. nova and the variant *Arabis scopoliana* var. nova (*holotypus*) is relevé No. 6 in table 1.

Synchorology

Similar stands were observed in the north-western part of the Liburnian Karst. They form the largest carpets on the summit of Mt Snežnik. They were also noted at lower altitudes on Snežnik Plateau, whereas on Mts Snježnik and Risnjak the stands we observed were developed above the treeline only fragmentarily within stands of the associations *Edraiantho-Caricetum firmae* and *Helianthemo alpestris-Caricetum kitaibeliana*e. In order to establish the south-eastern boundary of the distribution area of the association *Scabioso-Dryadetum*, further phytosociological and phytogeographical research will be needed.

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Appendix

Localities of relevés:

Phytosoc. tab. 1: Slovenia, Dinaric Region, Snežnik Plateau: **1–2** (20030727/6, 8) Mt Planinc, rocky ridge above the freezing ravine Črna draga; leg. D. Stešević et B. Surina. **3–4** (20030814/2, 3) margine of the freezing ravine with permanent snow at the bottom between Mt Zatrep and Grdobe; leg. U. Abram et B. Surina. **5–6** (20030816/1, 2) Mt Velesji vrh, E of summit of Mt Snežnik; leg. M. Blokar et B. Surina.

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