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# THE ASSOCIATION *DREPANOCLADO UNCINATI-HELIOSPERMETUM PUSILLI* (*ARABIDETALIA CAERULEAE, THLASPIETEA ROTUNDIFOLII*) IN THE TRNOVSKI GOZD PLATEAU (SLOVENIA, NW DINARIC MTS)

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**Abstract**

The phytosociology and ecology of *Heliosperma pusillum* in freezing ravines of the Trnovski gozd plateau (Slovenia, NW Dinaric Mts) are discussed. The species thrive on shadowy, moist, cold and stable screes of boulders with long-lasting snow cover. The stands belonged to the association *Drepanoclado uncinati-Heliospermetum pusilli* (*Salicion retusae*, *Arabidetalia caeruleae, Thlaspietea rotundifolii*). Due to close proximity to the Julian Alps, the stands host a significant number of SE – Alpine and N-Illyrian species. Therefore, a new geographical variant *Paederota lutea* is described. Differential species for the geographical variant are *Phyteuma scheuchzeri* ssp. *columnae, Valeriana saxatilis, Rhodothamnus chamaecistus*, and *Saxifraga cuneifolia*. For less stable screes with smaller rocky particles a new subassociation *salicetosum retusae* is described, and the differential species for the subassociation are *Salix retusa* and *Poa alpina*. Stands of the association *Drepanoclado-Heliospermetum* var. geogr. *Paederota lutea* from the Trnovski gozd plateau are on the north-westernmost part of the distribution area of the Dinaric alliance *Salicion retusae*.

**Key words:** Dinaric Mts, Trnovski gozd, phytosociology, snow-bed vegetation, freezing ravine, *Sanionia uncinata, Heliosperma pusillum, Drepanoclado uncinati-Heliospermetum pusilli, Salicion retusae, Thlaspietea rotundifolii*

**Izvleček**

Preučili smo fitocenološke in okoljske razmere vrste *Heliosperma pusillum* v mraziščih v Trnovskem gozdu (Slovenija, SZ Dinaridi). Vrsta uspeva na senčnih, vlažnih in hladnih ustaljenih meliščih in skalnatih blokih z dolgotrajno snežno odejo. Sestoji, v katerih uspeva vrsta *Heliosperma pusillum,* pripadajo združbi *Drepanoclado uncinati-Heliosperetum pusilli* (*Salicion retusae*, *Arabidetalia caeruleae, Thlaspietea rotundifolii*). Zaradi bližine Julijskih Alp je v sestojih prisotnih precej jugovzhodno-alpskih in severno-ilirskih vrst. Zato smo opisali novo geografsko varianto in jo poimenovali po vrsti *Paederota lutea* var. geogr. nova. Razlikovalne vrste za geografsko varianto so *Paederota lutea, Phyteuma scheuchzeri* ssp. *columnae, Rhodothamnus chamaecistus*, *Saxifraga cuneifolia*, and *Valeriana saxatilis*. Na manj umirjenih meliščih z drobnejšim kamenjem smo opisali novo subasociacijo *salicetosum retusae* subass. nova. Za razlikovalnici smo določili vrsti *Salix retusa* in *Poa alpina*. Sestoji asociacije *Drepanoclado-Heliospermetum* var. geogr. *Paederota lutea* iz Trnovskega gozda so na skrajnem severozahodnem robu areala vegetacije snežnih dolinic iz dinarske zveze *Salicion retusae*.

**Ključne besede:** Dinaridi, Trnovski gozd, fitocenologija, vegetacija snežnih dolinic, mrazišče, *Sanionia uncinata, Heliosperma pusillum, Drepanoclado uncinati-Heliospermetum pusilli, Salicion retusae, Thlaspietea rotundifolii*

## INTRODUCTION

Generally, the flora and vegetation of the Trnovski gozd plateau (W Slovenia, NW Dinaric Mts) are well known. Several botanists have focused their interest on this phytogeographically very interesting area, since the flora and vegetation consist of mixture of different geoelements: Alpine, Central-European, Illyrian (Illyricoid), Dinaric, and (Sub)Mediterranean. The great majority of the phytosociological studies were done on forest vegetation, and overviews were given lately

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by Surina (2001) and Dakskobler (2004). On the other hand, non-forest vegetation is still only poorly investigated. Poldini (1978), Kaligarič (1997), and Kaligarič & Poldini (1997) studied calcareous dry grasslands and pastures on the southern part, while Dakskobler did research on calcareous open sedge swards and stony grasslands of the northern part of the plateau (Dakskobler 1999, 2006). Rock-crevice vegetation on the north-western part of the area (Forest reserve Govci, Zeleni rob) was studied by Dakskobler (1998), and on the southern and sunny slopes by Poldini (1978). The latter did the only research on scree vegetation of the study area. As a result, a new association *Festuco carniolicae-Drypidetum jacquinianae* was described. The same stands were mentioned again by Wraber during his floristical and chorological paper on *Centaurea alpina* (Wraber 2004a). A brief survey of phytosociological researches of non-forestal vegetation was recently made by Dakskobler (2006), while Wraber (2004b) did an overview of all botanical researches (and botanists) in the area.

Studies on the ecology and vegetation of freezing ravines in the Trnovski gozd started already in the 19th century. Krašan (1880) was the first who pointed out interesting vegetation patterns (namely, dwarf pine *Pinus mugo* at the bottom of the karst dolina) in Smrekova draga valley. Subsequently, Beck (1906) tried to explain this phenomenon on the case of the Paradana ice-hollow and Smrekova draga dolina (north-western part of the Trnovski gozd plateau), but the most detailed research on ecology and vegetation of freezing ravines was performed by Martinčič (1977). He studied the ecology and vegetation patterns of some dolinas in the Trnovski gozd plateau: Paradana ice-hollow, Smrekova draga, dolina in Poslušanje, dolina SW from Mt. Bukov vrh (north-western part of the plateau), and Ožgani grič valley (southern part of the plateau on the border between the sub-Mediterranean and Dinaric phytogeographical region). Actually, vegetation studies in Ožgani grič had already been done by Piskernik (1973), who recognised three "climo-coenoses": *Hylocomio splendentis-Moehringietum muscosae* (the coldest growth sites with no woody species), *Salico appendiculatae-Moehringietum muscosae* (shrub stands with *Salix retusa*), and *Piceo excelsae-Moehringietum muscosae* (forest stands with *Picea abies*). Martinčič (1977) classified freezing ravines in the Trnovski gozd as follows: freezing ravines with screes with natural spruce (*Picea abies*) stands (Ožgani grič, Poslušanje), with stands of dwarf-pine (Smrekova draga, dolina SW from Mt. Bukov vrh), and freezing ravines with permanent temperature inversion (Paradana ice-hollow).

There were also extensive phytosociological studies of spruce forests in the Dinaric Mts (Zupančič 1978, 1980, 1999) which were related to the research topic. On the Trnovski gozd plateau, Zupančič studied spruce stands in Smrekova draga (*Lonicero caeruleae-Piceetum*), Smrečje, Velika and Mala Lazna valleys (*Stellario montanae-Piceetum*). Spruce forests occur in the Dinaric Mts only azonally, since they are more or less restricted to freezing ravines or cold, moist, and shaded sites.

During our research on the ecology of *Heliosperma pusillum* in the Dinaric Mts (see Surina & Vreš 2004), as well as flora and vegetation of the Trnovski gozd plateau, we observed very distinct and homogeneous stands with dominating *Heliosperma pusillum* and *Sanionia uncinata* (=*Drepanocladus uncinatus*) in freezing ravines on moist, cold and shadowy screes of boulders, most commonly, with long-lasting snow cover. Ecologically and/or floristically very similar stands were already observed and thoroughly studied on Mt. Snežnik (Piskernik 1973, Martinčič 1977, Surina & Vreš 2004), as well as the Trnovski gozd plateau (Martinčič 1977). However, phytosociological observations from the Trnovski gozd plateau were still missing. Thus the aim of this study was to put forward an ecological assessment and to determine the syntaxonomical position of stands from the Trnovski gozd plateau.

## METHODS

The phytosociology of stands with predominating *Heliosperma pusillum* was studied by applying the sigmatistic method (Braun-Blanquet 1964, Westhoff & van der Maarel 1973, Dierschke 1994). Numerical analyses were carried out with the help of the computer programme SYNTAX (Podani 2001). The coverage index ($I_c$) was calculated according to Lausi & al. (1982). Nomenclature and taxonomy of the taxa are in agreement with the Mala flora Slovenije (Martinčič & al. 2007) and Annotated checklist of mosses of Europe and Macaronesia (Hill & al. 2006), while that of the syntaxa with Surina & Vreš (2004), and geoelements and living forms with the Distribution atlas of the flora of Friuli Venezia Giulia (Poldini

1991). All the syntaxonomic units in the paper and their authors are given in the Appendix.

Vegetation studies were done in two dolinas (Kraljeva kamra, a freezing ravine W from Kraljeva kamra), and an ice-hollow of Paradana (see Appendix). Similar stands were observed also in Smrekova draga, where they were only fragmentarily developed and covered only small scree patches up to 1 $m^2$ within stands of dwarf pine (*Pinus mugo*) and/or large-leaved willow (*Salix appendiculata*). A distinct characteristic of those sites in Smrekova draga was – as already pointed out by Martinčič (1977) – cold and moist air constantly blowing from the hollows between the boulders of screes.

## RESULTS AND DISCUSSION

In nine relevés we found only 32 species of flowering plants, and 17 species of cryptogams (Tables 1 & 2). Hemicryptophytes (23 species, $I_c$=282), and cryptogams ($I_c$=257) prevailed. Six species belong to phanerophytes, three to chamephytes (both $I_c$=28), while there were only 1 geophyte (*Trisetum argenteum*$^2$, $I_c$=5), and therophyte (*Galeopsis speciosa*$^2$, $I_c$=2). The median number of species per relevé area was 21.

The moss layer was well developed and covered 10–80 % (average 35 %), while the herb layer covered 10–70 % (average 43 %) of the relevé areas. The shrub layer was only poorly developed, hardly exceeded 50 cm in height, and was composed of only two willow species: *Salix appendiculata*$^{+1}$, and *S. glabra*$^+$.

Frigophilous and hygrophilous mosses and flowering plants dominated. We found *Heliosperma pusillum*$^{2–5}$, *Viola biflora*$^{+–4}$, *Sanionia uncinata* ~~(=*Drepanocladus uncinatus*)~~$^{+–4}$, and *Orthothecium rufescens*$^{+–1}$ in all studied stands. Those species achieved also the highest coverage indices (Tab. 1). Other species with rather high frequency and coverage indices were *Campylium stellatum*$^{+–1}$, *Paederota lutea*$^{+–1}$, *Salix retusa*$^{+–3}$, *Tortella tortuosa*$^{+–1}$, *Pohlia elongata* ssp. *elongata*$^+$, *Schistidium apocarpum*$^+$, and *Distichium capillaceum*$^+$ (Tab. 1).

The highest coverage indices were achieved by species which usually thrive on screes (*Thlaspietea rotundifolii*) – $I_c$=120 (six species), while most species (seven) were from the class *Asplenietea trichomanis* ($I_c$=54). A rather high coverage index was achieved by species from the class *Mulgedio-Aconitetea* ($I_c$=80; mainly due to domination of *Viola biflora*, and also *Chrysosplenium alternifolium* to a certain extent). The number of species and coverage indices of other syntaxa are presented in Table 2.

From the ecological and syntaxonomical point of view, the studied stands from the Trnovski gozd plateau resembled closely the stands of the association *Drepanoclado uncinati-Heliospermetum pusilli* from the Snežnik plateau. Characteristic species of the association, specially edifier species of *Heliosperma pusillum* and *Sanionia uncinata*, were fully represented and with more or less high coverage indices. Additionally, stands from the Trnovski gozd plateau thrived in very similar ecological conditions: wet, shady and cold screes in freezing ravines with long lasting snow cover. An extensive syntaxonomical comparison showed that stands from the Trnovski gozd, Liburnian karst (sensu Beck 1901) and Velebit Mts clearly differ from other scree stands in the area of the SE Alps and NW Dinaric Mts (Surina 2005a, b, Surina & Modrić 2006), and form a single, more or less uniform group within the alliance *Salicion retusae* (the synoptic table is available from the first author); thus classifying the stands from the Trnovski gozd plateau into the association *Drepanoclado-Heliospermetum* within the Dinaric alliance *Salicion retusae*, was indisputable. Stands from the Trnovski gozd plateau are at the north-westernmost extent of the distribution area of the alliance *Salicion retusae*.

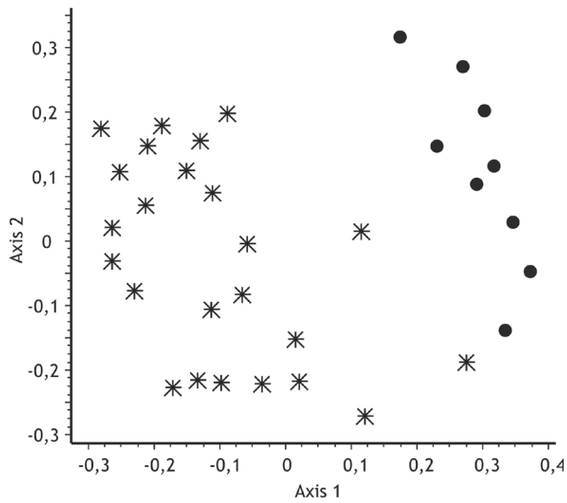


**Figure 1:** Two-dimensional scatter diagram of stands of the association *Drepanoclado-Heliospermetum* from the Trnovski gozd plateau (circles) and Mt Snežnik (stars) (NW Dinaric Mts); complete linkage, Sørensen's coefficient.

**Slika 1:** Dvoraszežnostni diagram sestojev asociacije *Drepanoclado-Heliospermetum* iz Trnovskega gozda (krogi) in Snežnika (zvezde); popolno povezovanje, Sørensenov koeficient.

**Table 1:** Phytosociological table of the association *Drepanoclado uncinati-Heliospermetum pusilli* from the Trnovski gozd plateau.

**Tabela 1:** Fitocenološka tabela asociacije *Drepanoclado uncinati-Heliospermetum pusilli* iz Trnovskega gozda.

| | Successive number | | 1 | 2 | 3* | 4 | 5 | 6 | 7 | 8 | 9 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Altitude (m) | | 1300 | 1353 | 1115 | 1115 | 1118 | 1115 | 1295 | 1295 | 1110 | | |
| | Aspect | | W | | S | W | N | SE | E | NE | N | | |
| | Inclination ($^0$) | | 20 | | 45 | 45 | 45 | 45 | 20 | 25 | 30 | | |
| | Relevé area (m$^2$) | | 4 | 2 | 8 | 4 | 12 | 8 | 6 | 8 | 1 | | |
| | Stoniness (%) | | 20 | 10 | 20 | 10 | 20 | 15 | 50 | 10 | 40 | | |
| | Shrub layer (%) | B | | | | 5 | 5 | | | | | | |
| | Herb layer (%) | C | 20 | 10 | 70 | 60 | 60 | 70 | 30 | 30 | 40 | | |
| | Moss layer (%) | D | 60 | 80 | 10 | 30 | 20 | 15 | 20 | 60 | 20 | | |
| | Number of flowering plants/relevé | | 27 | 12 | 24 | 22 | 18 | 21 | 21 | 12 | 12 | % | $I_c$ |
| | **Characteristic species of the association** | | | | | | | | | | | | |
| TR | *Heliosperma pusillum* | C | 2.3 | 2.3 | 4.3 | 4.3 | 3.3 | 4.3 | 3.3 | 3.3 | 5.3 | 100 | 78 |
| | *Sanionia uncinata* | D | 2.3 | 2.3 | 3.3 | 4.3 | 3.3 | 3.3 | 2.3 | +.3 | 2.3 | 100 | 62 |
| | *Campylium stellatum* | D | +.3 | +.3 | +.3 | 1.3 | +.3 | . | +.3 | . | +.3 | 78 | 18 |
| | *Carex capillaris* | C | +.2 | + | + | + | . | . | . | . | . | 44 | 10 |
| | *Oncophorus virens* | D | . | 1.3 | . | . | +.3 | . | . | . | . | 22 | 6 |
| | **Phytogeographical differential species** | | | | | | | | | | | | |
| AT | *Paederota lutea* | C | + | + | 1.2 | + | 1.2 | +.2 | . | . | . | 67 | 17 |
| AT | *Valeriana saxatilis* | C | + | . | +.2 | . | . | . | + | . | . | 33 | 7 |
| AT | *Phyteuma scheuchzeri* ssp. *columnae* | C | + | . | . | . | . | . | 1.2 | . | . | 22 | 6 |
| VP | *Saxifraga cuneifolia* | C | . | . | . | . | . | . | . | . | 2.2 | 11 | 6 |
| EP | *Rhodothamnus chamaecistus* | C | . | . | . | +.2 | . | . | . | . | . | 11 | 2 |
| | **Differential species for the subassociation** | | | | | | | | | | | | |
| TR | *Salix retusa* | C | +.2 | +.2 | 3.3 | 1.3 | 1.2 | +.2 | . | . | . | 67 | 23 |
| ES | *Poa alpina* | C | . | . | 3.2 | 1.1 | 1.2 | 2.2 | . | . | 1.2 | 56 | 26 |
| TR | ***Arabidetalia caeruleae* (incl. *Salicion retusae*) & *Thlaspietea rotundifolii*** | | | | | | | | | | | | |
| | *Arabis alpina* | C | . | . | + | . | . | 1.2 | . | + | . | 33 | 9 |
| | *Trisetum argenteum* | C | . | . | . | . | . | . | + | + | . | 22 | 5 |
| | *Adenostyles glabra* | C | . | . | . | +.2 | . | . | . | . | . | 11 | 2 |
| | *Cystopteris montana* | C | . | . | . | . | . | . | +.2 | . | . | 11 | 2 |
| AT | ***Asplenietea trichomanis*** | | | | | | | | | | | | |
| | *Cystopteris fragilis* | C | . | . | + | . | + | + | + | . | . | 44 | 10 |
| | *Carex brachystachys* | C | . | . | . | +.2 | . | . | + | . | . | 22 | 5 |
| | *Cystopteris regia* | C | +.2 | . | . | . | . | . | 1.2 | . | . | 22 | 6 |
| | *Primula carniolica* | C | . | . | . | +.2 | . | . | . | . | . | 11 | 2 |
| ES | ***Elyno-Seslerietea*** | | . | . | . | . | . | . | . | . | . | | |
| | *Pinguicula alpina* | C | + | . | . | . | . | . | + | . | . | 22 | 5 |
| | *Aster bellidiastrum* | C | + | . | . | . | . | . | . | . | . | 11 | 2 |
| | *Tofieldia calyculata* | C | + | . | . | . | . | . | . | . | . | 11 | 2 |
| AD | ***Mulgedio-Aconitetea*** | | | | | | | | | | | | |
| | *Viola biflora* | C | 1.1 | 1.1 | 4.2 | 3.2 | 2.2 | 2.2 | 3.2 | 2.2 | + | 100 | 55 |
| | *Chrysosplenium alternifolium* | C | . | . | . | . | . | +.2 | . | . | 1.2 | 22 | 6 |
| | *Salix appendiculata* | B | . | . | . | + | . | . | . | . | . | 11 | 2 |
| | *Salix appendiculata* | C | 1.2 | + | + | . | +.2 | . | . | . | . | 44 | 11 |
| | *Salix glabra* | B | . | . | . | . | + | . | . | . | . | 11 | 2 |
| | | C | . | . | . | . | + | . | . | . | . | 11 | 2 |

| | Successive number | | 1 | 2 | 3* | 4 | 5 | 6 | 7 | 8 | 9 | % | $I_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FS | ***Fagetalia sylvaticae*** | | | | | | | | | | | | |
| | *Saxifraga rotundifolia* | C | . | . | . | . | . | 2.2 | . | +.2 | +.2 | 33 | 11 |
| | *Ranunculus platanifolius* | C | . | . | +.2 | . | . | + | . | . | . | 22 | 5 |
| | *Festuca altissima* | C | . | . | . | . | . | + | . | . | . | 11 | 2 |
| EP | ***Erico-Pinetea*** | | | | | | | | | | | | |
| | *Rhododendron hirsutum* | C | + | | + | + | | | | | | 33 | 7 |
| | *Vaccinium vitis-idaea* | C | +.2 | | | | | | | | | 11 | 2 |
| VP | ***Vaccinio-Piceetea*** | | | | | | | | | | | | |
| | *Lonicera caerulea* | C | . | . | + | . | . | . | . | . | . | 11 | 2 |
| | ***Other species*** | | | | | | | | | | | | |
| | *Parnassia palustris* | C | + | . | . | . | . | . | + | . | . | 22 | 5 |
| | *Galeopsis speciosa* | C | . | . | . | . | . | . | . | + | . | 11 | 2 |
| | **Mosses and lichens** | | | | | | | | | | | | |
| | *Orthothecium rufescens* | D | 1.2 | +.2 | +.2 | 1.2 | +.2 | +.2 | 1.2 | 1.3 | 1.2 | 100 | 28 |
| | *Tortella tortuosa* | D | 1.3 | +.3 | . | +.3 | +.3 | +.3 | 1.3 | +.3 | 1.3 | 89 | 23 |
| | *Pohlia elongata* ssp. *elongata* | D | +.3 | . | +.3 | +.3 | +.3 | +.3 | +.3 | +.3 | . | 78 | 17 |
| | *Schistidium apocarpum* | D | +.3 | +.3 | . | +.3 | +.3 | +.3 | . | +.3 | +.3 | 78 | 17 |
| | *Distichium capillaceum* | D | . | +.3 | +.3 | . | +.3 | . | +.3 | . | +.3 | 56 | 12 |
| | *Ctenidium molluscum* | D | 1.3 | +.3 | . | . | . | . | +.3 | +.3 | . | 44 | 11 |
| | *Hylocomium splendens* | D | . | . | +.3 | . | . | 1.3 | . | . | 2.3 | 33 | 12 |
| | *Rhytidiadelphus loreus* | D | . | 4.3 | +.3 | . | . | 1.3 | . | . | . | 33 | 15 |
| | *Rhytidiadelphus triquetrus* | D | . | . | +.3 | +.3 | . | 1.3 | . | . | . | 33 | 9 |
| | *Solorina saccata* | D | + | . | . | . | 1.2 | . | . | + | . | 33 | 9 |
| | *Dicranum scoparium* | D | 1.3 | 1.3 | . | . | . | . | . | . | . | 22 | 7 |
| | *Polytrichastrum alpinum* | D | . | . | +.3 | . | . | 1.3 | . | . | . | 22 | 6 |
| | *Plagiochila asplenioides* | D | +.2 | . | . | . | . | . | . | . | . | 11 | 2 |
| | *Cladonia pyxidata* | D | . | + | . | . | . | . | . | . | . | 11 | 2 |

There were, however several notable differences between stands from the Trnovski gozd ~~plateau~~ and Snežnik plateau which were clearly supported also by the statistical analysis (Fig. 1). ~~(a)~~ Stands from the Snežnik plateau hosted considerably a greater total number of species as well as number of species per relevé (Tab. 2). ~~(b)~~ In both cases, covering indices of species from the class *Thlaspietea rotundifolii* prevail, and there were also high indices of species of *Mulgedio-Aconitetea* in both cases, but a much lower number of species and ~~covering~~ indices of species of *Elyno-Seslerietea, Erico-Pinetea, Vaccinio-Piceetea*, and group of other species in the Trnovski gozd plateau. Due to the close proximity to the Julian Alps, a much higher number of species of *Elyno-Seslerietea* was expected. Furhermore, on the Trnovski gozd plateu we did not find any species from the class *Querco-Fagetea* (but a higher coverage index of *Fagetalia sylvaticae* which is probably due to the lower altitude of the studied stands). Species from the order *Seslerietalia juncifoliae* were also missing, and here the reason was probably of phytogeographical origin itself. The considerably lower number and coverage indices of species of mentioned syntaxa in stands of the Trnovski gozd plateau were most probably due to spatial isolation of studied stands. In most cases they were, incontrary to stands from the Snežnik plateau, isolated and not in direct contact with forest stands of spruces and beeches as well as stands of tall-herbs. ~~(c)~~ Although the Mediterranean-montane geoelement prevailed in both studied areas, presences and coverage indices of European-Asiatic, European-Sibiric, and Arctic-Alpine geoelements were significantly smaller on the Trnovski gozd plateau. There were no paleotemperate and Alpine-Carpathian geoelements, while the coverage indices of Alpine and European geoelements were higher. From the phytogeographical point of view it was interesting to observe the higher coverage index of the SE Alpine-Illyrian geoelement and total absence of the Illyrian and SE-European geoelements on the Trnovski gozd plateau. ~~(d)~~ Although all characteristic species of the syntaxon *Drepanoclado-Heliospermetum* occurred

on the Trnovski gozd plateau, they had rather smaller constancy and coverage indices, however, still with sufficient presence. Interestingly, *Polygonum viviparum, Vaccinium vitis-idaea, V. myrtillus, Homogyne sylvestris, Oxalis acetosella, Deschampsia caespitosa, Campanula cochleariifolia, Carex atrata, Festuca nitida* etc., which were quite common in stands on the Snežnik plateau, were completely missing. On the other hand, some N-Illyrian and E-Alpine species occurred only in stands of the Trnovski gozd plateau: *Paederota lutea*$^{+-1}$, *Rhodotamnus chamaecistus*$^{+}$, *Valeriana saxatilis*$^{+}$, *Saxifraga cuneifolia*$^{2}$, and *Phyteuma scheuchzeri* ssp. *columnae*$^{+-1}$. They are quite common in the studied area and only rarely occur further towards the SE Dinaric Mts (e.g., *Saxifraga cuneifolia* and *Paederota lutea*). More detailed information on the distribution area of the mentioned taxa and the phytogeographical peculiarities of the area in general are given in Dakskobler (1998), Dakskobler & al. (2000), and Surina (2002). The Code of phytosociological nomenclature (Weber & al. 2000) does not consider geographical variants, hence the correct typification of the syntaxa of this rank is not possible. Nevertheless, we chose above mentioned taxa as geographically differential for the association *Drepanoclado-Heliospermetum* var. geogr. *Paederota lutea* var. geogr. nova on the Trnovski gozd plateau. Other species of phytogeographical importance for the Trnovski gozd plateau were also *Salix glabra* and *Primula carniolica*, the latter as one of the most prominent endemic plants of Slovenian flora (see Dakskobler & al. 2004). Phytogeographical distinctions were also observed in other studied syntaxa from the Trnovski gozd plateau, e.g. *Seslerio autumnalis-Fagetum* var. geogr. *Phyteuma columnae* (*Seslerio autumnalis-Fagetum* var. geogr. *Calamintha grandiflora* on Snežnik plateau), *Omphalodo-Fagetum* var. geogr. *Saxifraga cuneifolia* (*Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora* on Snežnik plateau, and *Homogyno-Fagetum* s. lat. in the Julian Alps), *Primulo carniolicae-Caricetum firmae* (*Edraiantho graminifolii-Caricetum firmae* on Snežnik plateau, *Gentiano terglouensis-Caricetum firmae* in the Julian Alps), *Caricetum mucronatae* var. geogr. *Primula carniolica* (*Scabioso silenifoliae-Caricetum mucronatae* on Snežnik plateau, *Caricetum mucronatae* s. lat. in the Julian Alps) etc. (see Dakskobler 1997, 2002, 2004, Surina 2002, Surina & Wraber 2005, Surina & Dakskobler 2005).

Within the stands from the Trnovski gozd plateau, two floristically and physiognomically distinct groups of relevés were observed (Tab. 1, Fig 2). In the first group (rel. 1–6), beside characteristic species of the association (*Heliosperma pusillum* and *Sanionia uncinata* above all), *Salix retusa*$^{+-3}$ and *Poa alpina*$^{1-3}$ prevailed on screes with tinier stony particles of diameter 5–10, and up to 20 cm, whereas typical stands used to thrive on completely settled screes within and on larger blocks or even boulders. Therefore a new subassociation *Drepanoclado-Heliospermetum salicetosum retusae*, subass. nova was described, and for the differential species we chose *Salix retusa* and *Poa alpina*.

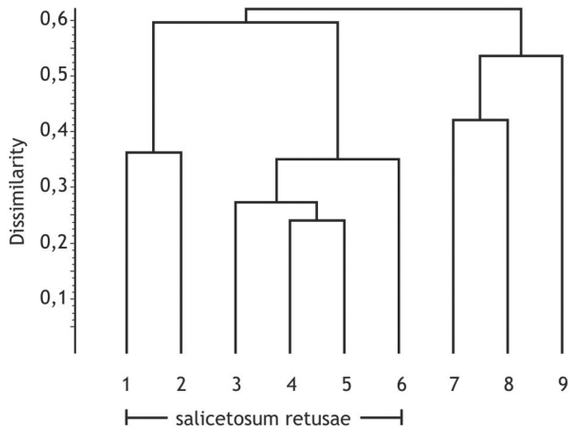


**Figure 2:** Dendrogram of relevés of the association *Drepanoclado-Heliospermetum* var. geogr. *Paederota lutea* var. geogr. nova on the Trnovski gozd plateau (complete linkage, similarity ratio).

**Slika 2:** Dendrogram popisov asociacije ***Drepanoclado-Heliospermetum*** var. geogr. ***Paederota lutea*** geogr. nova iz Trnovskega gozda (popolno povezovanje, koeficient podobnosti).

Typification of the geographical variant *Drepanoclado uncinati-Heliospermetum pusilli* Surina & Vreš 2004 var. geogr. *Paederota lutea* var. geogr. nova, and subassociation *salicetosum retusae* subass. nova: rel. No. 3 in the Table 1, holotypus hoc loco.

Classification of studied stands:

*Thlaspietea rotundifolii* Br.-Bl. in Br.-Bl. & Jenny 1926

*Arabidetalia caeruleae* Rübel ex Br.-Bl. 1949

*Salicion retusae* Horvat 1949

*Drepanoclado uncinati-Heliospermetum pusilli* Surina & Vreš 2004 geogr. *Paederota lutea* var. geogr. nova

-*salicetosum retusa*e subass. nova

**Table 2:** Syntaxonomical and chorological groups, life forms and some phytosociological parameters in stands of the association *Drepanoclado-Heliospermetum* from the Trnovski gozd and Snežnik plateaus.

**Tabela 2:** Sitaksonomske in horološke skpuine, življenjske oblike in nekateri fitocenološki parametri sestojev asociacije *Drepanoclado-Heliospermetum* iz Trnovskega gozda in Snežnika.

| | | Trnov. gozd plateau | | Snežnik plateau | |
|---|---|---|---|---|---|
| | | No. | Ic | No. | Ic |
| syntaxa | *Thlaspietea rotundifolii* s. lat. | 6 | 120 | 9 | 124 |
| | *Asplenietea trichomanis* | 7 | 54 | 5 | 37 |
| | *Seslerietalia juncifoliae* | . | . | 4 | 6 |
| | *Elyno-Seslerietea* | 4 | 36 | 20 | 66 |
| | *Mulgedio-Aconitetea* | 4 | 80 | 11 | 88 |
| | *Fagetalia sylvaticae* | 3 | 19 | 9 | 12 |
| | *Querco-Fagetea* | . | . | 4 | 17 |
| | *Erico-Pinetea* | 3 | 12 | 4 | 51 |
| | *Vaccinio-Piceetea* | 2 | 9 | 20 | 92 |
| | Other species | 3 | 17 | 8 | 96 |
| geoelements | Cosmopolitan | 2 | 16 | 5 | 34 |
| | Circumboreal | 4 | 89 | 18 | 163 |
| | Paleotemperate | . | . | 2 | 2 |
| | European-Asiatic | 3 | 6 | 7 | 28 |
| | European-Siberian | 1 | 5 | 4 | 42 |
| | Europaean | 3 | 30 | 4 | 4 |
| | Arctic-Alpine | 5 | 28 | 13 | 89 |
| | Alpine-Capathian | . | . | 1 | 2 |
| | Alpine | 2 | 14 | 1 | 12 |
| | E-Alpine | 2 | 7 | . | . |
| | Mediterranean-montane | 7 | 115 | 28 | 191 |
| | SE-Europaean | . | . | 2 | 2 |
| | Illyrian | . | . | 5 | 14 |
| | N-Illyrian | 5 | 29 | 4 | 5 |
| Life forms | Phanerophytes | 6 | 28 | 11 | 64 |
| | Chamephytes | 3 | 28 | 5 | 43 |
| | Hemicryptophytes | 23 | 282 | 65 | 401 |
| | Geophytes | 1 | 5 | 14 | 77 |
| | Therophytes | 1 | 2 | . | . |
| | Mosses and lichens | 17 | 257 | 19 | 325 |
| altitude (min-max, Me) | | 1110–1300 1118 | | 1200–1525 1273 | |
| total number of seed plants | | 32 | | 96 | |
| species/releve (min-max, Me), KV (%) | | 12–27. 21 30 | | 5–38, 19 41.7 | |

## CONCLUSIONS

(a) We classified the studied stands from the Trnovski gozd plateau into the association *Drepanoclado-Heliospermetum*; (b) the stands are floristically impoverished and not optimally developed; nevertheless, our field diagnosis, analytical and extensive synoptic tables as well as numerical analyses still firmly supported their classification into the association *Drepanoclado-Heliospermetum* within the Dinaric alliance *Salicion retusae*; (c) due to phytogeographical peculiarities of the area and floristical distinction of the association from the Trnovski gozd plateau, a new geographical variant was described: *Drepanoclado-Heliospermetum* var. geogr. *Paederota lutea*, and for geographically differential taxa we chose *Paederota lutea, Valeriana saxatilis, Saxifraga cuneifolia, Rhodotamnus chamaecistus*, and *Phyteuma scheuchzeri* ssp. *columnae*. (d) Within the association stands were floristically and ecologically distinguished into the new subassociation *Drepanoclado-Heliospermetum salicetosum retusae*, subass. nova. It thrived on not completely settled screes with tinier stony particles. Differential species for the subassociation were *Salix retusa* and *Poa alpina*.

## APPENDIX

### *1. Phytosociological Table 1: localites of the relevés*

NW Dinaric Mts, Slovenia, Trnovski gozd plateau

**1, 7, 8 –** Kraljeva kamra (MTB: 0049/141, UTM: VL19), moist and shady scree; **2 –** freezing ravine W from Kraljeva kamra, NW from Mt Veliki Golak (MTB: 0049/141, UTM: VL19), moist scree with long-lasting snow cover; **3–6, 9 –** Paradana (MTB: 0049/141, UTM: VL19), moist and shady screes. Leg. & det.: B. Vreš and B. Surina, 18.7.2001.

### *2. List of syntaxa mentioned in the article with authors*

*Arabidetalia caeruleae* Rübel ex Br.-Bl. 1949
*Asplenietea trichomanis* Br.-Bl. in Meier & Br.-Bl. 1934
*Caricetum mucronatae* (Br.-Bl. in Br.-Bl. & Jenny 1926) Thomaser 1977 var. geog. *Primula carniolica* Dakskobler 2006
*Drepanoclado uncinati-Heliospermetum pusilli* Surina & Vreš 2004
*Edraiantho graminifolii-Caricetum firmae* (Horvat 1930) 1934
*Elyno-Seslerietea* Br.-Bl. 1948
*Erico-Pinetea* Horvat 1959
*Fagetalia sylvaticae* Pawl. in Pawl. et al. 1928
*Festuco carniolicae-Drypidetum jacquinianae* Poldini 1978
*Gentiano terglouensis-Caricetum firmae* T. Wraber 1970
*Homogyno sylvestris-Fagetum* Marinček et al. 1993
*Lonicero caeruleae-Piceetum* Zupančič (1980) 2000
*Mulgedio-Aconitetea* Hadač & Klika in Klika 1948
*Omphalodo-Fagetum* (Tregubov 1957 corr. Puncer 1980) Marinček et al. 1993 var. geogr. *Saxifraga cuneifolia* Surina 2002
*Omphalodo-Fagetum* (Tregubov 1957 corr. Puncer 1980) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002
*Primulo carniolicae-Caricetum firmae* Dakskobler 2006
*Querco-Fagetea* Br.-Bl. & Vlieg. 1937
*Salicion retusae* Horvat 1949
*Scabioso silenifoliae-Caricetum mucronatae* Surina & T. Wraber 2005
*Seslerietalia juncifoliae* Horvat 1930
*Seslerio autumnalis-Fagetum* (Horvat 1950) M. Wraber ex Borhidi 1963 var. geogr. *Phyteuma columnae* Dakskobler 1997
*Seslerio autumnalis-Fagetum* (Horvat 1950) M. Wraber ex Borhidi 1963 var. geogr. *Calamintha grandiflora* Dakskobler 1997
*Stellario montanae-Piceetum* Zupančič 2000
*Thlaspietea rotundifolii* Br.-Bl. in Br. Bl. & Jenny 1926
*Vaccinio-Piceetea* Br.-Bl. 1939 emend. Zupančič (1976) 2000

## POVZETEK

**Asociacija *Drepanoclado uncinati-Heliospermetum pusilli* (*Arabidetalia caeruleae*, *Thlaspietea rotundifolii*) v Trnovskem gozdu (Slovenije, SZ Dinarsko gorstvo)**

S pomočjo sigmatistične metode (Braun-Blanquet 1964, Westhoff & van der Maarel 1973, Dierschke 1994) smo preučili fitocenološke in okoljske razmere četverozobega slanozorja (*Heliosperma pusillum*) v mraziščih Trnovskega gozda. Slanozor uspeva na senčnih, vlažnih in bolj ali manj ustaljenih meliščih z dologotrajno snežno odejo. Preučevani sestoji pripadajo asociaciji *Drepano-*

*clado uncinati-Heliospermetum pusilli* (*Salicion retusae, Arabidetalia caeruleae, Thlaspietea rotundifolii*), ki sta jo ista avtorja že prej opisala na Snežniku. Zaradi bližine Julijskih Alp je v teh sestojih prisotnih precej jugovzhodno-alpskih vrst, zato smo jih uvrstili v novo geografsko varianto – *Paederota lutea*. Ostale diferencialne vrste za geografsko varianto so: *Phyteuma scheuchzeri* ssp. *columnae, Valeriana saxatilis, Rhodothamnus chamaecistus* in *Saxifraga cuneifolia*. Na manj ustaljenih meliščih, kjer prevladuje vrsta *Salix retusa*, smo opisali novo subasociacijo: – *salicetosum retusae*, in za diferencialni vrsti izbrali *Salix retusa* in *Poa alpina*. Preučevani sestoji v Trnovskem gozdu predstavljajo skrajni severozahodni rob areala asociacije *Drepanoclado-Heliospermetum* in dinarske zveze *Salicion retusae*. Nomenklaturni tip za geografsko varianto *Drepanoclado uncinati-Heliospermetum pusilli* Surina & Vreš 2004 var. geogr. *Paederota lutea*, var. geogr. nova, in subasociacijo –*salicetosum retusae,* subass. nova, holotypus hoc loco, je popis št. 3 v tabeli 1.

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