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Original scientific paper

XEROPHILOUS GRASSLAND COMMUNITIES ON ROCKY OUTCROPS ON THE GORJANCI MOUNTAIN RANGE

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Grasslands are important due to their high biodiversity endemism and because they provide important ecological services. This study focuses on grasslands on rocky outcrops above carbonate bedrock in the Gorjanci mountain range. The aims of the study were to record the vegetation and to clarify some nomenclatural issues. Two plant communities were identified: one dominated by *Sesleria juncifolia* subsp. *kalnikensis* and the other by *Carex humilis*, and they were assigned to *Seslerietum kalnikensis* Horvat 1974 mut. Čarni nom. mut. novum and *Scabioso hladnikianae-Caricetum humilis* (Horvat 1931) Tomažič 1941. Both are classified within the alliance *Bromion* (*Mesobromion*), order *Brachypodietalia pinnati* and class *Festuco-Brometea*. A review of the historical literature and nomenclature led to a proposed mutation of the association name *Seslerietum juncifoliae* Ht. et al. 1974 and to tracing the development of the concept proposed by Horvat as *Xerobrometum erecti* Ht. 1931. Today, the latter concept results in three associations: *Scabioso hladnikianae-Caricetum humilis* (Horvat 1931) Tomažič 1941, *Bromo erecti-Plantaginetum mediae* (Horvat 1931) Brzac 1960 and *Bromo erecti-Danthonietum alpinae* Petkovšek 1974 nom. corr. We proposed also alternative names for the last two syntaxa.

This study is dedicated to an appreciation of the contributions of Academician Vlado Matevski to the study of the flora and vegetation of the southern Balkans.

Key words: *Bromion*; *Festuco-Brometea*; Gorjanci mountain range; grassland; nomenclature; plant community; Slovenia; vegetation

INTRODUCTION

Grasslands are among the largest and most diverse ecosystems in the world. Our article focuses on dry grasslands that occur on rocky outcrops and steep slopes over calcareous bedrock and are traditionally classified within *Festuco-Brometea*. These grasslands are characterized by high species diversity, local and regional endemism and are habitats for rare and endangered species. They also provide essential ecological services in European landscapes [1–4].

In the wider region, such grasslands can be further classified as (a) xerophilous open steppe

grasslands on flat, rocky calcareous and gravelly substrates in areas of Europe with low precipitation (*Stipo pulcherrimae-Festucetalia pallentis*); (b) meso-xerophytic grasslands on deep calcareous soils in areas with high precipitation (*Brachypodietalia pinnati*); (c) amphiadriatic dry grasslands in regions with a (sub)-mediterranean climate (*Scorzoneretalia villosae*) [5–7].

The aims of this study were to sample the vegetation of the rocky grasslands on the Gorjanci mountain range and to classify it in the European vegetation system. In addition, questions of nomenclature in connection with the identified grassland types were to be clarified.

This article is dedicated to Academician Vlado Matevski on his seventieth birthday and honors his significant contributions to the study of

the flora and vegetation of the southern Balkans. An important part of his extensive scientific work was also devoted to the vegetation of dry grasslands.

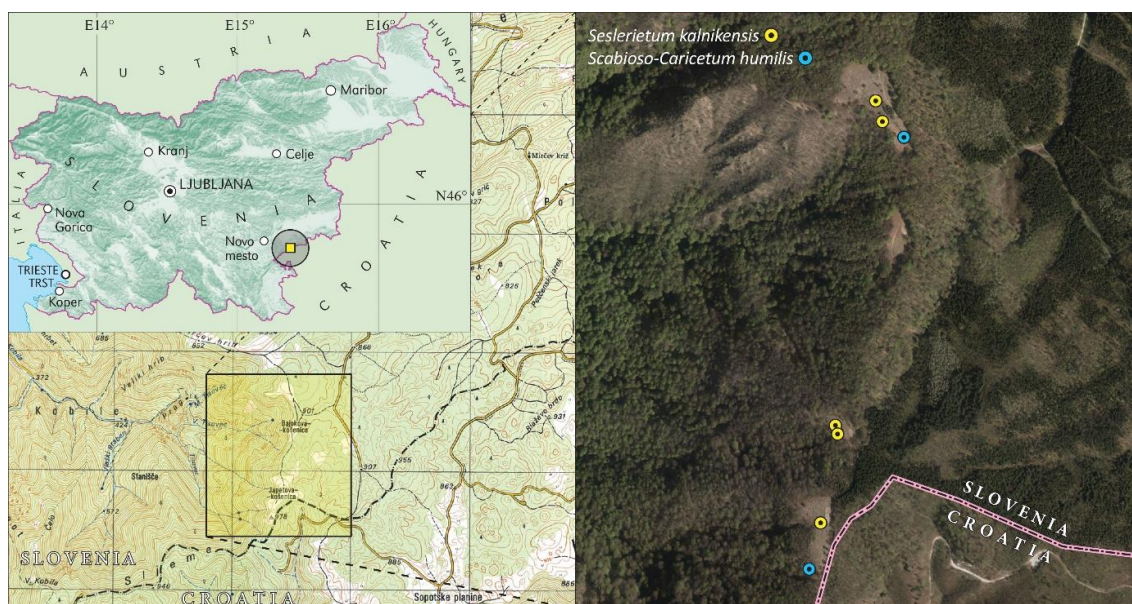


Figure 1. Sampled sites in the Gorjanci mountain range

MATERIAL AND METHODS

The Gorjanci mountain range is located in the south-east of Slovenia and extends some 45 km along the border with Croatia (Figure 1). Its highest peak, Trdinov vrh, rises to 1,178 meters. The mountain range is a tectonic outcrop that extends over the surrounding flat area and its bedrock consists mainly of limestone and dolomite. The average annual rainfall is around 1,300 mm and the average annual temperature is between 8°C and 9°C. The area is part of the Praedinaric phytogeographical region, which borders the Subpannonian region, which extends in the lowlands at the foot of the mountain range. Most of the Gorjanci mountain range is covered by various types of beech forest [8–11].

We sampled and analyzed the vegetation according to the standard Central European method [12]. The plant species were assigned to higher syntaxa according to Kaligarič and Willner and coauthors [13, 14]. The nomenclatural treatment of the syntaxa followed the guidelines of the International Code of Phytosociological Nomenclature (ICPN) [15]. The nomenclature of the plant species followed Mala flora Slovenije [16].

RESULTS

We identified two plant communities: one dominated by *Sesleria juncifolia* subsp. *kainikensis* and the other by *Carex humilis*. In addition to the dominant species, we found numerous species characteristic of meso-xerophytic grasslands on deep calcareous soils in high precipitation areas of *Brachypodietalia pinnati*. These species include *Briza media*, *Bromopsis erecta*, *Buphthalmum salicifolium*, *Carex flacca*, *Centaurea jacea* agg., *Lotus corniculatus*, *Salvia pratensis*, *Thymus longicaulis*, etc., which confirm the assignment of the communities to *Brachypodietalia pinnati*.

We also found species typical of xerophilous, open steppe grasslands on rocky sites associated with *Stipo-Festucetalia pallentis*, such as *Anthericum ramosum*, *Polygonatum odoratum* and *Teucrium montanum*. However, we did not find any diagnostic species that would suggest a classification of these communities into the sub-Mediterranean, amphiadriatic dry grasslands of *Scorzoneretalia villosae*. In addition, several species suggest a classification in the class *Festuco-Brometea*, including *Anthyllis vulneraria*, *Asperula cynanchica*, *Centaurea bracteata* and others.

Furthermore, the presence of species typically found on forest edges indicates a certain degree of land abandonment.

Table 1. Analytical table of the sampled communities

Relevé number	1	2	3	4	5	6	7
Ass. diagnostic species							
<i>Sesleria kalnikensis</i>	3	5	5	5	5	.	+
<i>Carex humilis</i>	2	+	+	+	+	4	4
Brometalia erecti							
<i>Lotus corniculatus</i>	+	+	+	+	+	+	+
<i>Bromus erectus</i>	1	+	+	+	1	.	1
<i>Centaurea jacea</i> agg.	+	.	+	.	+	+	+
<i>Thymus longicaulis</i>	.	+	+	+	.	+	3
<i>Buphthalmum salicifolium</i>	.	.	+	+	+	+	+
<i>Salvia pratensis</i>	+	+	+	.	+	.	.
<i>Briza media</i>	+	.	+	.	.	+	+
<i>Carex flacca</i>	+	.	+	.	.	+	+
<i>Polygala comosa</i>	.	.	+	+	+	+	.
<i>Potentilla erecta</i>	.	.	+	.	+	+	+
<i>Prunella laciniata</i>	+	+	.	.	.	.	+
<i>Cirsium pannonicum</i>	+	.	+	.	.	.	+
<i>Trifolium montanum</i>	.	.	.	+	.	1	+
<i>Brachypodium rupestre</i>	+	.	+	.	.	.	.
<i>Filipendula hexapetala</i>	.	.	.	.	.	+	+
<i>Plantago media</i>	.	.	.	.	.	+	+
<i>Carlina acaulis</i>	+	.	.	.	.	.	.
<i>Carex montana</i>	.	.	+	.	.	.	.
<i>Aster amellus</i>	.	.	.	.	.	+	.
<i>Centaurea scabiosa</i>	.	.	.	.	.	.	+
<i>Plantago lanceolata</i>	.	.	.	.	.	.	+
<i>Betonica officinalis</i>	.	.	.	.	.	.	+
Stipo-Festucetalia pallentis							
<i>Polygonatum odoratum</i>	+	+	+	2	.	.	.
<i>Anthericum ramosum</i>	+	.	.	.	.	.	.
<i>Teucrium montanum</i>	.	.	.	.	+	.	.
Festuco-Brometea							
<i>Helianthemum nummularium</i>	1	+	1	1	1	+	2
<i>Scabiosa hladnikiana</i>	+	+	+	+	+	+	+
<i>Erysimum carniolicum</i>	+	+	+	+	+	.	+
<i>Asperula cynanchica</i>	+	.	+	+	+	+	+
<i>Festuca rupicola</i>	1	.	+	+	+	1	+
<i>Koeleria pyramidata</i>	+	+	+	+	.	3	1
<i>Dianthus croaticus</i>	+	.	+	+	.	+	+
<i>Hypocrepis comosa</i>	+	.	.	+	+	2	2
<i>Euphorbia cyparissias</i>	.	+	+	+	+	.	+
<i>Thesium bavarum</i>	.	+	+	+	.	+	+
<i>Stachys recta</i>	.	.	+	+	+	+	+
<i>Silene nutans</i>	.	.	+	+	.	1	+
<i>Gymnadenia conopsea</i>	.	.	+	+	.	+	+
<i>Sanguisorba minor</i>	.	.	.	.	+	+	+
<i>Galium lucidum</i>	2	+	.	.	.	.	.

Table 1. Continues

Teucrium chamaedrys	+	.	+	.	.	.	.
Veronica jacquinii	+	.	.	.	.	+	.
Linum viscosum	.	+	+	.	.	.	.
Centaurea bracteata	.	.	.	+	+	.	.
Peucedanum oreoselinum	.	.	.	.	+	+	.
Anthyllis vulneraria	.	.	.	.	.	1	+
Potentilla recta	.	.	.	.	+	.	.
Galium verum	.	.	.	.	.	.	+
Other species							
Geranium sanguineum	+	+	+	+	+	+	.
Genista januensis	.	+	+	+	+	+	+
Laserpitium siler	2	2	1	2	2	.	.
Molinia arundinacea	+	.	+	+	+	.	+
Erica carnea	1	1	1	.	.	2	.
Cytisus hirsutus	2	1	1	.	.	+	.
Lilium carniolicum	+	+	+	.	+	.	.
Inula hirta	+	.	+	+	+	.	.
Thalictrum minus	.	+	+	+	.	.	.
Mercurialis ovata	.	.	.	+	1	.	+
Calamagrostis varia	+	+	.	.	.	.	.
Verbascum nigrum	+	.	.	+	.	.	.
Silene vulgaris	+	.	.	.	.	+	.
Hypericum perforatum	.	.	.	.	+	+	.
Phyteuma orbiculare	.	.	.	.	.	+	+
Euphrasia rostoviana	.	.	.	.	.	+	+
Libanotis sibirica ssp. montana	+	.	.	.	.	.	.
Acer pseudoplatanus	.	+	.	.	.	.	.
Dianthus sylvestris	.	.	+	.	.	.	.
Juniperus communis	.	.	+	.	.	.	.
Knautia drymeia	.	.	.	+	.	.	.
Euphorbia carniolica	.	.	.	+	.	.	.
Convallaria majalis	.	.	.	.	.	1	.
Hieracium bauchinii	.	.	.	.	.	+	.
Populus tremula	.	.	.	.	.	+	.
Hieracium pilosella	.	.	.	.	.	.	1

Localities and general information on relevés in Table 1: 1. Gorjanci, above Javorovica, 15.6.2016, altitude 965m, aspect SWW, slope 25°, area of relevé 25m², cover of vegetation 100 %, coordinates 45,77887N, 15,37210E; 2. Gorjanci, above Javorovica, 15.6.2016, 951m, W, 28°, 25m², 100 %, 45,78167N, 15,37298E; 3. Gorjanci above Javorovica, 15.6.2016, 945m, W, 30°, 25m², 100 %, 45,78180N, 15,37293E; 4. Gorjanci, above Javorovica, 15.6.2026, 918m, SSW, 10°, 25m², 100 %, 45,78846N, 15,37414E; 5. Gorjanci, above Javorovica, 15.6.2016, 917m, SSW, 10°, 25m², 100 %, 45,78809N, 15,37438E; 6. Gorjanci, above Ja-

vorovica, 15.6.2026, 969m, W, 2°, 15m², 95 %, 45,77982N, 15,37251E; 7. Gorjanci, above Javorovica, 15.6.2016, 918m, S, 2°, 20m², 95 %, 45,78774N, 15,37498E.

DISCUSSION

Sesleria juncifolia subsp. *kalnikensis* dominated communities

Tab. 1/1–5

Sesleria juncifolia subsp. *kalnikensis* was the dominant species in one group of relevés (Table

1/1–5). The *Sesleria juncifolia* complex is restricted to southern Europe and has a typical amphiadriatic disjunct distribution range [17]. Two subspecies of this complex can be found in Slovenia and Croatia: *Sesleria juncifolia* subsp. *juncifolia* and *Sesleria juncifolia* subsp. *kalnikensis*; *Sesleria juncifolia* and *Sesleria tenuifolia* are considered to be synonyms [16, 18]. According to some opinions, the two subspecies might be considered to be separate species [19, 20].

The typical subspecies, *Sesleria juncifolia* subsp. *juncifolia*, is distributed along the Dinaric mountains and the Apennines, and is the name-giving taxon for montane to alpine calcareous grasslands in the northern Balkans and the Apennines: *Seslerietalia tenuifoliae* [6]. In contrast, subspecies *kalnikensis* is found in the continental regions of both Slovenia and Croatia, especially along the common border, with a disjunct occurrence in sub-Mediterranean Slovenia. The distribution areas and ecological conditions of these two subspecies do not overlap [21, 22, 18]. In addition to grasslands, the species also occurs in other extreme habitats, such as rock crevices [23].

Grasslands dominated by *Sesleria juncifolia* subsp. *kalnikensis* were first mentioned in 1942 by Horvat, who described the association *Seslerietum kalnikensis* without giving relevant relevé material (nom. inval., Art. 2b). He found communities belonging to this association from Samoborsko Gorje in the south to Kalnik in the north. Communities typically occur in small patches, with larger surfaces found only on Mount Oštrc, where communities resemble communities dominated by *Sesleria juncifolia* in alpine grasslands. The communities grow on shallow soils above steep, rocky slopes [24].

The name of the association *Seslerietum kalnikensis* was also mentioned by Horvat in 1949 and 1962. Since the name of the association was not accompanied by relevé material or by reference to earlier published material, the description remained invalid (nom. inval., Art. 2b) [25, 26]. The association was also presented in the unpublished dissertations of Šugar and Vrbek [27, 28], but manuscript dissertations are considered nomenclaturally invalid (Art. 1). Šugar proposed the name *Carici humilis-Seslerietum kalnikensis* in a manuscript (nom. inval., Art. 1) in 1994 [29].

Horvat and coauthors [30] validly described the association in 1974, but the name of the complex *Sesleria juncifolia* was used as a name-giving taxon (p. 481), as well as being used in the synthetic table (Tab. 113), and so the valid name of the association is *Seslerietum juncifoliae* Horvat et al. 1974 (Art. 7).

Since those stands are dominated by the intra-specific taxon *Sesleria juncifolia* subsp. *kalnikensis*, we propose an alternative name of the association name and a replacement of the name-giving species *Sesleria juncifolia* with the more narrowly defined subspecies *Sesleria juncifolia* subsp. *kalnikensis* [31: 26, 16: 876]. Nikolić treats this taxon as *Sesleria tenuifolia* subsp. *kalnikensis* [18 (vol. 3): 367].

We suggest mutation of the association name – nomen mutatum of the association name *Seslerietum juncifoliae* Horvat et al. 1974 [30: 481] to *Seslerietum kalnikensis* Horvat et al. 1974 mut. Čarni nomen mutatum novum according to Art. 45. At the same time, we chose a neotype of the association in the area in which the association was described (Art. 21). The neotype was sampled by Ivan Šugar and published as a manuscript in the Guide to an Excursion of the Eastern Alpine and Dinaric Society for Vegetation Ecology to Samoborsko gorje in 1994 [29].

Neotype of the association *Seslerietum kalnikensis* Horvat et al. 1974 mut. Čarni nom. mut. novum, neotypus hoc loco:

Locality: Croatia, slope of Mount Oštrc, altitude 630, aspect W, 45,7648 N, 15,6470 E (coordinates were determined by the author of this article), author I. Šugar.

Sesleria juncifolia subsp. *kalnikensis* 4, *Carex humilis* 2, *Laserpitium siler* 2, *Scabiosa hladnikiana* 2, *Anthericum ramosum* 1, *Asperula cynanchica* 1, *Bromopsis erecta* 1, *Bupthalmum salicifolium* 1, *Erica carnea* 1, *Euphorbia cyparissias* 1, *Euphorbia verrucosa* 1, *Peucedanum oreoselinum* 1, *Teucrium montanum* 1, *Stachys recta* 1, *Aster amellus* +, *Campanula thysoidea*, *Centaurea jacea* +, *Centaurea phrygia* +, *Centaurea scabiosa* subsp. *fritschii* +, *Centaurea triumfettii* +, *Galium lucidum* +, *Geranium sanguineum* +, *Globularia punctata* +, *Heliathemum ovatum* +, *Leontodon incanus* +, *Salvia pratensis* +, *Teucrium chamaedrys* +, *Thesium bavarum* +, *Thymus pulegioides* +, *Veronica jacquinii* +.

Carex humilis dominated communities

Tab. 1/6–7

Horvat described the association *Xerobrometum erecti* in 1931 [33]. The description of the association is considered valid because it is based on two relevés and the association name complies with the nomenclatural rules (Art. 12). Horvat assigned each relevé to a subassociation: *caricetosum humilis* and *typicum*. Two subassociations were thus formed: *Xerobrometum erecti* Horvat 1931

typicum and *Xerobrometum erecti* Horvat 1931 *caricetosum humilis* Horvat 1931. Since only one relevé was assigned to the subassociation *typicum*, it serves as holotype (holotypus, relevé B) [33: 78] for the association and is also considered to be an autonym (Art. 19, 13b). The holotype of the subassociation *caricetosum humilis* is the other relevé (holotypus, relevé A) [33: 78].

The description of the association is valid; however, the name is illegitimate and should be rejected since it is a later homonym of *Xerobrometum erecti* Braun-Blanquet 1918 (Art. 31, Prin. V) [34, 35].

Horvat [33] described three subassociations within *Xerobrometum*: *caricetosum humilis*, *typicum* and *danthonietosum*. However, only two of these, *typicum* and *caricetosum humilis*, are represented by relevés (see above). Horvat noted that the typical subassociation thrives on dry slopes with relatively shallow soils, while *caricetosum humilis* is found on exposed ones. The subassociation *danthonietosum* occurs in sheltered sites with deeper soils and represents a developmental stage towards acidophilic communities.

The subassociation *Xerobrometum erecti* Horvat 1931 *caricetosum humilis* Horvat 1931 was raised to the rank of an association by Tomažič [36] and validly described as *Scabioso hladnikianae-Caricetum humilis* (Horvat 1931) Tomažič 1941. Tomažič designated Horvat's subassociation *caricetosum humilis* as a basionym (Art. 27d) and so the type relevé remained the same: relevé A [33:78] also for this association. Šugar [29] later proposed the name *Laserpitio sileris-Caricetum humilis* in a manuscript form (nom. inval., Art. 1).

Horvat stated the association name *Bromo-Plantaginetum mediae* in 1942 [24], 1949 [25] and in 1962 [26]. In all cases, the description was invalid (Art. 2b), since he did not publish any relevé material nor mention any reference to an earlier, effectively published relevé.

In 1949 Horvat [25] gave a more extensive description of the association *Bromo-Plantaginetum mediae*, which occurs extensively on calcareous substrates after deforestation. It thrives in sites where the potential natural vegetation would be oak or fir-beech forests. These grassland communities are either mowed once a year or grazed. Although they belong to the same association, their appearances vary considerably. In pastures, there are scattered shrubs, large grass tussocks and dwarf shrubs (e.g. *Ononis spinosa*, *Teucrium chamaedrys*), which are not present in meadows. The pastures are trampled and grazed, resulting in an ir-

regular distribution of species. In contrast, extensive meadows exhibit consistent species distribution throughout, creating a cultivated appearance. There are no shrubs or spiny dwarf shrubs and the surface seems even. Mowing creates a more uniform grassland, while grazing results in a more diverse structure. The association is fairly diverse, with one subassociation, '*Bromo-Plantaginetum caricetosum humilis* (Horvat)', occurring on shallow, skeleton-rich and humus-rich soils (rendzina), while other subassociations, such as *Bromo-Plantaginetum danthonietosum*, are found on deeper and moister mineral-carbonate soils. If the soil layer is deep enough, bases can leach from the upper horizons, leading to the development of acidophilic vegetation.

This suggests that Horvat had a comprehensive understanding of this association, including a large portion of the dry grasslands in the area, just like *Xerobrometum* Horvat 1931. He also described identical subassociations. This may implicitly suggest that Horvat viewed *Xerobrometum* and *Bromo-Plantaginetum* as synonyms [37]. Nonetheless, since there is only an implicit evidence suggesting that *Bromo-Plantaginetum* and *Xerobrometum* are the same associations, we think that this reasoning fails to fulfil the specified criteria of the ICPN [15] for the valid description of the association *Bromo-Plantaginetum* (Art. 2b).

A valid description of the association *Bromo erecti-Plantaginetum mediae* was provided by Brzac [38] on the basis of communities on alluvial deposits in the Savica area near the river Sava (part of Zagreb). After the regulation of the Sava River, which prevented floods, grasslands belonging to the association *Bromo-Plantaginetum mediae* gradually developed. Brzac compared those grasslands belonging to the association *Bromo-Plantaginetum* with typical *Bromo-Plantaginetum* stands found in more natural environments. However, in his English text, he discussed the differences between this secondary association, *Bromo-Plantaginetum*, and the typical *Xerobrometum*. Since Brzac's relevés do not reflect typical communities of the association [38], a lectotype could not be selected from his relevé material (Art. 19). We therefore opted to designate a neotype for the association *Bromo erecti-Plantaginetum mediae* [38: 237], neotypus hoc loco: relevé B (Art. 21) [33: 78]. This choice led to *Xerobrometum erecti* and *Bromo erecti-Plantaginetum mediae* being recognized as true (nomenclatural) synonyms. Since *Xerobrometum* is considered illegitimate, *Bromo-Plantaginetum mediae* remains the valid name for the association, which allows *Bromo-Plantaginetum* to be regarded as a nomen novum (Art. 39), and the

author citation should be *Bromo erecti-Plantaginetum mediae* (Horvat 1931) Brzac 1960.

Bromo-Plantaginetum mediae was elaborated in Horvat and coauthors [30], but in this publication they also proposed a new name for this association: *Diantho croatici-Brometum erecti*. The latter name should be rejected, as a later synonym (Def. VI). The association name *Bromo erecti-Plantaginetum mediae* has been widely used in the literature [27, 28, 39, 40].

The third association is *Bromo erecti-Danthonietum alpinae* Pekovšek 1974 nom. corr. (Art. 44) (originally *Bromo erecti-Danthonietum calycinae* Petkovšek 1974). This association is probably associated with the third subassociation of *Xerobrometum erecti* mentioned by Horvat [33], *danthonietosum*. Petkovšek [41], however, did not make an explicit connection. He merely stated that the association *Bromo-Danthonietum* is very similar to the association *Bromo-Plantaginetum mediae* but should be recognized as a separate association. The association was invalidly described in a manuscript by Šugar [27] (Art. 1) and Trinajstić et al. [42] (Art. 5). Our suggestion for the lectotype of the association *Bromo-Danthonietum alpinae* Petkovšek 1974 nom. corr. [41] is – lectotypus hoc loco: relevé 7 [41: 31–34].

As it is accepted that the name giving species *Bromus erectus* could belong to a separate genus *Bromopsis* Fourr. other than *Bromus* L. [16: 909, 19: 681] alternative mutated names of the syntaxa can be proposed, for *Bromo erecti-Plantaginetum mediae* (Horvat 1931) Brzac 1960 [38: 237] the alternative name would be *Bromopsio erectae-Plantaginetum mediae* (Horvat 1931) Brzac 1960 mut. Čarni nomen mutatum novum and for *Bromo-Danthonietum alpinae* Petkovšek 1974 nom. corr. [41: 31] *Bromopsio erectae-Danthonietum alpinae* Petkovšek 1974 nom. corr. et mut. Čarni nom. mutatum novum according to Art. 45.

Horvat's discoveries from 1931, which were made nearly a century ago, can still be identified in the present-day syntaxonomic classification. There are currently three recognized associations: *Scabioso hladnikiana-Caricetum humilis* (Horvat 1931) Tomažič 1941, *Bromo-Plantaginetum mediae* (Horvat 1931) Brzac 1960, and *Bromo-Danthonietum alpinae* Petkovšek 1974 nom. corr.

Syntaxonomic position

We have decided to accept the syntaxonomic classification of the two sampled associations, based on the analysis of Kaligarič and Škornik [43]. Their

study revealed that the order *Brometalia* is common in the central, eastern and south-eastern parts of Slovenia, comprising a single alliance *Bromion* (*Mesobromion*). This classification is widely accepted in the region [44, 5, 7]. Other classification systems propose that such communities mediate between *Bromion* and *Cirsio-Brachypodium* [14].

An alternative classification for these grasslands, especially those in extremely warm and dry sites, would be to place them in the order *Stipo-Festucetalia*. This order includes xerophilous, open to relatively closed perennial grasslands on rocky outcrops and steep slopes, mainly on calcareous rock in central and south-eastern Europe. Vegetation from this order was discovered in north-western Croatia and further assigned to the alliance of dealpine relict xerophilous steppe grasslands on calcareous substrates from southeastern Central Europe, *Diantho lumnitzeri-Seslerion albicantis* [45]. However, it appears that even the driest and most thermophilic communities in the study area (i.e. *Scabioso-Caricetum humilis*) cannot be assigned to this order [46]. Instead, these communities can be considered to be an extremely dry and thermophilic part of the *Bromion* alliance [37].

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REFERENCES

- [1] V. Matevski, A. Čarni R. Čušterevska et al., Syntaxonomy and biogeography of dry grasslands on calcareous substrates in the central and southern Balkans, *Appl. Veg. Sci.*, **21** (2018), pp. 488–513. <https://doi.org/10.1111/avsc.12374>
- [2] I. Biurrun, R. Pielech, I. Dembiczy, et al., Benchmarking plant diversity of Palaearctic grasslands and other open habitats, *J. Veg. Sci.*, **32** (2021), e13050. <https://doi.org/10.1111/jvs.13050>
- [3] I. García-Mijangos, A. Berastegi, I. Biurrun, et al., Grasslands of Navarre (Spain), focusing on the *Festuco-Brometea*: classification, hierarchical expert system and characterization, *Veg. Classif. Surv.*, **2** (2021), pp. 195–231. <https://doi.org/10.3897/VCS/2021/69614>
- [4] S. Škornik, N. Pipenbaher, A link between species abundance and plant strategies for semi-natural dry grasslands, *Plants*, **13** (2024), 2260. <https://doi.org/10.3390/plants13162260>
- [5] U. Šilc, A. Čarni, Conspectus of vegetation syntaxa in Slovenia, *Hacquetia*, **11** (2012), pp. 113–164. <https://doi.org/10.2478/v10028.012.0006.1>

- [6] L. Mucina, H. Bültmann, K. Dierssen et al., Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities, *Appl. Veg. Sci.*, **19** (2016), pp. 3–264. <https://doi.org/10.1111/avsc.12257>
- [7] Ž. Škvorc, N. Jasprica, A. Alegro et al., Vegetation of Croatia: Phytosociological classification of the high-rank syntaxa, *Acta Bot. Croat.*, **76** (2017), pp. 200–224. <https://doi.org/10.1515/botcro-2017-0014>
- [8] M. Wraber, Pflanzengeographische Stellung und Gliederung Sloweniens, *Vegetatio*, **17** (1969), pp. 176–199.
- [9] Ž. Košir, Ekološke, fitocenološke in gozdnogospodarske lastnosti Gorjancev v Sloveniji, *Zb. Gozdar. Lesar.*, **17** (1979), pp. 1–242.
- [10] D. Perko, M. Adamič Orožen, (Eds.), *Slovenija: pokrajine in ljudje [Slovenia: landscape and inhabitants]*, Mladinska knjiga, Ljubljana, 1998.
- [11] L. Marinček, A. Čarni, V. Babij, et al., *Vegetation map of forest communities of Slovenia in scale 1:50.000 – section Novo mesto*, Založba ZRC, Ljubljana, 2003.
- [12] J. Braun-Blanquet, *Pflanzensoziologie, Grundzüge der Vegetationskunde*, 3rd ed. Springer Verlag, Wien, 1964.
- [13] M. Kaligarič, *Rastlinstvo Primorskega krasa in Slovenske Istre: travniki in pašniki*, Zgodovinsko društvo za južno Primorsko: Znanstveno-raziskovalno središče Republike Slovenije, Koper, 1997.
- [14] W. Willner, A. Kuzemko, J. Dengler et al., A higher-level classification of the Pannonian and western Pontic steppe grasslands (Central and Eastern Europe), *Appl. Veg. Sci.*, **20** (2017), pp. 143–158. <https://doi.org/10.1111/avsc.12265>
- [15] P. J. Theurillat, W. Willner, F. Fernández-González et al., International code of phytosociological nomenclature, 4th edition, *Appl. Veg. Sci.*, **24** (2021), e12491. <https://doi.org/10.1111/avsc.12491>
- [16] A. Martinčič, (Ed.) *Mala flora Slovenije*, 4. izdaja, Tehniška založba, Ljubljana, 2007.
- [17] R. Di Pietro, P. R. Wagensommer, A new *Sesleria juncifolia* association from south-eastern Italy and its position in the amphi-Adriatic biogeographical context, *Acta Bot. Croat.*, **73** (2014), pp. 171–207.
- [18] T. Nikolić, *Flora Croatica, Vaskularna flora Republike Hrvatske*, Vol. 1–4. Alfa, Zagreb, 2020.
- [19] S. Pignatti, *Flora d'Italia (2nd ed.)*, Vol. 1, Edagricole, Milano, 2017.
- [20] I. Hodálová, L. Mártonfióvá, K. Skokanová et al., The utility of genome size in plant identification: a case study on *Sesleria* (Poaceae) from Croatia and Slovenia, *Plant Syst. Evol.*, **306** (2020), 87. <https://doi.org/10.1007/s00606-020-01715-2>
- [21] N. Jogan, (Ed.) *Materials for the atlas of flora of Slovenia*, Center za kartografijo favne in flore, Miklavž na Dravskem polju, 2001.
- [22] I. Dakskobler, J. Peljhan, *Viola pyrenaica* Ramond ex DC in the northern part of the Dinaric mountains (the plateaus of Trnovski gozd and Nanos, Slovenia), *Hacquetia*, **6** (2007), pp. 143–169. <https://doi.org/10.2478/v10028-007-0009-5>
- [23] M. Accetto, The new associations *Sesleria kalnikensis-Jovibarbetum hirtae* ass. nov. and *Sesleria calcariae-Jovibarbetum hirtae* ass. nov. in Slovenia, *Zb. Gozar. Lesar.*, **69** (2003), pp. 61–89
- [24] I. Horvat, *Biljni svijet Hrvatske*, Zemljopis Hrvatske, Zagreb, 1942.
- [25] I. Horvat, *Nauka o biljnim zajednicama*, Nakladni zavod Hrvatske, Zagreb, 1949.
- [26] I. Horvat, *Vegetacija planina zapadne Hrvatske*, Acta Biol. 2, Prir. Istraž. Jugosl. Akad. **30**, Zagreb, 1962.
- [27] I. Šugar, *Biljni svijet Samoborskog gorja*, Ph.D. Thesis, University in Zagreb, Zagreb, 1972.
- [28] M. Vrbek, *Flora i nešumska vegetacija Žumberka*, Ph.D. Thesis, University of Zagreb, Zagreb, 2005.
- [29] I. Šugar, *La végétation sur le trajet Samobor – Hajdovščak – Palačnik – Gregurić Breg – Veliki Dol – Oštrc – Preseka – Prekrižje – Samobor dans la région de Samoborsko Gorje*, Guide de l'excursion de 5 juillet 1994, Istočnoalpsko-dinarsko društvo za proučavanje vegetacije, Zagreb, 1994.
- [30] I. Horvat, V. Glavač, H. Ellenberg, *Vegetation Südosteuropas*, Gustav Fischer Verlag, Stuttgart, 1974.
- [31] N. Jogan, Nomenclatural notes to the 3ed edition of Mala flora Slovenije (1999), *Hladnikia*, **11** (2001), pp. 25–26.
- [32] B. Valdés, H. Scholz, *Poaceae*, Euro+Med Plantbase, <https://www.emplantbase.org>, accessed 10 October 2024.
- [33] I. Horvat, Die Berg-Wiesen und Heiden in Kroatien, *Acta Bot. Croat.*, **6** (1931), pp. 76–90.
- [34] J. Braun-Blanquet, Eine pflanzengeographische Exkursion durchs Unterengadin und in den schweizerischen Nationalpark, *Beitr. Geobot. Landesaufn. Schweiz*, **4** (1918), pp. 1–80.
- [35] M. Terzi, R. Di Pietro, P.-J. Theurillat, Nomenclature of the class *Festuco-Brometea* in Italy and remarks on the interpretation of articles 1 and 2b ICPN, *Bot. Lett.*, **163** (2016), pp. 307–319. <https://doi.org/10.1080/23818107.2016.1201692>
- [36] G. Tomažič, Senožeti in pašniki na plitvih, pustih in suhih tleh Slovenije, *Zb. Prirodoslov. Druš.*, **2** (1941), pp. 76–82.
- [37] S. Škornik, A contribution to the knowledge of dry grassland vegetation of the *Brometalia erecti*

- Koch 1926 order in Slovenia, *Acta Biol. Slov.*, **44** (2001), pp. 29–43.
- [38] T. Brzac, Meadows on skeletal calcareous gravelly soils I. Association of *Bromus erectus* – *Plantago media*, *Vet. Arh.*, **30** (1960), pp. 37–246.
- [39] N. Šegulja, *Biljni pokrov Vukomeričkih gorica*, Ph.D. Thesis, University in Zagreb, Zagreb, 1974.
- [40] S. Škornik, *Suha in polsuha travnišča reda Brometalia erecti Koch 1926 v Sloveniji*, Ph.D. Thesis, Univerza v Ljubljani, Ljubljana, 2000.
- [41] V. Petkovšek, Travniska združba *Bromo-Danthonietum calycinae* Šugar 1972 in njena razširjenost v Sloveniji, *Biol. Vestn.* **22**, 1 (1974), pp. 29–37.
- [42] I. Trinajstić, Z. Pavletić, I. Šugar, Contribution à la connaissance de la composition floristique et de la distribution de l'ass. *Bromo-Danthonietum alpinae* Šugar dans les régions montagneuses de Croatie, *Acta Bot. Croat.*, **40** (1981), pp. 155–163.
- [43] M. Kaligarič, S. Škornik, Variety of dry and semi-dry secondary grasslands (Festuco-Brometea) in Slovenia - contact area of different geoelements, *Razpr. IV Raz. SAZU*, **43** (2002), pp. 227–246.
- [44] J. Bavcon, K. Malovrh, M. Tomšič, B. Ravnjak, In situ conservation of dry meadows, *Land (Basel)*, **13** (2024), 315. <https://doi.org/10.3390/land13030315>
- [45] I. Trinajstić, *Biljne zajednice Republike Hrvatske*, Akademija šumarskih znanosti, Zagreb, 2008.
- [46] M. Janišová, N. Bauer, J. Csiky et al., Broad-scale plant diversity patterns of Central European *Carex humilis* steppes, *Tuexenia*, **40** (2020), pp. 499–526. <https://doi.org/10.14471/2020.40.018>

КСЕРОФИЛНИ ТРЕВЕСТИ ЗАЕДНИЦИ НА КАМЕЊАРИ НА ПЛАНИНСКИОТ ВЕНЕЦ ГОРЈАНЦИ

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Пасиштата претставуваат значајни живеалишта поради нивниот ендемизам, високата биолошка разновидност и поради тоа што обезбедуваат важни еколошки услуги. Оваа студија се фокусира на пасиштата на камењари, кои се развиваат на карбонатна подлога, на планинскиот венец Горјанци во Словенија. Целите на студијата беа да се евидентира вегетацијата и да се разјаснат некои номенклатурни прашања. Идентификувани се две растителни заедници: во едната доминира *Sesleria juncifolia* subsp. *kalnikensis* а во другата *Carex humilis*, и тие беа доделени на ass. *Seslerietum kalnikensis* Horvat 1974 mut. Čarni nom. mut. novum и ass. *Scabioso hladnikiana-Caricetum humilis* (Horvat 1931) Tomažič 1941. Двете се класифицирани во сојузот *Bromion* (*Mesobromion*), редот *Brachypodietalia pinnati* и класата *Festuco-Brometea*. Прегледот на историската литература и номенклатура доведе до предложена мутација на името на асоцијацијата *Seslerietum juncifoliae* Ht. et al. 1974, така што беше следен развојот на концептот предложен од Хорват како *Xerobrometum erecti* Ht. 1931. Денес, вториот концепт резултира со три асоцијации: *Scabioso hladnikiana-Caricetum humilis* (Horvat 1931) Tomažič 1941, *Bromo erecti-Plantaginetum mediae* (Horvat 1931) Brzac 1960 and *Bromo erecti-Danthonietum alpinae* Petkovšek 1974 nom. corr. Притоа, предложени се, исто така, алтернативни имиња за последните два синтаксони.

Клучни зборови: *Bromion*, *Festuco-Brometea*, планински венец Горјанци, пасишта, номенклатура, растителна заедница, Словенија, вегетација