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Research Article

A phytosociological description of a new plant association of the *Saturejion subspicatae* alliance in southern Croatia (SE Europe)

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Abstract – This paper presents a phytosociological study of grassland communities in the transition zone between the Mediterranean and Temperate regions in the interior of southern Croatia. Thirty-two vegetation relevés were carried out according to the phytosociological approach of Braun-Blanquet. A new association belonging to the *Saturejion subspicatae* alliance and characterised by hemicryptophytic dominance, namely *Saturejo subspicatae-Scabiosetum delminianae*, including three subassociations – *typicum*, *jurinetosum mollis* and *dalmatocytisetosum dalmatici* is described and discussed from a floristic and ecological point of view.

Keywords: Dinaric karst, *Festuco-Brometea*, new syntaxon, phytosociology, syntaxonomy, vegetation

Introduction

Grasslands are one of the world's most important ecosystems, covering almost a third of the Earth's terrestrial surface (Bengtsson et al. 2019, and references therein). Both natural and semi-natural grasslands are of great importance due to their biodiversity and their ability to provide ecosystem services (e.g. Richter et al. 2021, Pergola et al. 2024). Unfortunately, grasslands have declined globally over the last century (Egoh et al. 2016), mainly due to conversion to cropland for the production of animal feed and, conversely, lack of management and abandonment of land (Queiroz et al. 2014). In addition, the biodiversity of grassland ecosystems is undergoing significant upheaval due to the extent of climate change and the overexploitation of natural resources, including in protected areas.

In Croatia, dry grassland habitats are an extremely interesting and diverse element of the vegetation landscape of the hilly and montane areas of the Dinaric Karst. The region is recognised as part of the World Natural Heritage and is valued for its exceptional biodiversity and high level of endemism due to palaeoclimatic and geological events that have shaped the region over time (Nikolić et al. 2015). The very rich species pool and the diverse land use patterns over thousands of years have contributed to the high degree of coenological diversification (cf. Trinajstić 2008).

However, there are still many gaps in the cenological knowledge of calcareous rocky grasslands on shallow soils that lie between the Mediterranean and the Temperate zone, i.e. extending into the interior of southern Croatia. In fact, phytosociological knowledge of the study area (especially the Dalmatian hinterland) has been significantly neglected over the last 40 years (e.g. Trinajstić and Pavletić 1988, Milović et al. 2020).

In this paper, new phytosociological data, the ecological context and the phytosociological classification of grasslands where endemic species occur are presented and discussed. In particular, we have formalised the proposal of a new phytosociological association of grasslands dominated by *Scabiosa delminiana* Abadžić and *Dalmatocytisus dalmaticus* (Vis.) Trinajstić, two species that have a limited distribution in Croatia (Milović et al. 2022, 2025). This research aims to identify suitable habitats and vegetation types to enable population monitoring, facilitate the discov-

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ery of new occurrences, support conservation efforts and contribute to ecological restoration in areas where this is necessary.

Material and methods

Study area

This study covers the area between the village of Udbina (839 m a.s.l.) in the north and the town of Sinj (326 m a.s.l.) and the neighbouring area in the south (Fig. 1). This area belongs to the long-term carbonate deposits of the platform, usually referred to as "karst Dinarides" and more precisely classified as megafacies of "limestones with chert" (Tišljar et al. 2002). In the morphologically lower parts of the areas, the karstic poljes and dolines, evaporites and associated sediments represent the oldest deposits. In Sinj, on the other hand, dolomites alternate with evaporites alongside calcareous marls and clayey limestones, or they can be found as intercalations in limestones (Šušnjara and Sakač 1988, Šušnjara et al. 1992).

In Udbina and the neighbouring karstic fields, various soil types can be found – from medium-deep eutric Cambisols to Rendzina, Luvisols, colluvial and other soils on Quaternary and glaciofluvial deposits (Bogunović et al. 2001). The most widespread soils in Sinj and the surrounding area are brown soils (Calcocambisol) and black soils (Calcomelanosol) on limestone and dolomite (Bogunović et al. 1996).

In the Udbina region, the mean annual air temperature is 8.7 °C and the mean annual precipitation is 1365 mm (data for the period 1971–2000 from the nearest meteorological station Gospić; Zaninović et al. 2008). In Sinj, the mean annual air temperature is 12.9 °C and the mean annual precipitation is 1147 mm (data for the period 1981–2010 from the Croatian Meteorological and Hydrological Service). According to Köppen's climate classification (Köppen and Geiger 1954, Sträßser 1998), the entire study area has a temperate humid climate with warm summers or a Cfb climate type (Šegota and Filipčić 2003: 35).

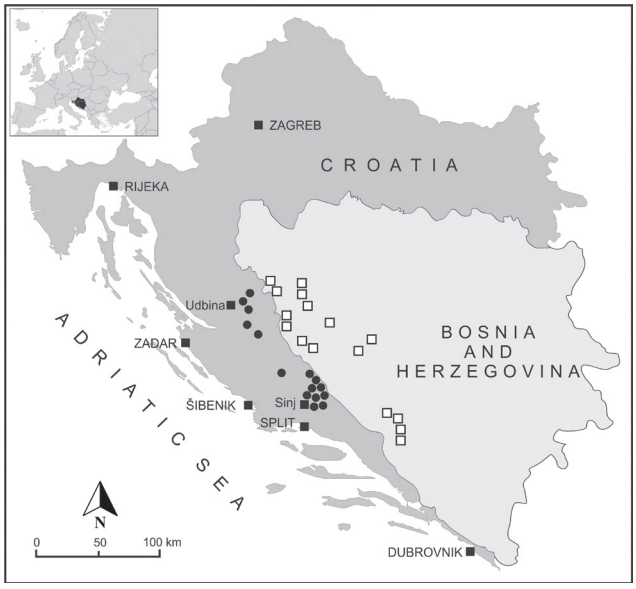

Fig. 1. Geographical distribution of thirty-two relevés with *Scabiosa delminiana* collected in southern Croatia (●). The distribution range of *Scabiosa delminiana* in Bosnia and Herzegovina (□) is also shown (*sensu* Abadžić 2007).

According to the assumed biome typology and the occurrence of thermotypes in each of the climatic zones (see Loidi et al. 2022), the area belongs to the temperate ombroestival ecozone, the temperate deciduous forest biome and the temperate deciduous forest subbiome. The deciduous vegetation is present in the lower altitudes and belongs to the thermophilic deciduous oak forests of the *Quercetea pubescentis* vegetation class, while mesophilic deciduous and mixed forests of the *Carpino-Fagetea sylvaticae* class occur in the higher belts (Horvat 1961-1962, Nikolić et al. 2010). On the other hand, the study area also includes pastures and stony grasslands of the order *Scorzoneretalia villosae*, i.e. grasslands on shallow, calcareous soils at lower altitudes of the *Chrysopogono grylli-Koelerion splendentis* (Terzi et al. 2024) and at higher altitudes of the *Scorzonerion villosae* and *Saturejion subspicatae* alliances (see Terzi 2011, 2015 for details).

Today, the area around Udbina (Krbava field, Podlapača) is recognised as one of the Important Plant Areas (IPAs) in Croatia due to the high structural diversity of its vegetation (for details, see Nikolić et al. 2010). This region is also part of the Croatian NATURA 2000 ecological network (site code HR2000632, among others) (Official Gazette 2019). Similarly, Sinj and its surroundings are included in an IPA that is also part of the NATURA 2000 network (site code HR2001313, which includes the middle reaches of the Cetina River and the Hrvace and Sinj fields). In this study, the vegetation is also sampled on Kamešnica mountain near Sinj, which is part of the Dinara Nature Park.

Human impact has been manifested over the last 30 years in the form of depopulation. The reduced intensity of grazing on grasslands has generally led to natural succession into scrub and forest, while fires continue to occur frequently.

Vegetation sampling and data analysis

The field data comprise thirty-two vegetation samples (relevés) and were collected from August 2020 to August 2021. The relevés were conducted according to the Braun-Blanquet approach (Westhoff and van der Maarel 1980) on plot sizes of 25–60 m^2, with a mode value of 30 m^2. The main physical characteristics of the habitat (e.g. slope, exposure, altitude) were also recorded.

The taxonomic nomenclature follows the portal *Flora Croatica Database* (Nikolić 2025). The biological form was verified in the field and denoted according to the categories given in Pignatti et al. (2017-2019), which are based on the classification of Raunkiaer (1934). Unweighted average ecological indicator values (EIVs) were used to interpret the ecological conditions of the vegetation types studied

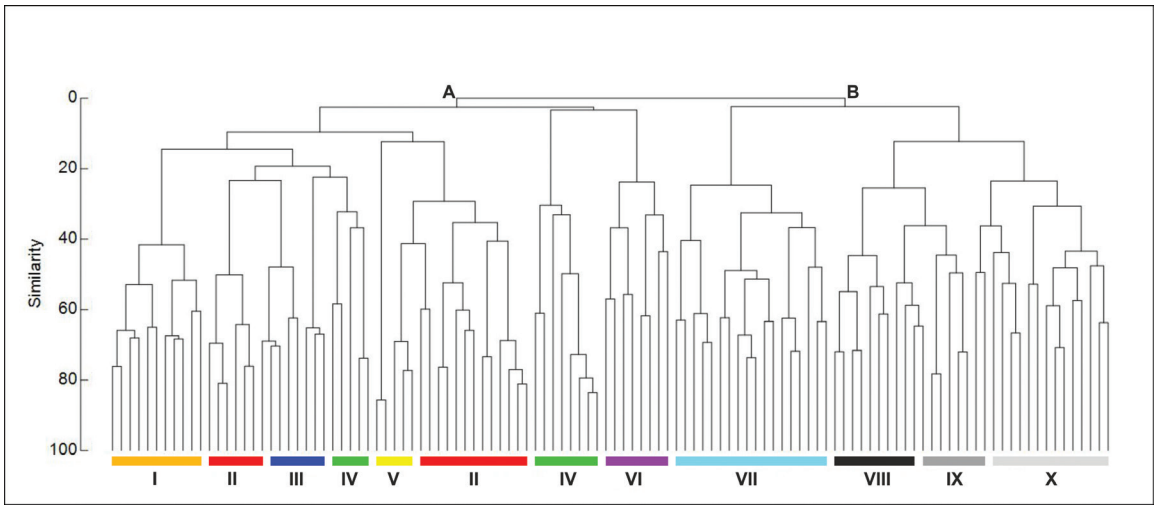

Fig. 2. Dendrogram of the hierarchical cluster analysis based on the Bray-Curtis similarity distance and Ward's minimum variance method for the data matrix of 346 taxa × 114 relevés. I = *Minuartio-Genistetum pulchellae* (Mosor Mt.), II = *Carex humilis-Centaurea rupestris* (incl. *Carici-Centaureetum rupestris* (Medvjeđak, Biokovo and Kozjak Mts.), III = *Bromo-Seslerietum tenuifoliae* (Krk Island, Biokovo Mt.), IV = *Saturejo subspicatae-Caricetum humilis* (Velebit Mt., Gorski Kotar, Tomislavgrad – BA), V = *Stipo-Caricetum humilis* (Krk Island), VI = *Astragalo-Seslerietum robustae* (Biokovo Mt.), VII = *Genisto-Globularietum bellidifoliae* (Lovćen Mt.), VIII = *Saturejo subspicatae-Scabiosetum delminianae typicum* (this study), IX = *Saturejo subspicatae-Scabiosetum delminianae jurinetosum mollis* (this study), X = *Saturejo subspicatae-Scabiosetum delminianae dalmatocytisetosum dalmatici* (this study). See On-line Suppl. Tab. 1 for the sources of the phytosociological relevés included in the data set.

(Pignatti et al. 2005, 2017-2019), calculated in JUICE 7.0. The syntaxonomic nomenclature follows the EuroVegChecklist, EVC (Mucina et al. 2016, Škvorc et al. 2017) and FloraVeg.EU (Chytrý et al. 2024). Nomenclature decisions follow the fourth edition of the International Code of Phytosociological Nomenclature (ICPN) (Theurillat et al. 2021).

The vegetation was classified using numerical methods. We created a matrix with the aim of comparing the relevés collected in this study with those previously published and originally assigned to the *Saturejion subspicatae* alliance (Trinajstić 2008; On-line Suppl. Tab. 1). The matrix consists of 346 taxa × 114 samples (relevés). It is important to emphasise that the aim of this work was not to revise the alliance (see for example Terzi et al. 2024), but to tentatively position the newly described communities within the *Saturejion subspicatae* alliance. The taxon scores originally recorded according to the Braun-Blanquet scale were replaced by the 1–9 ordinal values (van der Maarel 1979, Westhoff and van der Maarel 1980) prior to the numerical analyses.

An agglomerative hierarchical clustering algorithm based on Bray-Curtis similarity and the Ward method for determination of group linkages was used (McCune and Mefford 2016). Differences between the groups obtained during classification were tested by analysis of similarities (ANOSIM). Cluster analyses were performed using the PRIMERv7 software packages (Clarke and Gorley 2015). To visualise the floristic and ecological relationships among clusters of relevés, nonmetric multidimensional scaling (NMDS) was applied using the Bray-Curtis similarity matrix. NMDS with passive projection of environmental variables was performed using the R package 'vegan' (https://cran.r-project.org/ web/packages/vegan) operated through the JUICE software (Tichý 2002).

Results

From the total of 114 relevés (rels.), the dendrogram obtained from the hierarchical clustering analysis of the data matrix makes it possible to distinguish two main groups (A, B) of clusters (Fig. 2). The first cluster (A) primarily consists of relevés originally assigned to various communities of the *Saturejion subspicatae* alliance (On-line Suppl. Tab. 1). These relevés cover an area extending from the island of Krk and Gorski Kotar in the north to Mount Biokovo in the south at an altitude between 370 and 1550 m a.s.l. The second cluster (B) includes relevés from four relatively similar groups: (i) *Genisto-Globularietum bellidifoliae* from Mount Lovćen, Montenegro, altitudes between 650 and 1275 m a.s.l. (Fig. 2, cluster VII), and (ii) the thirty-two relevés collected in this study (Fig. 2, clusters VIII, IX and X), covering altitudes between 330 and 1171 m a.s.l. The latter clusters are proposed here as a new plant association, *Saturejo subspicatae-Scabiosetum delminianae* with three subassociations: (i) *typicum*, (ii) *jurinetosum mollis*, and (iii) *dalmatocytisetosum dalmatici* (Fig. 2, clusters VIII, IX, X).

In the dendrogram, some relevés belonging to the same communities (II and IV, i.e., *Carex humilis-Centaurea rupestris* and *Saturejo subspicatae-Caricetum humilis*) and are placed in different clusters, primarily reflecting the geographical origin of the relevés (On-line Suppl. Tab. 1). This issue needs to be addressed in the context of a revision of the *Saturejion subspicatae* alliance and falls beyond the aims of this study.

The NMDS (Fig. 3) resulted in a two-axis solution with a final stress of 0.224, which indicates a fairly good ordination. The relevés originally classified in the *Saturejion subspicatae* are mainly located in the left part of the diagram. All three

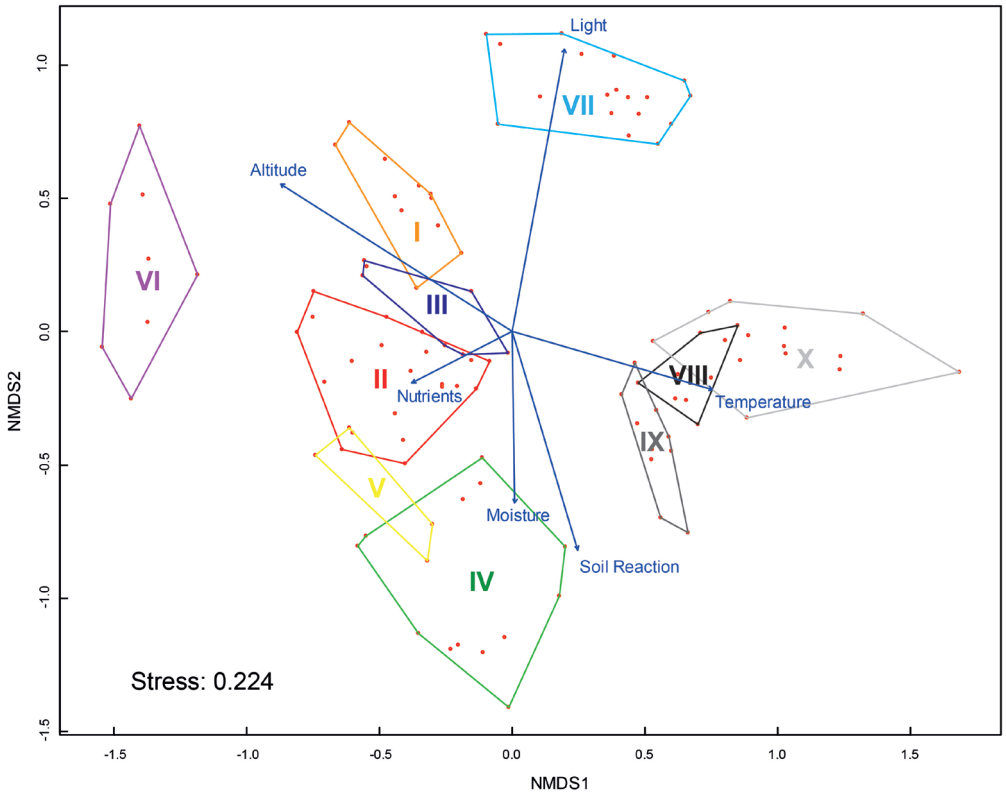

Fig. 3. Ordination of the relevés classified into the ten communities based on non-metric multidimensional (NMDS) of a Bray-Curtis similarity matrix. The community acronyms correspond to Fig. 2.

subassociations proposed here (clusters VIII-X) are clearly separated from each other in the right part of the diagram (Fig. 3). These stands occupy warmer habitats with shallow soils, mainly based on dolomite. The closely related association *Genisto-Globularietum bellidifoliae* (cluster VII) showed higher light values with stands located on the skeleton-rich soils, often on the southern slopes of Lovćen Mt.

Based on these results and according to the phytosociological table, a new association *Saturejo subspicatae-Scabiosetum delminianae*, including three subassociations: *typicum*, *jurinetosum mollis*, and *dalmatocytisetosum dalmatici*, was proposed and discussed here (On-line Suppl. Tab. 2). Their holotype relevés are listed in the Appendix. Photos of typical stands of subassociations are provided in On-line Suppl. Fig. 1.

The analysis of plant life forms showed that the association, including all three subassociations, was dominated by hemicryptophytes (49-63%) followed by chamaephytes (20-28%) and phanerophytes (7-17%), whereas therophytes and geophytes contributed the least (2-5%) (On-line Suppl. Tab. 3). These plant communities can be classified as in the following syntaxonomic scheme:

Festuco-Brometea Braun-Blanquet & Tuxen ex Klika & Hadač 1944
Scorzoneretalia villosae Kovačević 1959
Saturejion subspicatae Tomić-Stanković 1970
Saturejo subspicatae-Scabiosetum delminianae ass. nov. hoc loco
S.s.-S.d. typicum subass. nov. hoc loco
S.s.-S.d. jurinetosum mollis subass. nov. hoc loco
S.s.-S.d. dalmatocytisetosum dalmatici subass. nov. hoc loco

Discussion

The study identified plant communities dominated by *Scabiosa delminiana* forming grasslands in the transitional zone between the Mediterranean and Temperate regions in the interior of southern Croatia.

Scabiosa delminiana was first described by Abadžić (2007) from karstic fields (*polje*) and dolomitic areas in western Bosnia and Herzegovina, where it occurs in a northwest-southeast belt roughly following the Croatia-Bosnia and Herzegovina border (Fig. 1). In earlier literature (e.g., Ritter-Studnička 1967, 1972), the species was attributed to *S. canscens* Waldst. & Kit. However, all previously recorded localities were later confirmed to correspond to *S. delminiana* (Abadžić 2007). According to Nikolić (2025), the species is considered endemic to Croatia, and this study documents the westernmost limit of its entire distribution range.

The grassland vegetation dominated by *S. delminiana* is proposed here as a new association, *Saturejo subspicatae-Scabiosetum delminianae* (On-line Suppl. Tab. 2). According to a total of 32 vegetation relevés, this association is

characterized by a relatively high floristic richness, comprising 130 taxa overall. The number of species per relevé ranged from 17 to 38, with an average of 26.8. Similar levels of species richness have been reported for other associations within the *Saturejion subspicatae* alliance, such as *Carici-Centaureetum rupestris* (Trinajstić and Pavletić 1988, 1990). In the present study, the high species richness may be attributed to the relatively broad geographic scope of the sampling area, as well as to specific orographic conditions that allow Mediterranean climatic influences to penetrate areas otherwise characterized by different climatic regimes. The association occurs across an altitudinal range from 330 to 1171 m a.s.l., most frequently on northern and eastern exposures, on slopes ranging from 0° (flat) to 40°. Vegetation cover ranges from 70% to 100%, with full coverage (100%) being most commonly observed.

The taxa *S. delminiana*, *Globularia cordifolia* L. subsp. *bellidifolia* (Ten.) Wettst., and *Satureja subspicata* Bartl. ex Vis. are considered constant and dominant within the proposed association. The association includes eight taxa characteristic of the *Saturejion subspicatae* alliance and 22 taxa of the *Scorzoneretalia villosae* order. In total, 53 taxa are attributed to the *Festuco-Brometea* class. Additionally, 40 companions were recorded, originating from 14 different vegetation classes. Among the companions, the majority belong to the *Quercetea pubescentis* (13 taxa) and *Ononido-Rosmarinetea* (7 taxa) classes. Notably, the association includes a relatively high proportion (12.3%) of endemic taxa in Croatia (*sensu* Nikolić et al. 2015), such as *Edraianthus tenuifolius* (Waldst. & Kit.) A.DC., *Onosma echioides* (L.) L. subsp. *dalmatica* (Scheele) Peruzzi & N.G. Passal., and *Seseli montanum* L. subsp. *tommasinii* (Rchb. f.) Arcang., etc.

In our analysis (Figs. 2, 3), *Saturejo subspicatae--Scabiosetum delminianae* shows a close relationship to relevés of *Genisto-Globularietum bellidifoliae*, reported from the dolomitic area of Mount Lovćen, Montenegro (Tomić-Stanković 1970), primarily due to the presence of numerous dolomitic taxa. Furthermore, *S. delminiana* (originally attributed to *S. canescens*) has been documented as a characteristic species of two associations – *Saponario--Scabiosetum canescentis* and *Festuco-Linetum flavi* – described from karstic fields and surrounding dolomitic areas in western Bosnia and Herzegovina (Ritter-Studnička 1967, 1972; see also Fig. 1). Unfortunately, *Saponario--Scabiosetum canescentis* was only briefly described, lacking a supporting phytosociological table, which limits its comparability with our dataset. Floristically and ecologically, *Saturejo subspicatae-Scabiosetum delminianae* differs notably from *Festuco-Linetum flavi*. While our proposed association clearly fits within the *Saturejion subspicatae* alliance, the syntaxonomic position of the Bosnian-Herzegovinian associations has been subject to varying interpretations. According to the EuroVegChecklist (EVC; Mucina et al. 2016, Terzi et al. 2024), these associations should be subordinated to the *Chrysopogono grylli-Koelerion splendentis* alliance.

Our results support the distinction and formal proposal of three subassociations: *typicum*, *jurinetosum mollis*, and *dalmatocytisetosum dalmatici* (On-line Suppl. Tab. 2; see Appendix for holotype relevés). In addition to differences in differential taxa, the subassociations also exhibit variation in some ecological conditions, particularly with respect to altitudinal distribution. The *typicum* subassociation occurs at higher elevations, ranging from 655 to 1171 m a.s.l. In contrast, the *jurinetosum mollis* subassociation, distinguished by the presence of *Jurinea mollis*, is primarily found on lower slopes at altitudes below 400 m a.s.l. The subassociation *dalmatocytisetosum dalmatici*, dominated by *Dalmatocytisus dalmaticus* and sharing many species with *jurinetosum mollis*, is typically located on north- or northeast-facing slopes between 330 and 410 m a.s.l. *Dalmatocytisus dalmaticus* is a Croatian stenoendemic species, classified as 'Endangered' and strictly protected by Croatian law (Official Gazette 2013, Milović et al. 2022). Its distribution is restricted to a predominantly dolomitic area of approximately 1.5 km² near the town of Sinj in southern Croatia (Nikolić et al. 2015). Notably, within the subassociation *dalmatocytisetosum dalmatici*, *Scabiosa delminiana* reaches the southwesternmost limit of its entire distribution range.

At several localities within the study area, the encroachment of planted black pine (*Pinus nigra* J.F.Arnold) forests onto grasslands is already evident. As a result, beyond forest edges and clearings, *D. dalmaticus* occupies a significant portion of the herb layer within *P. nigra* stands, growing on shallow soils derived from the erosion of soft, porous calcareous marls (Šušnjara et al. 1992). This indicates a certain level of shade tolerance in *D. dalmaticus*. However, it is hypothesized that further forest development and the consequent closure of the canopy could substantially decrease light availability in the understory, thereby threatening the long-term survival of this species.

In other parts of the area, the grasslands show clear signs of succession toward shrubland and forest, primarily dominated by *Quercus pubescens* Willd. and *Ostrya carpinifolia* Scop. This successional trend likely accounts for the notable representation of companion species from the *Quercetea pubescentis* class. Milović et al. (2022) highlighted the significant anthropogenic pressures in the area inhabited by *D. dalmaticus*, including habitat reduction, fragmentation, and ruderalization, primarily resulting from settlement expansion, quarrying, and surface construction activities. These findings underscore the urgent need to develop and implement targeted conservation strategies to safeguard both *D. dalmaticus* and its associated grassland communities.

Conclusion

This study introduces a new grassland association, *Saturejo subspicatae-Scabiosetum delminianae*, comprising three subassociations, thereby contributing to the understanding of Croatian syntaxonomic diversity – an important indicator of overall ecological diversity. The association is characterized by high floristic richness and a notable presence of endemic species. These findings highlight the urgent need for targeted conservation measures, including succes-

sion management and the reduction of anthropogenic pressures, to preserve these valuable grassland habitats and ensure the long-term protection of regional biodiversity. Future research should focus on comprehensive phytosociological surveys and ecological analyses to further explore the complex ecosystems of the Dinaric karst and promote their sustainable management.

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Author contribution statement

MP – planned the research and sampled vegetation. NJ – led the writing with contributions of ŽŠ and MP. MM, JK – identified plant specimens and revised herbarium material. NJ, ŽŠ – made the statistical analysis. NJ, ŽŠ, MP – critically revised the manuscript. MP and NJ – share the first authorship. All authors have read and agreed to the published version of the manuscript.

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Appendix

Holotypes of the new plant communities.

Saturejo subspicatae-Scabiosetum delminianae typicum [locality: Croatia, Zadar County, Gračac Municipality, the Cerovac Bruvanjski karstic field; holotypus: On-line Suppl. Tab. 2, relevé no. 3; altitude 785 m a.s.l.; aspect E; slope 10°; plot size 40 m^2; vegetation cover 100%; date 19.9.2020; coordinate: 44.431028 N, 15.926356 E]: *Scabiosa delminiana*, 4; *Globularia cordifolia* subsp. *bellidifolia*, +; *Satureja subspicata*, 1; *Plantago holosteum*, +; *Teucrium montanum*, +; *Eryngium amethystinum*, +; *Seseli montanum* subsp. *tommasinii*, +; *Dorycnium germanicum*, 1; *Inula ensifolia*, +; *Plantago media*, +; *Betonica officinalis*, +; *Pseudolysimachion barrelieri*, +; *Carex humilis*, 1; *Asperula purpurea*, +; *Linum tenuifolium*, +; *Fumana procumbens*, +; *Asperula aristata* subsp. *scabra*, +; *Cirsium acaulon*, +; *Sanguisorba minor* subsp. *muricata*, +; *Carlina vulgaris*, +; *Hieracium hoppeanum* subsp. *testimoniale*, +; *Koeleria macrantha*, +; *Bromus erectus*, 1; *Centaurea weldeniana*, +; *Teucrium chamaedrys*, +; *Prunella laciniata*, +; *Carlina acaulis*, +; *Helleborus multifidus*, +; *Thesium divaricatum*, +; *Genista sylvestris* subsp. *sylvestris*, +; *Inula hirta*, +; *Euphrasia salisburgensis*, +; *Cuscuta europaea*, +; *Knautia* sp., +.

Saturejo subspicatae-Scabiosetum delminianae jurinetosum mollis [locality: Croatia, Split-Dalmatia County, the town of Sinj, Petrada hill; holotypus: On-line Suppl. Tab. 2, relevé no. 16; altitude 360 m a.s.l.; slope 0°; plot size 60 m^2; vegetation cover 100%; date 27.9.2020; coordinate: 43.731461 N, 16.650800 E]: *Scabiosa delminiana*, 4; *Globularia cordifolia* subsp. *bellidifolia*, 2; *Satureja subspicata*, 1; *Edraianthus tenuifolius*, +; *Jurinea mollis*, +; *Teucrium montanum*, +; *Eryngium amethystinum*, +; *Seseli montanum* subsp. *tommasinii*, +; *Koeleria splendens*, +; *Linum alpinum* subsp.

julicum, +; *Betonica officinalis*, +; *Stachys recta*, +; *Potentilla australis*, +; *Carex humilis*, +; *Asperula purpurea*, +; *Linum tenuifolium*, +; *Fumana procumbens*, +; *Cirsium acaulon*, +; *Sanguisorba minor* subsp. *muricata*, +; *Hieracium hoppeanum* subsp. *testimoniale*, +; *Ononis antiquorum*, +; *Bromus erectus*, 1; *Helianthemum nummularium* subsp. *obscurum*, +; *Artemisia alba*, +; *Echinops ritro* subsp. *ruthenicus*, +; *Onosma echioides* subsp. *dalmatica*, +; *Ruta graveolens*, +; *Cotinus coggygria* juv., +; *Rhamnus intermedia*, +; *Thesium divaricatum*, +; *Hieracium heterogynum*, +; *Pinus nigra* juv., +.

Saturejo subspicatae-Scabiosetum delminianae dalmatocytisetosum dalmatici [locality: Croatia, Split-Dalmatia County, the town of Sinj, Planica hill; holotypus: On-line Suppl. Tab. 2, relevé no. 32; 330 m a.s.l.; aspect W; slope 40°; plot size 50 m^2; vegetation cover 95%; date 12.8.2021; coordinate: 43.727598 N, 16.691710 E]: *Dalmatocytisus dalmaticus*, 4; *Globularia cordifolia* subsp. *bellidifolia*, 2; *Satureja subspicata*, 1; *Teucrium montanum*, +; *Koeleria splendens*, +; *Eryngium amethystinum*, +; *Dorycnium germanicum*, +; *Asperula purpurea*, +; *Asperula aristata* subsp. *scabra*,+; *Carex humilis*, +; *Echinops ritro* subsp. *ruthenicus*, +; *Anthericum ramosum*,+; *Thymus longicaulis*, +; *Prunella laciniata*, +; *Fraxinus ornus* juv., +; *Quercus pubescens* juv., +; *Cotinus coggygria*, +; *Genista sylvestris* subsp. *sylvestris*, +; *Hieracium heterogynum*, +.