

A short review of developments in phytosociological research across Europe, with emphasis on Croatia (2021–2025)

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Abstract

Recent syntaxonomic studies have significantly advanced our understanding of vegetation diversity and classification across Europe. The following overview highlights selected scientific achievements published in the past five years, at both continental and national levels, with particular emphasis on contributions relevant to Croatia.

Keywords: ecology, nomenclature, phytosociology, syntaxa, vegetation

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Sažetak

Nedavne sintaksonomske studije značajno su unaprijedile naše razumijevanje raznolikosti i klasifikacije vegetacije diljem Europe. U ovom preglednom radu ističemo odabrana znanstvena dostignuća objavljena u posljednjih pet godina, kako na kontinentalnoj tako i na nacionalnoj razini, s posebnim naglaskom na doprinose relevantne za Hrvatsku.

Ključne riječi: ekologija, fitocenologija, klasifikacija, sintaksoni, vegetacija

Studies of vegetation diversity and classification in Europe

In the period from 2021 to 2025, several publications have been released that significantly enhance our knowledge of vegetation units, both at the European and at the regional or national levels. The aim of this short overview is to highlight selected scientific achievements in the field of syntaxonomic research over the past five years in Europe, and particularly in Croatia.

The first comprehensive checklist of European phytosociological alliances, orders, and classes – the EuroVegChecklist (EVC) – was published by Mucina et al. (2016). However, this work did not include detailed information on the geographical distribution of individual vegetation types. Subsequently, Preislerová et al. (2022) compiled data on the occurrence of phytosociological alliances in European countries and regions from literature sources and vegetation-plot databases. They produced distribution maps for 1,105 alliances of vascular-plant-dominated vegetation listed in the EVC. For each territorial unit, three occurrence probability levels were indicated: (a) verified occurrence, (b) uncertain occurrence, and (c) absence. These individual maps were complemented by summary maps showing the total number of alliances and the alliance-area relationship, with all distribution data also available in spreadsheet format. This review of the occurrence of phytosociological alliances reveals possible regional gaps in the current knowledge of vegetation diversity, mainly in Eastern Europe, the Balkan Peninsula, and the Transcaucasian area.

More recently, Preislerová et al. (2024) developed a new database that, based on literature review and expert knowledge, assigns standardized categorical attributes of 12 ecological and structural variables to all vascular-plant alliances defined in the EVC. These variables include dominant life form, phenological optimum, substrate moisture and reaction, salinity, nutrient status, soil organic matter, vegetation region, altitudinal vegetation belt, azonality,

successional status, and naturalness (see <https://floraveg.eu/download/>). This database substantially increases the applicability of phytosociological classification in both research and practice, and facilitates understanding of this classification for non-specialists.

Additionally, Preislerová & Chytrý (2025) (a) reviewed high-rank syntaxa from Europe newly published between 2017 and 2022, as well as those described before 2017 but not included in the EVC, and (b) analyzed the temporal dynamics of publishing new high-rank syntaxa of European vegetation since the emergence of the Braun-Blanquet school in the early 20th century. They concluded that the number of high-rank syntaxa newly described from Europe has not declined following the publication of the EVC (Mucina et al. 2016). On the contrary, many new syntaxa continue to be published each year, even from well-studied European regions with a long tradition of syntaxonomic research. Interestingly, a large number of these syntaxa have not been validly described according to the ICPN, and for most of them, the authors have not yet submitted a proposal to the European Vegetation Classification Committee (<https://euroveg.org/evc-committee/>) for their inclusion in the EVC.

Furthermore, Willner & Faber-Langendoen (2021) established a link between the Braun-Blanquet types of the EVC and the upper hierarchical levels of the International Vegetation Classification (IVC), proposing a division-level classification for Europe. The authors organized the EVC classes into 21 formations and 30 divisions, identifying several classes that did not fit neatly within existing formations – because, either their content corresponded to more than one formation, or it did not align with any described formation. This work represents an important step toward integrating European syntaxonomy into a global framework of vegetation classification.

We consider it important to highlight several studies that focus on the methodology of collecting phytosociological data. Guarino et al. (2022)

proposed an equation (“classification efficiency coefficient”) to evaluate the efficiency of a classification as a function of the effort required and the population size of data collectors. The equation suggests that a classification system based on vascular plants offers the best compromise between sampling effort, resolution power and data availability. The authors argued that the inclusion of cryptogams in the description of phytocoenoses dominated by vascular plants should rely on a synusial approach, conceived as complementary to the traditional Braun-Blanquet approach. In addition, Dengler & Dembicz (2023) explored the errors resulting from different methods of recording plant cover in vegetation plots, specifically comparing the direct estimation of percentage cover with the use of the 7-step Braun-Blanquet and the 5-step Hult-Sernander-Du Rietz scales. Except for a few cases with unrealistic settings (very high estimation error and omission of species with low cover values), direct percentage estimation produced better results than the use of these scales. Based on the authors’ personal experience (op. cit.), the careful application of an ordinal scale is not faster than direct percentage estimation. For this reason, there appears to be no plausible argument supporting the continued use of ordinal cover scales when virtually all subsequent analyses are numerical. Further, Quattrini et al. (2025) demonstrated a strong positive relationship between species abundance data collected by drones and traditional field methods in both forest and grassland ecosystems. The supervised classification achieved an overall accuracy exceeding 90% in assigning drone-surveyed plots to predefined plant associations.

Ecological indicator values (EIV) enable a quick and reliable assessment of site conditions based on the floristic composition of a vegetation plot and are widely used by vegetation ecologists throughout Europe. A quantitative indicator system for vascular plants developed by German biologist, botanist and ecologist Heinz Ellenberg for most species occurring in Central Europe was among the first

and is certainly the most well-known such system. To date, more than 30 similar systems have been developed, often differing considerably from one another, thereby limiting their use across larger geographic areas and hindering the comparability of results. Recently, two new EIV systems for Europe were published: the Ellenberg-type indicator values by Tichý et al. (2023) and the Ecological Indicator Values for Europe (EIVE) 1.0 by Dengler et al. (2023). Tichý et al. (2023) use the same scales as Ellenberg et al. (1991), while Dengler et al. (2023) use a uniform interval scale of 0–10 for all indicators. Both systems provide indicator values for moisture, nutrients, soil reaction, light and temperature, while Tichý et al. (2023) additionally include values for salinity. In addition, both systems describe the position of the ecological niche, while Dengler et al. (2023) also provide information on niche breadth.

In addition to the new systems of ecological indicator values, several studies have been published that will facilitate and advance vegetation ecology research across Europe. Midolo et al. (2023) introduce a new system for the quantitative assessment of natural and anthropogenic disturbance based on the floristic composition of a vegetation plot. The dataset contains five main continuous indicator values for European plants: disturbance severity, disturbance frequency, mowing frequency, grazing pressure, and soil disturbance. Lososová et al. (2023) provide seed dispersal distance classes and predominant dispersal modes, while Midolo et al. (2024) provide data on Raunkiær’s life forms for most species of European vascular plants.

Generally, recent syntaxonomic studies have significantly advanced our understanding of vegetation diversity and classification across Europe in the past five years. Here, we selected scientific achievements published both at the continental and regional levels. Several formalized classifications of various vegetation types across Europe have been published, such as those of mountain river gravel bars (Kalníková et al. 2021), bog vegetation of the *Oxycocco-Sphagneteta* class (Jiroušek et al. 2022),

European oak-hornbeam forests (*Carpinetalia betuli*) together with related vegetation types (Novák et al. 2023), and the vegetation of springs with constant water flow (*Montio-Cardaminetea*) (Peterka et al. 2023). Bonari et al. (2021) proposed a new syntaxonomic scheme for Mediterranean lowland to submontane pine forests with 15 alliances and one new class – *Pinetea halepensis*. Marcenò et al. (2024) reviewed the phytosociological nomenclature of syntaxa of European coastal dune vegetation (*Ammophiletea arundinaceae*, *Honckenyo peploidis-Elymetea arenarii*, *Koelerio glaucae-Corynephoretea canescentis*), while Iemelianova et al. (2025) presented a revised syntaxonomic framework of the annual vegetation in European saline seasonal wetlands (*Crypsieteae aculeatae*). Koljanin et al. (2025) studied Illyrian forest indicator species by their distribution, analysed their biogeographic patterns, evaluated their role in floristic differentiation, and explored the potential distribution of Illyrian mesophilous forests. An Interpretative manual of European riparian forests and shrublands was published by Mandžukovski et al. (2021).

At the regional or national level, several publications have contributed to improving our understanding and refinement of vegetation classification. Based on dataset of 4,717 vegetation relevés, Kavgaçı et al. (2021) classified the forest and shrubland vegetation in Mediterranean Turkey. An updated phytosociological checklist of high-rank syntaxa in Bulgaria was compiled by Apostolova (2023). Koljanin et al. (2023) classified wetland forests and scrub in the western Balkans (Slovenia, Croatia, and Bosnia and Herzegovina) at the alliance level, identifying the main ecological gradients driving species composition within the *Alno glutinosae-Populetea albae*, *Salicetea purpureae*, *Alnetea glutinosae*, and *Franguletea* classes. Interestingly, Armenia, a country in the South Caucasus, located at the crossroads of Europe and Asia, has recently received its first syntaxonomic classification of dry grasslands and thorn-cushion communities (Vynokurov et al. 2024). Vasheniak et

al. (2025) revised previous syntaxonomic concepts, compared chalk rocky grasslands with other calcareous rocky grasslands and provided a unified classification of chalk rocky grasslands in the arid Eastern European Plain including Ukrainian, Russian and Kazakh communities.

Aiming to make a major contribution towards the harmonization of grassland classification in Europe, Vassilev et al. (2024) published a classification of high-rank syntaxa of dry grasslands in the Central and Eastern Balkans (Serbia, Kosovo, North Macedonia, Bulgaria, and northern Greece). They distinguished four classes (*Tuberarietea guttatae*, *Stipo-Brachypodietea distachyi*, *Festuco-Brometea*, and *Koelerio-Corynephoretea*) comprising eight orders and twelve alliances. More recently, Vassilev et al. (2025) published a review article on the high-rank syntaxa of riparian shrubland and forest vegetation (*Salicetea purpureae*, *Alno glutinosae-Populetea albae*) in Bulgaria. Iemelianova & Borsukevych (2025) critically revised the previous concept and syntaxonomic structure of the *Alnetea glutinosae* class in Ukraine.

Finally, though by no means least, the resurvey of historical vegetation plots (relevés) has become a fundamental methodology in ecological research during last decade, as it provides a unique opportunity to assess vegetation and environmental changes over time (e.g., Knollová et al. 2024, Siccardi et al. 2025). Mediterranean island ecosystems are particularly vulnerable to climate change and are likely to exhibit complex and unpredictable responses. Therefore, the early detection of such effects at small spatial scales and over short temporal periods is crucial for developing reliable climate change scenarios (Médail 2022).

Dengler et al. (2024a) and Biurrun et al. (2025) reported on the content of articles published in *Vegetation Classification and Survey* from 2020–2024 and its development relative to other ecological journals.

Databases

An online open-access database on European vegetation units (phytosociological syntaxa), vegetated habitats, and plant taxa – **FloraVeg.EU** (<https://floraveg.eu/>) – was presented by Chytrý et al. (2024). It consists of three modules:

(1) The **Vegetation module** includes 149 phytosociological classes, 378 orders, and 1,305 alliances from an updated version of the *EVC*, modified according to the decisions of the European Vegetation Classification Committee. Vegetation units dominated by vascular plants are characterized by country-based distribution maps and data on dominant life forms, phenology, soil properties, relationships to vegetation regions, altitudinal vegetation belts and azonal habitats, successional status, and degree of naturalness. A list of diagnostic taxa is also provided for each class.

(2) The **Habitats module** includes vascular-plant-dominated terrestrial, freshwater, and marine habitat types from the first to the third (or fourth) hierarchical levels of the EUNIS classification. Of these, 249 vegetated habitats are characterized by a brief description, a point-based distribution map, diagnostic, constant, and dominant taxa, and a list of corresponding alliances.

(3) The **Species module** provides information on 37 characteristics of European vascular plant species and some infrageneric or infraspecific taxa, including functional traits (habitus and growth type, leaf, flower, fruit, and seed traits, and trophic mode), taxon origin (native vs. alien), and ecological information (environmental relationships, Ellenberg-type indicator values, disturbance indicator values, and relationships to vegetation units and habitat types). Values for at least three variables are available for more than 36,400 species. All taxa, vegetation units, and habitats in these three modules are illustrated by more than 34,000 photographs. The *Download* section of **FloraVeg.EU** provides open-access datasets in spreadsheet format suitable for analysis. *FloraVeg.EU* thus represents a

valuable new resource offering easily accessible data for research in vegetation science, ecology, and biogeography, as well as for educational and conservation purposes.

For researchers and professionals dealing with arable habitats (i.e., fields, orchards, vineyards, and their fallows), a new resource – the **AgriWeedClim database** (<https://agriweedclim.univie.ac.at/>) – has been established (Glaser et al. 2022). It contains vegetation plot data (relevés) from Central Europe (Germany, Czech Republic, Slovakia, Switzerland, Liechtenstein, Austria, Hungary, northern Italy, Slovenia, and Croatia). Vegetation plot data were obtained from large repositories (e.g., the European Vegetation Archive), specialized regional databases, colleagues, and the literature. The data were then checked for completeness and standardized (e.g., taxonomy, nomenclature, crop types). Species were classified as native, archaeophyte, or neophyte. The *AgriWeedClim* database version 1.0 contains georeferenced data from 32,889 vegetation plots sampled between 1916 and 2019.

A very important initiative at the European level is the creation of an online nomenclatural database for the registration of phytosociological names (**PhytoS**). This database is being developed by Michel Uiterwijk and the Steering Committee of the Working Group for Phytosociological Nomenclature (IAVS) (Theurillat & Uiterwijk 2023). The *PhytoS* platform is planned to provide free and open access to information on published names of plant communities, searchable according to various criteria such as syntaxonomy, geography, author, and year.

Phytosociological studies in Croatia

Carpino-Fagetea sylvaticae Jakucs ex Passarge 1968

Škvorc et al. (2021) assessed vegetation diversity of beech forests in the Žumberak and Samobor highlands. Based on a total of 243 phytosociological

relevés (99 extracted from the literature and 144 newly collected), seven associations within two alliances were identified. One new association and two subassociations were established.

In this paper, each syntaxonomic scheme below highlights in **bold** all plant communities that have been newly described or nomenclaturally validated in recent studies.

Carpino-Fagetea sylvaticae Jakucs ex Passarge 1968

Luzulo-Fagetalia sylvaticae Scamoni et Passarge 1959

Luzulo-Fagion sylvaticae Lohmeyer et Tx. in Tx. 1954

Luzulo luzuloidi-Fagetum Meusel 1937

***Gentiano asclepiadeae-Fagetum sylvaticae* Škvorc et al. 2021**

Fagetalia sylvaticae Pawłowski 1928

Aremonio-Fagion (Horvat 1938) Borhidi in Török et al. 1989

Ostryo-Fagenion Borhidi 1963

Ostryo-Fagetum M. Wraber ex Trinajstić 1972

Epimedio-Fagenion Marinček et al. 1993

Vicio oroboidi-Fagetum Horvat (1938) Pócs et Borhidi in Borhidi 1960

Hacquetio-Fagetum Ž. Košir ex Borhidi 1963

***aceretosum obtusati* Škvorc et al. 2021**

Lamio orvalae-Fagenion Borhidi ex Marinček et al. 1993

Lamio orvalae-Fagetum Horvat 1938

***fraxinetosum orni* Škvorc et al. 2021**

Cardamini savensi-Fagetum Ž. Košir ex Marinček et al. 1993

Jelinčić et al. (2024) studied the syntaxonomy of Illyrian oak-hornbeam forests on the limestone cliffs of the Kupa River canyon (*Epimedio-Carpinetum betuli* (Horvat 1938) Borhidi 1963). Šapić et al. (2025) examined the occurrence and ecology of forest communities with *Tilia tomentosa* at the western edge of its natural distribution, focusing primarily on Zrinska Gora and extending the analysis to neighbouring countries (Bosnia and Herzegovina, Hungary, and Serbia).

In the on-line book by Vukelić et al. (2023), the authors provided a comprehensive overview of the forest vegetation of Plitvička jezera National Park, based on 201 original vegetation plots. The overview includes 16 plant communities classified into 9 alliances within 4 classes. In addition, a new association, *Lamio orvalae-Aceretum obtusati* Vukelić, Šapić et Baneković 2023, within the alliance *Tilio platyphylli-Acerion pseudoplatani* Klika 1955, is described.

Festuco-Brometea Braun-Blanquet & Tuxen ex Klika & Hadač 1944

Vegetation diversity and ecology of grassland communities with *Salvia officinalis* L. were assessed throughout the distribution range of the species, including northern Italy, Croatia, Bosnia and Herzegovina, Montenegro, Albania, North Macedonia, and Serbia (Terzi et al. 2022, 2023). Based on a total of 346 phytosociological relevés (259 extracted from the literature and 87 newly collected in Montenegro and the Middle Dalmatian Islands of Croatia), seventeen associations within five alliances and four vegetation classes were identified (Terzi et al. 2023). In total, three associations and one subassociation were described for the first time across the entire distribution range of *S. officinalis*. For the Croatian territory, two new associations were established – *Brachypodio retusi-Salvietum officinalis* (Kornati islands) and *Salvietum brachydonti-officinalis* (Pelješac Peninsula) (Fig. 1A, 3A).

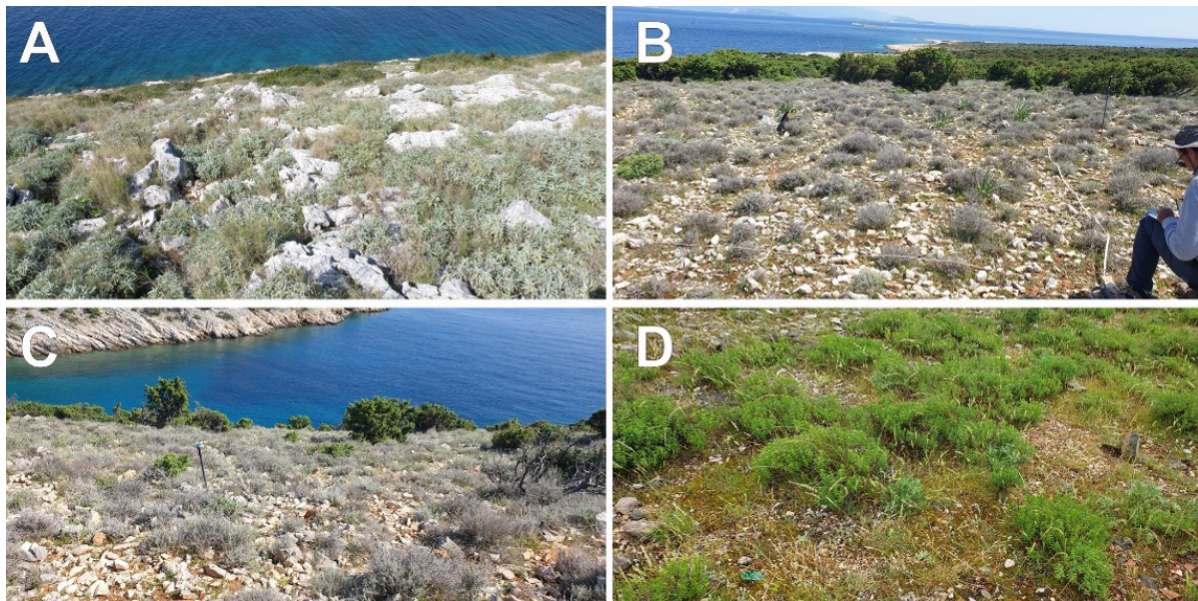


Figure 1. *Chrysopogono-Koelerion*: A – *Brachypodio retusi-Salvietum officinalis* (Kornati islands, 7 October 2014), B – *Helichrysetum italici typicum*, C – *Helichrysetum italici salvietosum officinalis* (Plavnik Island, 25–26 May 2023), D – *Centaureo cristatae-Chrysopogonetum grylli rhamnetosum intermediae* (Kukuljanovo near Rijeka, 29 May 2022) (photos by N. Jasprica, except 1A by Marija Pandža).

Slika 1. *Chrysopogono-Koelerion*: A – *Brachypodio retusi-Salvietum officinalis* (Kornatsko otočje, 7. 10. 2014.), B – *Helichrysetum italici typicum*, C – *Helichrysetum italici salvietosum officinalis* (otok Plavnik, 25.–26. 5. 2023.), D – *Centaureo cristatae-Chrysopogonetum grylli rhamnetosum intermediae* (Kukuljanovo kraj Rijeke, 29. 5. 2022.) (fotografije N. Jasprica, osim 1A Marija Pandža).

In that study (op. cit.), the alliances *Chrysopogono grylli-Koelerion splendidis* and *Saturejion subspicatae* were classified within the order *Koelerietalia splendidis* and the class *Helianthemo cani-Seslerietea nitidae*, whose recognition in the western Balkans represents a syntaxonomic novelty (see Terzi et al. 2021). Nomenclatural issues are beyond the scope of this review and have been discussed elsewhere (e.g., Dengler et al. 2024b, Vassilev et al. 2024, and references therein).

The changes in grassland vegetation that have occurred over the past century on the northeastern Adriatic island of Plavnik (Croatia) were investigated by Terzi and Jasprica (2024a,b). Based on the current syntaxonomic framework for grassland associations, three associations and two sub-associations were identified on the island. Among them, *Festuco valesiaca-Poetum bulbosae* (*Poetea bulbosae*), *Helichrysetum italici salvietosum officinalis*

(*Festuco-Brometea*), and *Hedypnoido rhagadioloidis-Asphodeletum ramosi* were proposed as new to science (Fig. 1B–C, 4). Three associations previously recorded on the island (*Festucetum valesiaca*, *Asphodeletum microcarpi*, and *Andropogonetum grylli*) were considered extinct, possibly as a consequence of changes in grazing intensity and type.

A comprehensive revision of the dry grassland vegetation belonging to the alliance *Chrysopogono grylli-Koelerion splendidis* along the eastern Adriatic (Albania, Bosnia and Herzegovina, Croatia, Italy, Montenegro, and the Republic of North Macedonia) was presented by Terzi et al. (2024a). The revision is based on 490 phytosociological relevés, including 44 newly collected from the *loci classici* of previously identified associations. The communities of the *Chrysopogono grylli-Koelerion splendidis* alliance predominantly occur in the sub-Mediterranean variant of the temperate bioclimate. In total, fifteen

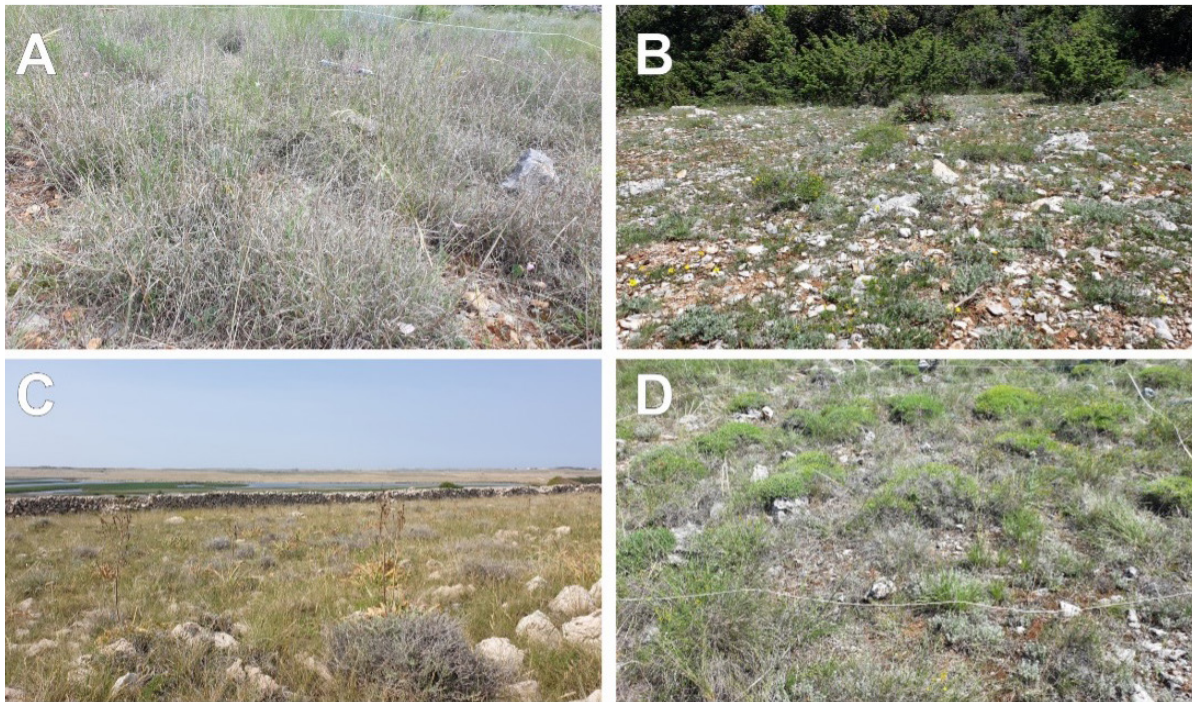


Figure 2. *Chrysopogono-Koelerion*: A – *Lactuco vimineae-Ischaemetum helichrysetosum italicum* (Krk Island, 25 May 2022), B – *Bromopsido erectae-Festucetum lapidosae* (Brač Island, 20 May 2022), C – *Bromopsido erectae-Chrysopogonetum grylli* (Pag Island, 23 May 2022), D – *Bromopsido erectae-Chrysopogonetum grylli piloselletesum officinarum* (Podi-Vrpolje near Šibenik, 21 May 2022) (photos by N. Jasprica).

Slika 2. *Chrysopogono-Koelerion*: A – *Lactuco vimineae-Ischaemetum helichrysetosum italicum* (otok Krk, 25. 5. 2022.), B – *Bromopsido erectae-Festucetum lapidosae* (otok Brač, 20. 5. 2022.), C – *Bromopsido erectae-Chrysopogonetum grylli* (otok Pag, 23. 5. 2022.), D – *Bromopsido erectae-Chrysopogonetum grylli piloselletesum officinarum* (Podi-Vrpolje kraj Šibenika, 21. 5. 2022.) (fotografije N. Jasprica).

associations and one plant community were identified, including the description of a new association, *Sideritido purpureae-Asphodeletum ramosi*, from Montenegro, together with four new subassociations, all from Croatia (Fig. 1D, 2).

Pandža et al. (2025) formalized the proposal of a new phytosociological association of grasslands dominated by *Scabiosa delminiana* Abadžić and *Dalmatocytisus dalmaticus* (Vis.) Trinajstić, two species with a limited distribution in Croatia (for details see Milović et al. 2022, 2025). Based on a total of 32 vegetation relevés, the newly described association *Saturejo subspicatae-Scabiosetum delminianae*

is characterized by relatively high floristic richness and a notable presence of endemic species. The results support the distinction and formal recognition of three subassociations – *typicum*, *jurinetosum mollis*, and *dalmatocytisetosum dalmatici* – which differ in diagnostic taxa and show variation in certain ecological conditions, particularly with respect to altitudinal distribution (Fig. 3B–D). These findings emphasize the urgent need for targeted conservation measures, including succession management and the mitigation of anthropogenic pressures, to preserve these valuable grassland habitats and ensure the long-term protection of regional biodiversity.

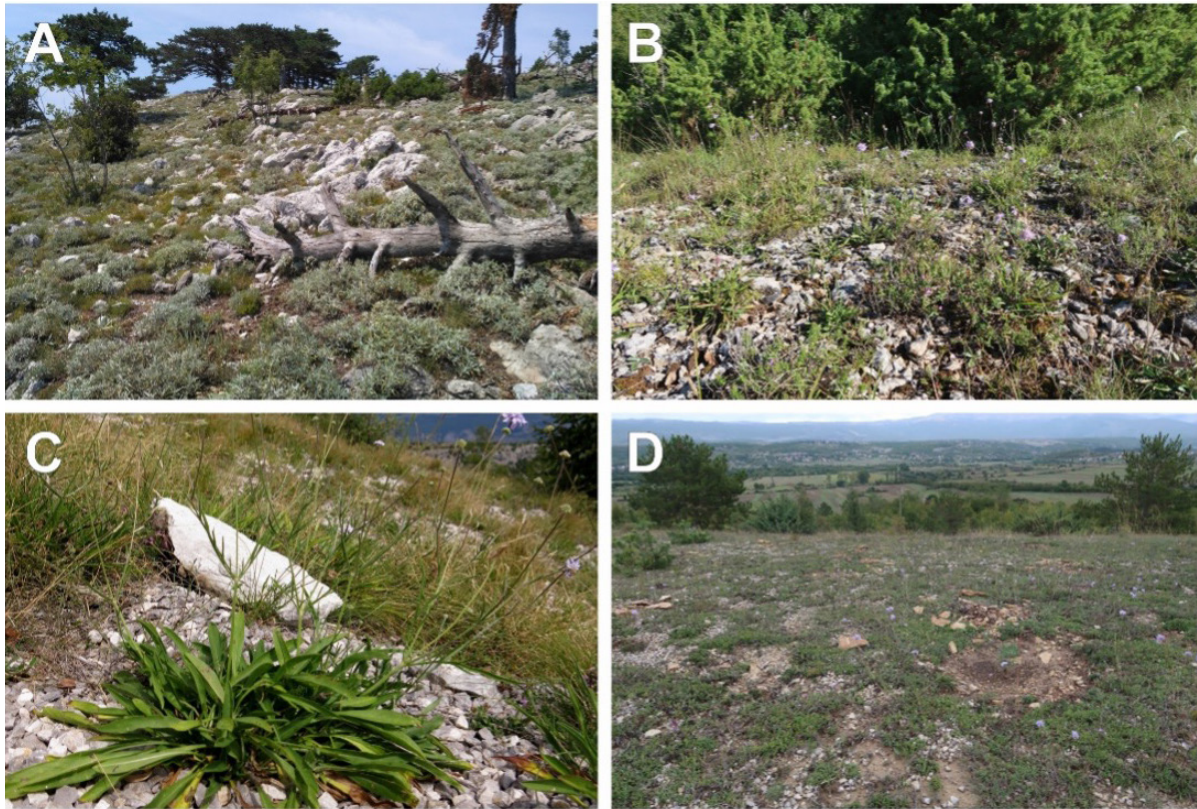


Figure 3. *Saturejion subspicatae*: A – *Salvietum brachyodonti-officinalis* (Pelješac Peninsula, 8 August 2018), B – *Saturejo subspicatae-Scabiosetum delminianae typicum* (Malovan, Lika, 20 August 2020), C – *Saturejo subspicatae-Scabiosetum delminianae jurinetosum mollis* (Svilaja Mt., 14 August 2019), D – *Saturejo subspicatae-Scabiosetum delminianae dalmatocytisetosum dalmatici* (Petrada, Sinj, 27 September 2020) (photos by Marija Pandža, except 3A by Ivan Radosavljević).

Slika 3. *Saturejion subspicatae*: A – *Salvietum brachyodonti-officinalis* (poluotok Pelješac, 8. 8. 2018.), B – *Saturejo subspicatae-Scabiosetum delminianae typicum* (Malovan, Lika, 20. 8. 2020.), C – *Saturejo subspicatae-Scabiosetum delminianae jurinetosum mollis* (Svilaja, 14. 8. 2019.), D – *Saturejo subspicatae-Scabiosetum delminianae dalmatocytisetosum dalmatici* (Petrada, Sinj, 27. 9. 2020.) (fotografije Marija Pandža, osim 3A Ivan Radosavljević).

Festuco-Brometea Braun-Blanquet et Tuxen ex Klika & Hadač 1944

Koelerietalia splendentis Horvatić 1973 (*Scorzoneretalia villosae* Kovačević 1959, p.p.?)

Chrysopogono grylli-Koelerion splendentis Horvatić 1973

***Brachypodio retusi-Salvietum officinalis* Terzi, Jasprica, Pandža, Milović et Caković 2023** (Kornati islands)

Helichrysetum italici Horvatić 1927 *typicum*

***salvietosum officinalis* Terzi et Jasprica 2024** (Plavnik Island)

***Festuca dalmatica-Brachypodium retusum* plant community**

[=*Koelerio splendentis-Festucetum illyricae brachypodietosum retusi sensu* Kamenjarin and Pavletić 2003] (Čiovo Island)

Centaureo cristatae-Chrysopogonetum grylli Ferlan et Giacomini 1957 nom. invers.
***rharnetosum intermediae* (Horvat in Horvat, Glavač et Ellenberg 1974) Terzi, Jasprica et Pesaresi 2024**

[=*Saturejo montanae-Ischaemetum* Horvat in Horvat, Glavač et Ellenberg 1974]
(Kukuljanovo near Rijeka)

Lactuco vimineae-Ischaemetum Poldini 1975

***helichrysetosum italici* (Trinajstić ex Poldini 1975) Terzi, Jasprica et Pesaresi 2024**

[=*Dichanthio ischaemum-Cleistogenetum serotinae* Trinajstić ex Poldini 1975]
(Krak Island)

***Bromopsido erectae-Festucetum lapidosae* Trinajstić 1992 mut. Terzi, Jasprica et Pesaresi 2024 nom. mut.** (Brač Island)

***Bromopsido erectae-Chrysopogonetum grylli* Horvatić 1934 mut. Terzi, Jasprica et Pesaresi 2024 nom. mut.** (Pag Island)

***piloselletosum officinarum* (Horvatić 1963) Terzi, Jasprica et Pesaresi 2024**

[=*Festuco-Koelerietum splendentis* Horvatić 1963] (Podi and Vrpolje near Šibenik)

***Narcisso tazettae-Asphodeletum ramosi* Šegulja 1969 mut. Terzi, Jasprica et Pesaresi 2024 nom. mut.** (Sveta Marina, Istria)

***sisymbrietosum officinalis* Hećimović ex Terzi, Jasprica et Pesaresi 2024**
(Bobara Island)

Saturejion subspicatae Tomić-Stanković 1970

***Salvietum brachyodonti-officinalis* Terzi, Jasprica, Pandža, Milović et Caković 2023** (Pelješac Peninsula)

***Saturejo subspicatae-Scabiosetum delminiana* Pandža, Jasprica, Škvorc, Milović et Karadole 2025**

typicum (Cerovac Bruvanjski karstic field, Gračac, Zadar County)

jurinetosum mollis (Petrada hill, near Sinj, Dalmatia)

dalmatocytisetosum dalmatici (Planica hill, near Sinj, Dalmatia)

Association *Hedypnoido rhagadioloidis-Asphodeletum ramosi* on the island of Plavnik

The plant community dominated by *Asphodelus ramosus* L. on the island of Plavnik differs both floristically and ecologically from the *Asphodeletum microcarpi* described by Horvatić (1927), as well as from similar communities occurring at other sites

along the eastern Adriatic coast (e.g., Terzi 2023). The *A. ramosus*-dominated community on Plavnik has therefore been proposed as a new association, *Hedypnoido rhagadioloidis-Asphodeletum ramosi* (Terzi & Jasprica 2024a) (Fig. 4A–B). However, its classification at higher syntaxonomic levels remains uncertain.

Class has yet to be clarified: ?

***Hedypnoido rhagadioloidis-Asphodeletum ramosi* Terzi et Jasprica 2024** (Plavnik Island)

Poetea bulbosae Rivas Goday et Rivas-Martínez ex Navarro Andrés et Valle Gutiérrez 1984

The *Romuleion*, the only alliance of the order *Poetalia bulbosae* (class *Poetea bulbosae*) occurring on the Balkan Peninsula, represents Mediterranean perennial and ephemeral pastures. It has been recorded in several Balkan countries, including Greece, the Republic of North Macedonia, Montenegro, Croatia, and Bulgaria (Terzi et al. 2024b). However, a revision of its nomenclature according to the fourth edition of the *International Code of Phytosociological Nomenclature* (Theurillat et al. 2021) revealed that the name of the alliance had not been validly published.

Consequently, Terzi et al. (2024b) described a new alliance, *Romuleion graecae*, along with the new association *Plantagini lagopodis-Poetum bulbosae* (see also Čarni et al. 2014).

The *Romuleion* currently comprises six associations. The *Festuco valesiacaе-Poetum bulbosae* association, recently described by Terzi & Jasprica (2024a) from the island of Plavnik, is of particular interest, although its placement within this alliance remains open to discussion (see Terzi et al. 2024b). Importantly, the *Festuco valesiacaе-Poetum bulbosae* provides the first phytosociological evidence of the occurrence of the class *Poetea bulbosae* in Croatia (Fig. 4C–D).

Poetea bulbosae Rivas Goday et Rivas-Martínez ex Navarro Andrés et Valle Gutiérrez 1984

Poetalia bulbosae Rivas Goday et Rivas-Martínez in Rivas Goday et Ladero 1970

***Romuleion graecae* Oberdorfer ex Terzi, Jasprica, Čarni, Matevski, Bergmeier et Theurillat 2024**

***Festuco valesiacaе-Poetum bulbosae* Terzi et Jasprica 2024** (Plavnik Island)

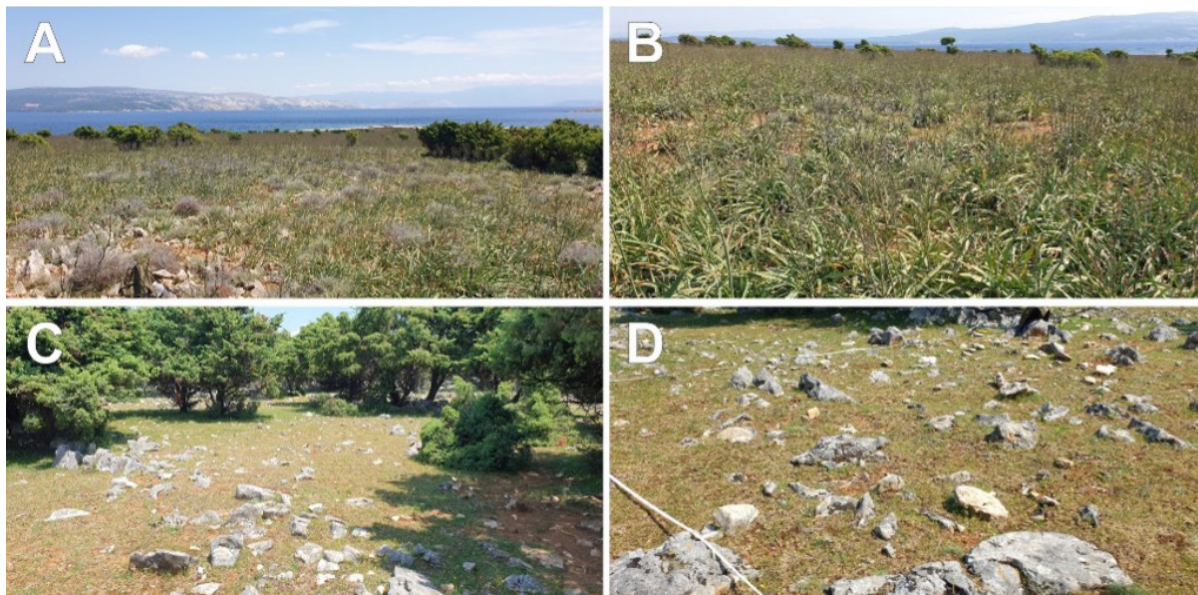


Figure 4. A – *Hedypnoido rhagadioloidis-Asphodeletum ramosi* (Plavnik Island, 26 May 2023), B – *Hedypnoido rhagadioloidis-Asphodeletum ramosi*, detail (Plavnik Island, 26 May 2023); ***Romuleion graecae***: C – *Festuco valesiacaе-Poetum bulbosae* (Plavnik Island, 28 May 2023), D – *Festuco valesiacaе-Poetum bulbosae*, detail (Plavnik Island, 28 May 2023) (photos by N. Jasprica).

Slika 4. A – *Hedypnoido rhagadioloidis-Asphodeletum ramosi* (otok Plavnik, 26. 5. 2023.), B – *Hedypnoido rhagadioloidis-Asphodeletum ramosi*, detalj (otok Plavnik, 26. 5. 2023.); ***Romuleion graecae***: C – *Festuco valesiacaе-Poetum bulbosae* (otok Plavnik, 28. 5. 2023.), D – *Festuco valesiacaе-Poetum bulbosae*, detalj (otok Plavnik, 28. 5. 2023.) (fotografije N. Jasprica).

Crithmo-Staticetea Br.-Bl. in Br.-Bl. et al. 1952

Jasprica & Stamenković (2023) studied plant communities characterized by the constant presence of two insular endemic species of the genus *Brassica* (*B. cazzae* Ginzb. et Teyber and *B. mollis* Vis.) on small southeastern Adriatic islands and islets in southern Croatia. On the island of Sušac (4.02 km²), within the alliance *Limonium anfracti-cancellati*, they described the new association *Plantagino holostei-Limonietum cazzae*, whereas on the island of Koločep (2.44 km²), within the alliance *Anthyllidion barbae-jovis* (see Terzi et al. 2020), they identified the new association *Brassico mollis-Anthyllidetum barbae-jovis* (Fig. 5A). The distribution of these plant communities along the altitudinal gradient of vertical sea cliffs on these islands, as well as across the nearby islets of the Korčula Archipelago (Obljak, Kosor, Stupa), was analyzed in detail.

Crithmo-Staticetea Br.-Bl. in Br.-Bl. et al. 1952*Crithmo-Staticetalia* Molinier 1934

Limonium anfracti-cancellati (Horvatić 1934) Mucina in Mucina et al. 2106

***Plantagino holostei-Limonietum cazzae* Jasprica et Stamenković 2023** (Sušac Island)

Plantagino holostei-Limonietum subanfracti Terzi et al. 2020 *typicum*

***helichrysetosum italicum* Jasprica et Dolina 2025** (Proizd Islet)

Helichrysetalia italicum Biondi et Gehu in Gehu et Biondi 1994

Capparo orientalis-Aurinion leucadeae Lovrić ex Terzi, Bogdanović, D'Amico et Jasprica 2020

***Pimpinello lithophilae-Centaureetum lovricii* Jasprica et Terzi 2023** (Vis Island)

Anthyllidion barbae-jovis S. Brullo et De Marco 1989

***Brassico mollis-Anthyllidetum barbae-jovis* Jasprica et Stamenković 2023** (Koločep Island)

***Asplenietea trichomanis* (Br.-Bl. in Meier et Br.-Bl. 1934) Oberd. 1977**

Until recently, the association *Centaureetum ragusinae* included three subassociations: *typicum*, *limonietosum anfracti*, and *limonietosum cancellati* (see Terzi et al. 2017, Terzi & Jasprica 2020). In the study by Jasprica & Stamenković (2023), a new

Jasprica & Terzi (2023) described the new association *Pimpinello lithophilae-Centaureetum lovricii* (alliance *Capparo orientalis-Aurinion leucadeae*) from the island of Vis (southern Croatia). This new association replaces *Pimpinello lithophilae-Centaureetum issaeae* (Terzi et al. 2020), which was published invalidly because the taxon name *Centaurea issaea* Lovrić is a *nomen nudum* (Bogdanović et al. 2022). Consequently, Bogdanović et al. (2022) validly described the new species *C. lovricii* Bogdanović, Boršić, Ljubičić, Brullo et Giusso, and Jasprica & Terzi (2023) subsequently proposed the new association *Pimpinello lithophilae-Centaureetum lovricii* (Fig. 5B).

The halophytic vegetation of low coastal rocks within the *Limonium anfracti-cancellati* alliance on the islet of Proizd (0.63 km²), located at the westernmost part of the island of Korčula (southern Adriatic), is dominated by *Plantagino holostei-Limonietum subanfracti*. For this association, Jasprica & Dolina (2025) proposed a new subassociation *helichrysetosum italicum* (Fig. 5C).

subassociation, *Centaureetum ragusinae limonietosum cazzae*, was described from the island of Sušac, distinguished by the presence of the stenoe endemic *Limonium cazzae* Bogdanović et Brullo (Fig. 5D). This community is also directly influenced by sea-borne salt spray along the altitudinal gradient of vertical cliffs.

Asplenietea trichomanis (Br.-Bl. in Meier et Br.-Bl. 1934) Oberd. 1977

Centaureo dalmaticae-Campanuletalia pyramidalis Trinajstić ex Terzi et Di Pietro 2016

Centaureo cuspidatae-Portenschlagiellion ramosissimae Trinajstić ex Terzi et Di Pietro 2016

Centaureetum ragusinae Horvat ex Terzi, Jasprica et Caković 2017

***limonietosum cazzae* Jasprica et Stamenković 2023** (Sušac Island)

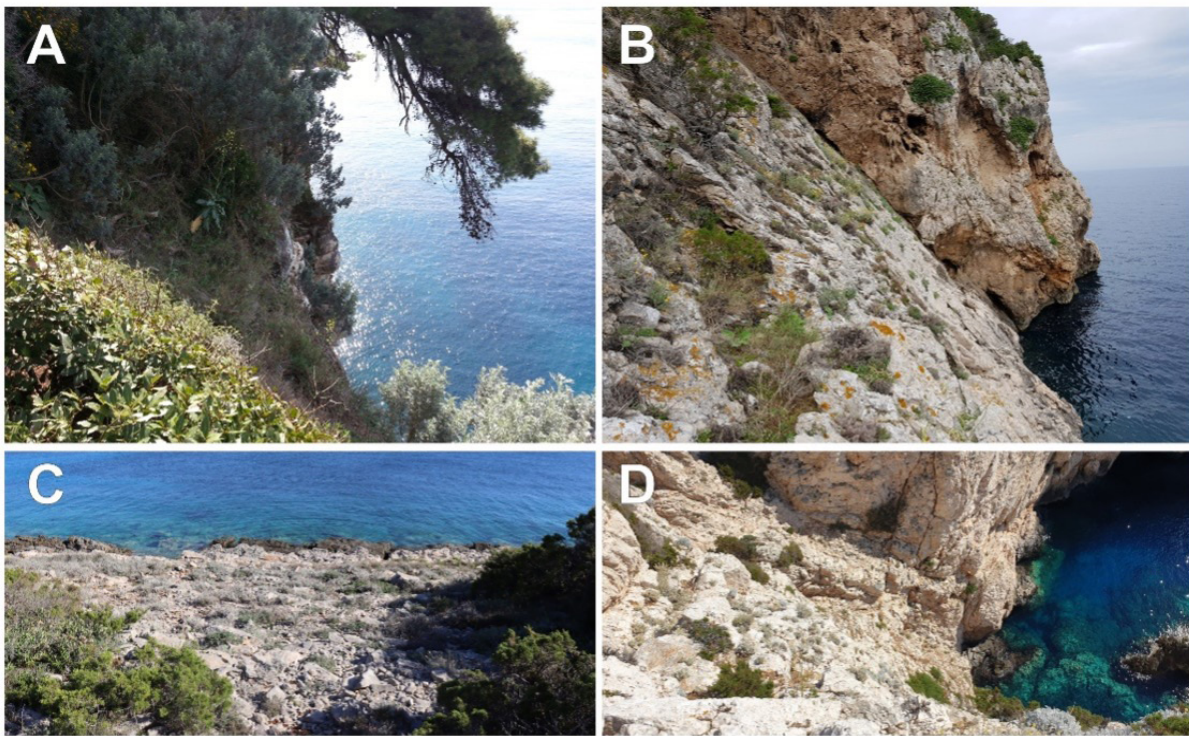


Figure 5. *Anthyllidion barbae-jovis*: A – *Brassico mollis-Anthyllidetum barbae-jovis* (Koločep Island, 11 March 2014); ***Capparo-Aurinion*:** B – *Pimpinello lithophilae-Centaureetum lovricii* (Vis Island, 30 May 2018); ***Limonion anfracti-cancellati*:** C – *Plantagino holostei-Limonietum subanfracti helichrysetosum italici* (Proizd Islet, 14 October 2024); ***Centaureo-Portenschlagiellion*:** D – *Centaureetum ragusinae limonietosum cazzae* (Sušac Island, 6 July 2022) (photos by N. Jasprica).

Slika 5. *Anthyllidion barbae-jovis*: A – *Brassico mollis-Anthyllidetum barbae-jovis* (otok Koločep, 11. 3. 2014.); ***Capparo-Aurinion*:** B – *Pimpinello lithophilae-Centaureetum lovricii* (otok Vis, 30. 5. 2018.); ***Limonion anfracti-cancellati*:** C – *Plantagino holostei-Limonietum subanfracti helichrysetosum italici* (otočić Proizd, 14. 10. 2024.); ***Centaureo-Portenschlagiellion*:** D – *Centaureetum ragusinae limonietosum cazzae* (otok Sušac, 6. 7. 2022.) (fotografije N. Jasprica).

Conclusion

The presented syntaxa novelties update the classification of Croatian vegetation (Trinajstić 2008, Škvorc et al. 2017, Jasprica & Škvorc 2000) in line with European standards, provide a basis for further research, and highlight the importance of methodological advances and community

collaboration in achieving a consistent and comprehensive understanding of Croatian vegetation.

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