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Contribution to the syntaxonomy of plant communities with insular endemic species of genus *Brassica* (southern Croatia)

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Key words: coastal plant communities, distribution, eastern Adriatic, NE Mediterranean, small islands, vegetation diversity.

Ključne besede: obalne rastlinske združbe, razširjenost, vzhodni Jadran, SV Sredozemlje, majhni otoki, raznolikost vegetacije.

Abstract

Communities with constant presence of two insular endemic species of genus *Brassica* (*B. cazzae* Ginzb. et Teyber, *B. mollis* Vis.) were studied on the small south-eastern Adriatic islands and islets (South Croatia), following the Braun-Blanquet approach. From a total of 51 phytosociological relevés, mostly collected in the period from 2020 and 2022, eight associations and three subassociations belonging to seven alliances and six classes were identified. *Brassica cazzae* and *B. mollis* occur in a variety of habitat types (i) in bare or very shallow soils on which halophilous and halotolerant communities of the *Limonion anfracti-cancellati* and *Anthyllidion barbae-jovis* mostly thrive, (ii) on rocky crevices and cliffs with rupicolous chasmophytic vegetation of the *Centaureo cuspidatae-Portenschlagiellion ramosissimae*, (iii) within woody vegetation of the *Pistacio lentisci-Pinion halepensis*, maquis of the *Oleo-Ceratonion siliquae* and garrigues of the *Cisto cretici-Ericion manipuliflorae*, and (iv) grasslands of the *Chrysopogono grylli-Koelerion splendentis*. Two associations (*Plantagino holostei-Limonietum cazzae*, *Brassico mollis-Anthyllidetum barbae-jovis*) and one subassociation (*Centaureetum ragusinae limonietosum cazzae*) are described for the first time.

Izvleček

Preučevali smo združbe s stalno prisotnostjo dveh otoških endemičnih vrst iz rodu *Brassica* (*B. cazzae* Ginzb. et Teyber, *B. mollis* Vis.) na majhnih otokih in otočkih v jugovzhodnem Jadranu z Braun-Blanquetovo metodo. V obdobju med 2020 in 2022 smo naredili 51 fitocenoloških popisov in jih uvrstili v osem asociacij in tri subasociacije, ki pripadajo sedmim zvezam in šestim razredom. *Brassica cazzae* in *B. mollis* se pojavljata v različnih habitatnih tipih (i) na golih ali zelo plitvih tleh, kjer pogosto uspevajo slanoljubne in slanotolerantne združbe zvez *Limonion anfracti-cancellati* in *Anthyllidion barbae-jovis*, (ii) v skalnih razpokah in na klifih s hazmofitsko vegetacijo sten zveze *Centaureo cuspidatae-Portenschlagiellion ramosissimae*, (iii) v gozdni vegetaciji zveze *Pistacio lentisci-Pinion halepensis*, v makiji zveze *Oleo-Ceratonion siliquae,* v garigi zveze *Cisto cretici-Ericion manipuliflorae* in (iv) na travišči zveze *Chrysopogono grylli-Koelerion splendentis*. Dve asociaciji (*Plantagino holostei-Limonietum cazzae*, *Brassico mollis-Anthyllidetum barbae-jovis*) in ena subasociacija (*Centaureetum ragusinae limonietosum cazzae*) so opisane prvič.

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Introduction

The genus *Brassica* L. includes about 40 taxa, distributed mainly in the Mediterranean region, southwestern Europe and north-western Africa. Alongside the indigenous taxa, the genus includes the cultivated varieties, and oilseeds as well as their products of great importance in the global economy.

According to Nikolić et al. (2015), and Nikolić (2022) twenty-four *Brassica* taxa occur in Croatia, three of which are insular endemics: (i) *Brassica botteri* Vis. (endemic to the Palagruža Archipelago), (ii) *B. cazzae* Ginzb. et Teyber (endemic of the Middle Adriatic islands Vis, Kamik, Svetac and Sušac), and (iii) *B. mollis* Vis. (endemic of the southern Adriatic islands and islets of the Dubrovnik Region). This recent taxonomic point of view is adopted in the present study, although some authors consider the above-mentioned endemic species as wild taxa closely related to *Brassica oleracea* L., and mostly ascribed to *B. incana* Ten. (e.g., Raimondo et al., 1991; Heywood & Zohary, 1995, Euro+Med, 2006+, etc.).

The salt-sprayed vegetation of the low rocky coasts of the eastern Adriatic islands has been widely explored and a lot of data have been published to date (e.g., Trinajstić, 1975, 1980, 1995; Pavletić, 1983, 1992; Terzi et al., 2020, etc.). Additionally, plant communities colonizing the vertical coastal cliffs of these islands have been adequately studied (e.g., Rac & Lovrić, 2002; Lovrić & Rac, 2003). However, no detailed phytosociological data on the vegetation of insular endemics of genus *Brassica* is so far available. This knowledge, which until now is lacking, is essential to habitat description, assessing and monitoring of their quality, searching for new localities of endangered plant communities, re-establishment of them, and the evaluation of management effects of protected habitats/species.

The aim of the present study is the phytosociological description, syntaxonomic assignment and assessment of the ecological relevance of plant communities characterized by the constant presence of the endemics *B. mollis* and *B. cazzae* on the eastern Adriatic islands and islets.

Material and methods

Study area

The study area includes some small islands of the eastern Adriatic coast (southern Croatia): (i) the island of Koločep (2.44 km^2) near the city of Dubrovnik; (ii) three small islets (Kosor 0.05 km^2, Obljak 0.03 km^2 and Stupa 0.02 km^2) adjacent to the southern coast of the island of Korčula (Korčula Archipelago); and (iii) the island of Sušac (4.02 km^2) (Figure 1, Table 1).

Table 1: Geographic and geological features of the islands and islets studied in the southern Croatia.

Tabela 1: Geografske in geološke značilnosti otokov in otočkov na južnem Hrvaškem.

Island / Islet	Geology period	Surface area (km^2)	Coastline length (km)	Altitude (m a.s.l.)
Sušac	Jurassic	4.02	16.8	239
Koločep	Upper Cretaceous	2.44	12.8	125
Kosor	Upper Cretaceous	0.05	1.244	13
Obljak	Upper Cretaceous	0.03	0.645	43
Stupa	Upper Cretaceous	0.02	0.944	8

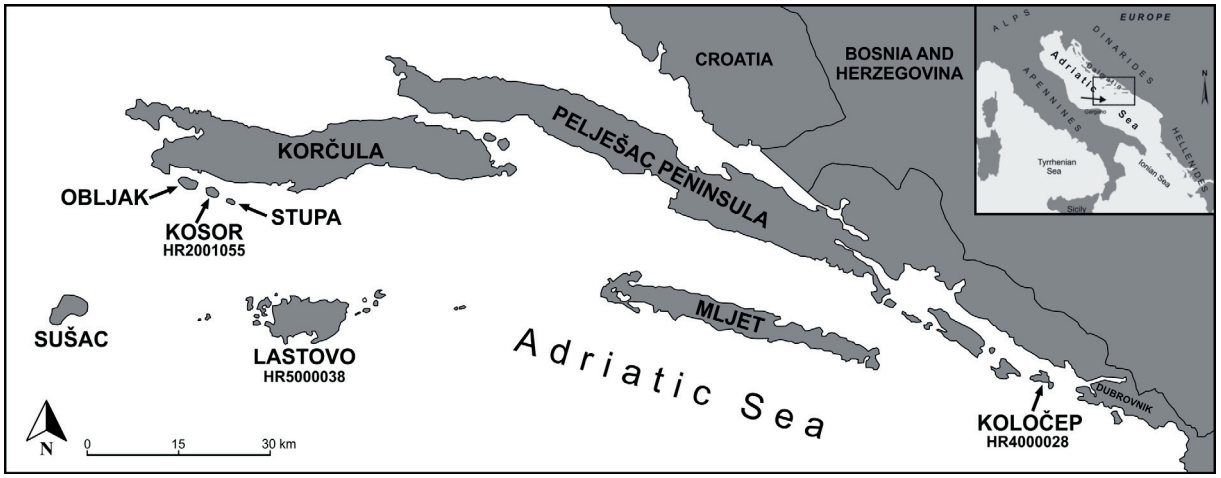

Figure 1: Map of the studied islands and islets with endemic *Brassica* taxa in the southern Croatia. Site codes of the NATURA 2000 European Ecological Network in Croatia are also indicated.

Slika 1: Zemljevid preučevanih otokov in otočkov z endemičnimi vrstami rodu *Brassica* na južnem Hrvaškem. Prikazane so tudi oznake območij omrežja NATURA 2000.

In general, these islands show a predominant W–E or WSW–ENE direction. On the small islets the coastline is mainly low and rocky. The bigger islands (Koločep and Sušac) also consist of coastal steep cliffs mostly oriented in a SW–SE direction which on Koločep and Sušac rise up to 60 or 90 (–110) m a.s.l. (Magaš et al., 2001; Rac & Lovrić, 2002).

Palaeogeographically, the central Adriatic area is considered to represent a Jurassic to Palaeogene Adriatic basin enclosed between the Apulia carbonate platform to the southwest (Italy), and the Adriatic (Dalmatian) carbonate platform to the northeast (Croatia) (see Vlahović et al., 2005). The investigated islands are mostly composed of Mesozoic carbonate rocks that are intensely fractured and karstified (Jagačić, 1970; Vlahović et al., 2005) (Table 1). Lithosol, Terra Rossa, anthropogenic and the brown soils on limestone and dolomites (calcocambisol) are the most commonly encountered soil types in the study area (e.g., Martinović, 1986; Bognar, 1996; Ljubenkov, 2012).

The island flora of Koločep and Sušac includes 446 and 189 plant taxa (species and subspecies), respectively, and is on average rich compared to other Adriatic islands of similar size (Hećimović & Hećimović, 1987; Nikolić et al., 2008; Nikolić, 2022). Mediterranean floral elements, mostly circum-Mediterranean plant taxa, and therophytes predominate on the islands. Complete floristic lists for the small islets of the Korčula Archipelago are not yet available. The area in question is also among the richest sites of endemic flora of the central Adriatic (Nikolić et al., 2008, 2015). On Koločep, 12 taxa are considered endemic, most of which belong to the group of Illyrian-Adriatic endemics, while there are no true island endemics. In contrast, there are two stenoendemic plant species on Sušac, namely *Brassica cazzae* and *Limonium cazzae* Bogdanović et Brullo (for details see Nikolić et al., 2008).

The climate of the study area is Mediterranean with mild, humid, and rainy winters and dry/hot summers (*Csa* subtype of Mediterranean climate, *sensu* Gajić Čapka & Zaninović, 2008). The area of study which encompasses the most remote eastern Adriatic islands is semiarid, representing the hottest part of the Croatian coast i.e. is included in the xeromediterranean zone (Milković, 1996; Rac & Lovrić, 2002; Lovrić & Rac, 2003). Sušac has a mean annual air temperature of 16.3 °C, the lowest precipitation values (300 – 600 mm yr^{-1}) on the eastern Adriatic and more than 2880 of sunshine hours per year (Perčec Tadić & Gajić Čapka, 2010; Bonacci & Ljubenkov, 2020). For comparison, the island of Korčula has an average annual air temperature of 16.8 °C, precipitation ranges between 1000 – 1250 mm yr^{-1} and 2400 hours of sunshine a year (Krklec et al., 2011). The average annual temperature in Dubrovnik (the nearest station to Koločep) is 16.3 °C while the average annual rainfall is 1064 mm yr^{-1} (Meteorological and Hydrological Service of Croatia, https://klima.hr/k1/k1_2/dubrovnik.pdf).

The islands and islets included in this study are part of the Important Plant Areas (IPAs) in Croatia (Alegro et al., 2010) and are part of the NATURA 2000 European Ecological Network (Anonymous, 2019; Figure 1).

Phytogeographically, the majority of islets belong to the thermo-Mediterranean vegetation belt of the *Oleo-Ceratonion siliquae* Br.-Bl. ex Guinochet & Drouineau 1944 with orographically conditioned exclaves (e.g., Koločep) of the meso-Mediterranean *Fraxino orni-Quercion ilicis* Biondi et al. ex Biondi, Casavecchia et Gigante 2013 (Pavletić, 1983).

Data collection and analysis

Field data were collected from fifty-one vegetation sample plots (relevés) most of which (forty-seven relevés) were conducted from July 2020 to September 2022, while the rest (four relevés) in March 2014. Vegetation was studied in accordance with the principles of the Braun-Blanquet approach (Braun-Blanquet, 1964), adopting the International Code of Phytosociological Nomenclature (Theurillat et al., 2021). The plot sizes were 20–50(–100) m^2 (mode 20 m^2) for the *Crithmo-Staticetalia*, 25 m^2 for the *Asplenietea trichomanis*, and 20–100 m^2 (mode 100 m^2) for woody vegetation of the *Pinetalia halepensis* and small-tree vegetation of the *Pistacio lentisci-Rhamnetalia alaterni* (cf. Westhoff & van der Maarel, 1980). The average plot size of the relevés of the garrigue and grassland vegetation was 51 and 25 m^2, respectively. These were largely in concordance with previously recommended plot sizes for particular vegetation types (e.g., Chytrý & Otýpková, 2003).

Vegetation was classified using numerical methods and compared with traditional syntaxonomy. The matrices consist of 119 taxa × 51 samples (relevés). The taxon scores originally recorded according to the Braun-Blanquet scale, were replaced by the 1–9 ordinal values (Whestoff & van der Maarel, 1980) before the numerical analyses. An agglomerative, hierarchical clustering algorithm based on Bray-Curtis similarity and Ward's method for determination of group linkages was used (McCune & Mefford, 2006). Differences between groups obtained in the classification were tested by analysis of similarities (ANOSIM). For these purposes the PC-ORD ver. 5 and PRIMERv7 software packages (McCune & Mefford, 2006; Clarke & Gorley, 2015) were used.

The delimitation of vegetation units (Tables 2–4) was carried out utilizing species groups derived from the

Braun-Blanquet technique. The results were interpreted from a syntaxonomic standpoint and the relevant syntaxonomic scheme is presented below. Geographical coordinates of relevés are given below each phytosociological table (Tables 2–4).

The nomenclature of high-rank vegetation units also follows the syntaxonomical system (the EuroVegChecklist) proposed by Mucina et al. (2016), and followed by Škvorc et al. (2017) except for the vegetation units of the *Asplenietea trichomanis* class whose classification is according to Terzi et al. (2017, 2020). The taxonomy and nomenclature of taxa follow Nikolić (2022) with the only exception being the genus *Limonium* for which the revision of Bogdanović & Brullo (2015) is adopted.

EUNIS habitat types were determined according to Chytrý et al. (2020, version 2021-06-01), and using the Database of the European Flora and Vegetation (www.floraveg.eu). In addition, classification of the vegetation units (alliances) distinguished into habitat types of Annex I of the Habitats Directive 92/43/EEC was made according to the List of NATURA 2000 habitats declared by the Croatian Government (Anonymous, 2019).

Results

From the total of 51 relevés (rels.), 16 were carried out on Koločep island (halophilous bare or very shallow soils 7 rels., Aleppo pine forest 5 rels., garrigue vegetation 4 rels.), 17 in the Korčula Archipelago islets (halophilous bare or very shallow soils 7 rels., maquis vegetation 8 rels., grasslands 2 rels.), and 18 on Sušac (halophilous bare or very shallow soils 6 rels., rocky crevices and cliffs 4 rels., maquis 8 rels.).

The dendrogram obtained from the hierarchical clustering analysis of the data matrix, makes possible to distinguish two main clusters (A, B) of associations (Figure 2). The first cluster (A) mainly includes rupicolous chasmophytic association (I), and halophilous and halotolerant associations (II), while the second cluster (B) includes associations from the garrigues (IV), woody (V) and maquis vegetation (VI). The group III represents a few relevés collected from the grasslands and maquis located alongside the low rocky sea coast.

Data processing resulted in the distinction of eleven vegetation types (eight associations and three subassociations) belonging to seven alliances and six classes, which are presented in phytosociological tables (Tables 2–4) and discussed below. Among them the associations *Plantagino holostei-Limonietum cazzae* and *Brassico mollis-Anthyllidetum barbae-jovis*, and subassociation *Centaureetum ragusinae limonietosum cazzae*, are described for the first time (Tables 2, 3; Appendix 1). The complete syntaxonomic scheme is presented below [the islands or islets on which each association was found are mentioned in square brackets]:

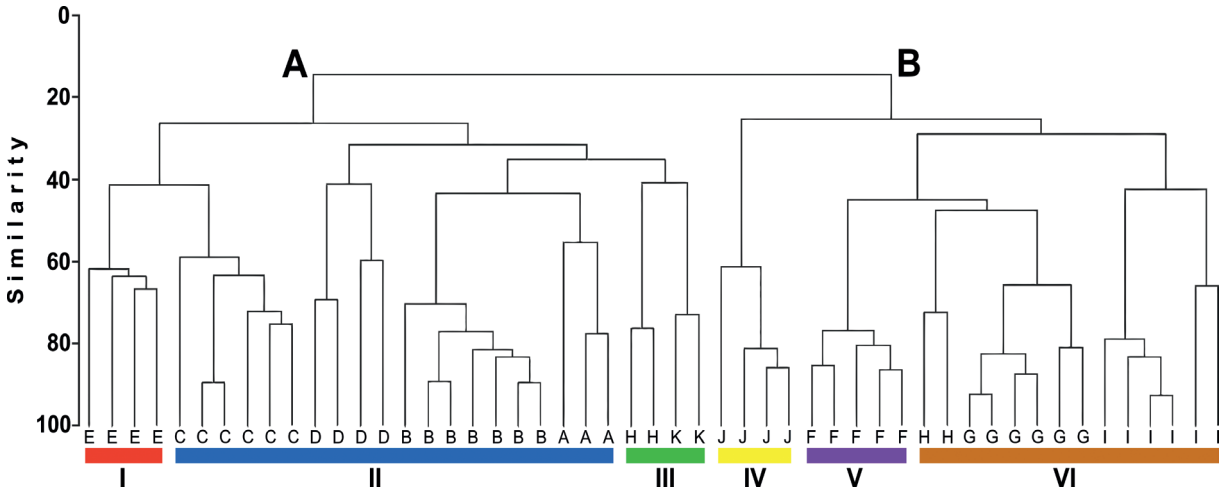

Figure 2: Hierarchical cluster analysis dendrogram based on Bray-Curtis similarity distance and Ward's minimum variance method of the data matrix of 119 taxa × 51 relevés. **I – *Asplenietea trichomanis*** (E, *Centaureetum ragusinae limonietosum cazzae*); **II – *Crithmo-Staticetea*** (C, *Plantagino holostei-Limonietum cazzae*; D, *Brassico mollis-Anthyllidetum barbae-jovis*; B, *Plantagino-Limonietum cancellatae*; A, *Limonietum anfracti lavatereto-sum arboreae*); **III – *Festuco-Brometea*** (K, *Narciso tazettae-Asphodeletum microcarpi*) and H, *Myrto communis-Pistacietum lentisci*; **IV – *Ononido-Rosmarinetea*** (J, *Erico manipuliflorae-Calicotometum infestae*); **V – *Pinetea halepensis*** (F, *Pistacio lentisci-Pinetum halepensis*); **VI – *Quercetea ilicis*** (H, *Myrto communis-Pistacietum lentisci*; G, *Pistacio lentisci-Juniperetum turbinatae*; I, *Oleo-Euphorbietum dendroidis coronilletosum emeroidis*).

Slika 2: Dendrogram hierarhične klasterske analize na osnovi razdalje podobnosti po Bray-Curtisu in Wardove metode minimalne variance in podatkovne matrike 119 taksonov × 51 popisov.

Syntaxonomic scheme

***Crithmo-Staticetea* Br.-Bl. in Br.-Bl. et al. 1952**
Crithmo-Staticetalia Molinier 1934
Limonion anfracti-cancellati (Horvatić 1934) Mucina in Mucina et al. 2106
Plantagino-Limonietum cancellatae Horvatić (1934) 1939 **[Obljak, Kosor, Stupa]**
Plantagino holostei-Limonietum cazzae ass. nov. hoc loco **[Sušac]**
Limonietum anfracti Ilijanić et S. Hećimović 1982
lavateretosum arboreae Ilijanić et S. Hećimović 1982 **[Koločep]**
Helichrysetalia italici Biondi et Géhu in Géhu et Biondi 1994
Anthyllidion barbae-jovis S. Brullo et De Marco 1989
Brassico mollis-Anthyllidetum barbae-jovis ass. nov. hoc loco **[Koločep]**

***Pinetea halepensis* Bonari et Chytrý in Bonari et al. 2021**
Pinetalia halepensis Biondi, Blasi, Galdenzi, Pesaresi et Vagge in Biondi et al. 2014
Pistacio lentisci-Pinion halepensis Biondi, Blasi, Galdenzi, Pesaresi et Vagge in Biondi et al. 2014
Pistacio lentisci-Pinetum halepensis De Marco, Veri et Caneva1984 **[Koločep]**

***Quercetea ilicis* Br.-Bl. ex A. Bolós et O. de Bolòs in A. Bolòs y Vayreda 1950**
Pistacio lentisci-Rhamnetalia alaterni Rivas-Mart. 1975
Oleo-Ceratonion siliquae Br.-Bl. ex Guinochet et Drouineau 1944
Oleo-Euphorbietum dendroidis Trinajstić 1973
coronilletosum emeroidis Trinajstić 1973 **[Obljak, Kosor, Sušac]**
Pistacio lentisci-Juniperetum turbinatae Trinajstić 1987 ex Asensi, Díez-Garretas et Quézel 2007[**Kosor, Sušac**]
Myrto communis-Pistacietum lentisci (Molinier 1954) Rivas-Mart. 1975 **[Stupa, Sušac]**

***Ononido-Rosmarinetea* Br.-Bl. in A. Bolòs y Vayreda 1950**
Cisto-Micromerietalia julianae Oberd. 1954
Cisto cretici-Ericion manipuliflorae Horvatić 1958
Erico manipuliflorae-Calicotometum infestae Horvatić 1958 **[Koločep]**

***Festuco-Brometea* Br.-Bl. & Tx. ex Klika & Hadač 1944**
Scorzoneretalia villosae Kovačević 1959
Chrysopogono grylli-Koelerion splendentis Horvatić 1973
Narcisso tazettae-Asphodeletum microcarpi Šegulja 1969 **[Obljak]**

***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 subass. nov. hoc loco **[Sušac]**

Seven alliances were assigned to seven of the EUNIS habitat types: (1) *Limonion anfracti-cancellati* [EUNIS2020 habitat code: N32, habitat type name: Mediterranean and Black Sea rocky sea cliff and shore]; (2) *Anthyllidion barbae-jovis* [S71, Western Mediterranean spiny heath]; (3) *Pistacio lentisci-Pinion halepensis* [T3A, Mediterranean lowland to submontane *Pinus* forest]; (4) *Oleo-Ceratonion siliquae* [S51, Mediterranean maquis and arborescent matorral]; (5) *Cisto cretici-Ericion manipuliflorae* [S63, Eastern garrigue]; (6) *Chrysopogono grylli-Koelerion splendentis* [R19, Dry steppic submediterranean pasture of the Amphi-Adriatic region]; (7) *Centaureo cuspidatae-Portenschlagiellion ramosissimae* [U38, Mediterranean base-rich inland cliff].

The above-mentioned alliances are also related to five habitat types of Annex I (Habitats Directive 92/43/EEC): (1) vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp. [habitat code 1240]; (2) Mediterranean pine forests with endemic Mesogean pines [9540]; (3) *Olea* and *Ceratonia* forests [9320]; (4) eastern sub-Mediterranean dry grasslands (*Scorzoneretalia villosae*) [62A0]; and (5) calcareous rocky slopes with chasmophytic vegetation [8210].

Discussion

Insular endemics *Brassica cazzae* and *B. mollis* occur in a variety of habitat types (Tables 2–4, Figures 2–4). These species grow (i) in bare or very shallow soils on which halophilous (*Crithmo-Staticetalia*) and halotolerant communities (*Helichrysetalia italici*) mostly thrive (Table 2, rels. 1–16 and 17–20); (ii) on rocky crevices and cliffs with rupicolous chasmophytic vegetation of the *Centaureo cuspidatae-Portenschlagiellion ramosissimae* (Table 3); (iii) within woody vegetation of the *Pistacio lentisci-Pinion halepensis* and maquis of the *Oleo-Ceratonion siliquae*, and garrigues of the *Cisto cretici-Ericion manipuliflorae* (Table 4, rels. 1–21 and 22–25); and (iv) grasslands of the *Chrysopogono grylli-Koelerion splendentis* (Table 4, rels. 26–27).

Brassica cazzae on the island of Sušac was found among vegetation of the association *Plantagino holostei-Limonietum cazzae* and subassociation *Centaureetum ragusinae limonietosum cazzae*, described here for the first time (see Tables 2, 3; see Appendix 1 for the holotypes description). It was also found within maquis of the *Pistacio lentisci-Juniperetum turbinatae* association (*Oleo-Ceratonion siliquae*) at the cliff top. The presence of the *Artemisia arborescens-Coronilla valentina* community of the *Artemisio arborescentis-Capparidion spinosae* alliance (*Cymbalario-Parietarietea diffusae*) was observed on the lowest part of the cliff (Figure 3B). The occurrence of this community,

not studied here, is restricted to the most thermophilous habitats of eastern Adriatic i.e. in South Croatia and Montenegro (Jasprica et al., 2021).

Brassica mollis mostly occurs on low rocky coasts except on Koločep Island where it colonizes vertical sea-cliffs (Figure 3). It is more abundant within the stands of the association *Plantagino-Limonietum cancellatae* occurring on the small islets of the Korčula Archipelago in comparison to stands of *Limonietum anfracti lavateretosum arboreae* or *Brassico mollis-Anthyllidetum barbae-jovis* encountered on Koločep (Table 2). According to Terzi et al. (2020), this species (attributed to *B. incana*) was found on the island of Vis within the association *Pimpinello lithophyllae-Centaureetum issaeae* of the central Adriatic endemic alliance *Capparo orientalis-Aurinion leucadeae* (*Helichrysetalia italici*).

From sea level to the most elevated localities of the study area, the pattern of vegetation distribution follows the environmental gradient and is represented by three main vegetation groups. The first group encompasses the halophilous and halotolerant vegetation of salt-sprayed areas near the sea. It includes (a) the halo-rupicolous chasmophytic communities, represented by different vicariant associations of the "*Crithmo-Limonietum* s.l.", and (b) the nano-phanerophytic and chamaephytic vegetation of the *Helichrysetalia italici*. The second group is represented by the rupicolous chasmophytic vegetation of the *Centaureo cuspidatae-Portenschlagiellion ramosissimae* which thrives on the summits of high cliffs and is weakly affected by the marine aerosol. Finally, vegetation stands with shrubs (maquis and garrigues) and small trees (*Pinetalia halepensis*) occurring inland comprises the third group. However, due to the generally low altitudes that characterize the study area and especially the small islets, salt spray affects even the most remote locations of the elevation gradient.

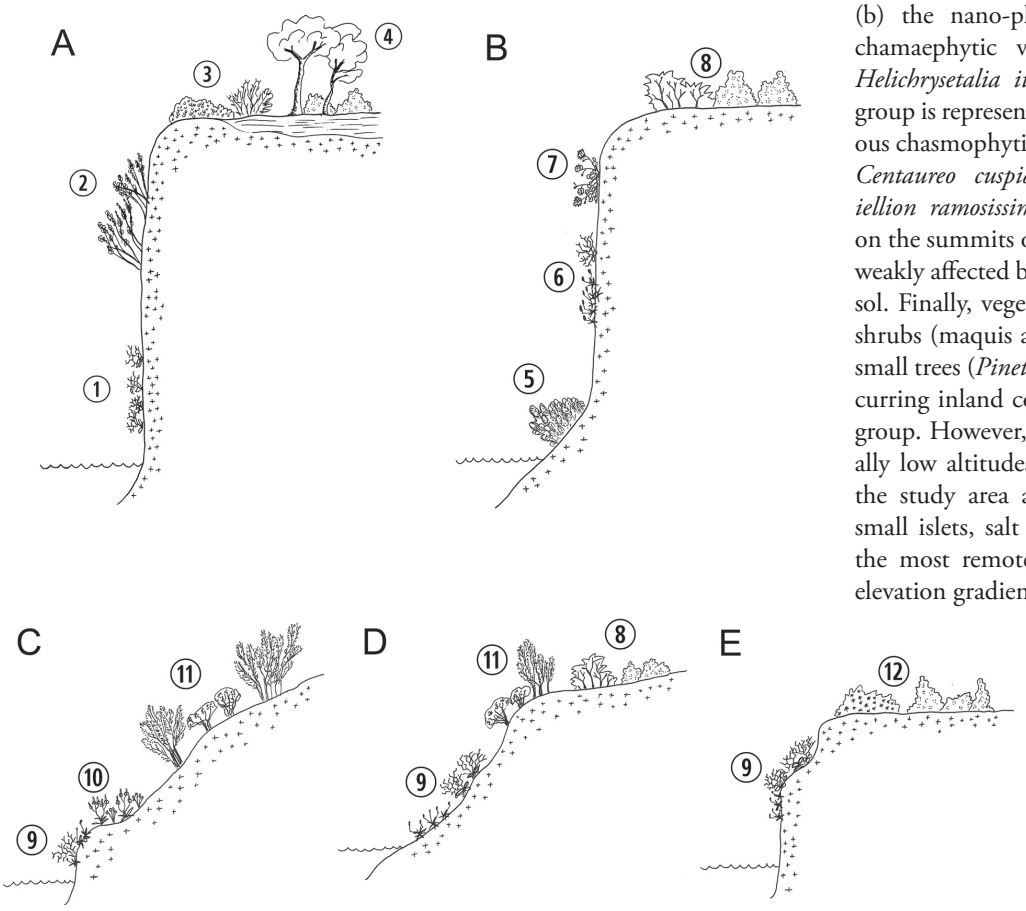

Figure 3: Schemes of the distribution of the plant communities along the altitudinal gradient of the vertical sea-cliffs on the islands of Koločep (A) and Sušac (B), and over the islets of Obljak (C, max. 43 m a.s.l.), Kosor (D, max. 13 m a.s.l.), and Stupa (E, max. 8 m a.s.l.).
Abbreviations – 1. *Limonietum anfracti lavateretosum arboreae*, 2. *Brassico mollis-Anthyllidetum barbae-jovis*, 3. *Erico manipuliflorae-Calicotometum infestae*, 4. *Pistacio lentisci-Pinetum halepensis*, 5. *Artemisia arborescens-Coronilla valentina* community, 6. *Plantagino holostei-Limonietum cazzae*, 7. *Centaureetum ragusinae limonietosum cazzae*, 8. *Pistacio lentisci-Juniperetum turbinatae*, 9. *Plantagino-Limonietum cancellatae*, 10. *Narcisso tazettae-Asphodeletum microcarpi*, 11. *Oleo-Euphorbietum dendroidis coronilletosum emeroidis*, 12. *Myrto communis-Pistacietum lentisci*
(Drawn by V. Stamenković).

Slika 3: Shema razširjenosti rastlinskih združb vzdolž višinskega gradienta na vertikalnih morskih klifih na otokih Koločep (A) in Sušac (B) in na otočkih Obljak (C, maks. 43 m nmv), Kosor (D, maks. 13 m nmv) in Stupa (E, maks. 8 m nmv).
Okrajšave – 1. *Limonietum anfracti lavateretosum arboreae*, 2. *Brassico mollis-Anthyllidetum barbae-jovis*, 3. *Erico manipuliflorae-Calicotometum infestae*, 4. *Pistacio lentisci-Pinetum halepensis*, 5. *Artemisia arborescens-Coronilla valentina* community, 6. *Plantagino holostei-Limonietum cazzae*, 7. *Centaureetum ragusinae limonietosum cazzae*, 8. *Pistacio lentisci-Juniperetum turbinatae*, 9. *Plantagino-Limonietum cancellatae*, 10. *Narcisso tazettae-Asphodeletum microcarpi*, 11. *Oleo-Euphorbietum dendroidis coronilletosum emeroidis*, 12. *Myrto communis-Pistacietum lentisci*
(Slika V. Stamenković).

Our data did not confirm the presence of *B. mollis* within the chasmophytic vegetation of the *Seslerio robustae-Putorietum calabricae* association (*Centaureo cuspidatae-Portenschlagiellion ramosissimae*) in Koločep, as has been previously reported by Horvatić (1971). The *Seslerio robustae-Putorietum calabricae* does not include halophilous species (Terzi & Jasprica, 2020).

The vegetation distribution across the vertical cliff height gradient described above (see also Figure 3) is largely consistent with a general scheme of typical chain succession of microhabitats on Mediterranean cliffs, to which correspond various vegetation typologies described by Biondi (2007, p. 6). According to this scheme (op. cit.), the vegetation types are arranged on the vertical profile from bottom to top of the cliffs as follows: 1) halo-rupicolous chasmophytic vegetation of Crithmo-Staticetalia; 2) halotolerant chamaephytic garrigue vegetation of *Helichrysetalia italici* (*Euphorbion pithyusae*); 3) therophytic vegetation of *Malcolmietalia ramosissimae*; 4) the halotolerant nano-phanerophytic and chamaephytic vegetation of *Anthyllidion barbae-jovis*; 5) the bushy and small-tree vegetation of *Quercetea ilicis*; and 6) the rupicolous chasmophytic vegetation of *Asplenietea trichomanis*. However, the halotolerant chamaephytic garrigue vegetation of the ledges of the cliffs with early soil is not found in our case. In addition, Škvorc et al. (2017) suggested that subaerohaline dwarf scrub of *Crucianellion rupestris* probably occurs on salt-sprayed cliffs in Croatia, but due to the lack of relevant vegetation data, its occurrence is still unconfirmed.

In this study we describe two new associations (*Plantagino holostei-Limonietum cazzae* and *Brassico mollis-Anthyllidetum barbae-jovis*) within the *Crithmo-Staticetalia* and *Helichrysetalia italici*, respectively. The *Limonium* vegetation of the island of Sušac was originally classified in the *Plantagino-Limonietum cancellati* but without this assignment being substantiated by quotation of relevé clusters (e.g., Rac & Lovrić, 2002). However, Bogdanović and Brullo (2015) report that *Limonium cancellatum* (Bernh. ex Bertol.) Kuntze is restricted to the North Adriatic calcareous rocky coasts, whereas in the vertical cliffs of Sušac island it is replaced by *Limonium cazzae*. For this reason, the new endemic association *Plantagino holostei-Limonietum cazzae* is defined, differentiated by the presence / dominance of *Limonium cazzae* and *Plantago holosteum* (Table 2, Appendix 1). In addition, for the same reason, the new halophilous subassociation *Centaureetum ragusinae limonietosum cazzae* is here proposed, and distinguished by the steno-endemic *Limonium cazzae* (Table 3, Appendix 1). The halophytic aspect of the *Centaureetum ragusinae* association is characterized by the presence of some ingressive taxa from the *Crithmo-Staticetea* class (*Crithmum maritimum*, *Lotus cytisoides*, *Limonium* spp.). According to Terzi & Jasprica (2020), stands of other two subassociations (*C.r. typicum*, *C.r. limonietosum cancellati*) are also under direct influence of sea-born salt spray over altitudinal gradient of vertical cliffs.

The case of *Anthyllis barba-jovis* L. is interesting. This species is endemic to the central Mediterranean and common in the central and southern Adriatic islands (see Nikolić, 2022). However, few data are available on the vegetation of *Anthyllidion barbae-jovis* in the eastern Adriatic. This alliance was documented by six relevés of *A. barba-jovis* dominated stands on the coastal cliffs of Vis Island (Terzi et al., 2020). Biondi et al. (1997) reported that *A. barba-jovis* also occurs in other habitats (e.g., in different syntaxa of *Quercetea ilicis*), but this was not observed in our study. In our case, this habitat type is more associated with the rocky sea cliffs and coasts of the Mediterranean and Black Seas (N32) than with the western Mediterranean thorny heath (S71) (cf. Chytrý et al., 2020). However, the *Anthyllidion barbae-jovis* alliance is defined as only one part of this habitat type, occurring in Corsica, Sardinia, Pantelleria and the Gulf of Taranto.

Anthyllis barba-jovis appears not to tolerate competition and thrives far from its optimum conditions only in localities where other shrubs are lacking (Fanelli et al., 2004). In addition, it is worth noting that vegetation structure of rocky shores is not only influenced by species salt tolerance, but also, by the chemical composition of the marine aerosol at a regional or local scale (Fanelli et al., 2004; Tedeschi & Piazzola, 2010). In case of smallest islets, halophilous and halotolerant vegetation largely overlap i.e. the strong dominance of species such as *Limonium* spp. or *Helichrysum italicum*, even *Crithmum maritimum* may be masked due to the continuous influence of the sea (waves, salt spray and strong wind) over altitudinal gradient.

Here, we consider the stands with *Anthyllis barba-jovis* and *Brassica mollis* as a new association the *Brassico mollis-Anthyllidetum barbae-jovis*, which is differentiated from the *Anthyllis barba-jovis* community known from the island of Vis (Terzi et al., 2020) due to the presence of *B. mollis*. However, the study of *A. barba-jovis* vegetation of eastern Adriatic requires further improvement and collecting phytosociological data from other additional areas of Croatian territory (e.g., Franjić et al., 2003). This would make possible comparison of the communities on a large-scale i.e. from Central Mediterranean and/or Italian territory (see also Terzi et al., 2020).

Unfortunately, studies of the vegetation with *B. botteri* – species distributed in the most remote Croatian islets of the Palagruža Archipelago – planned as a research cruise within the project for early summer 2020 were cancelled

due to the COVID-19 pandemic. Data on its phytosociology still remains unknown. Lovrić & Rac (2003), within their general discussion of the vegetation synecology in Palagruža, mention that *B. botteri* have marked as "one of six insular endemics of central Adriatic found within the aerosaline vegetation".

This work provides new insight on the coastal and subcoastal vegetation of the islands and islets and its rarity. The association of these species with specific NATURA 2000 habitat types demonstrates the value of protecting and conserving both species and habitats. Both halophilous and halotolerant communities are threatened by tour-

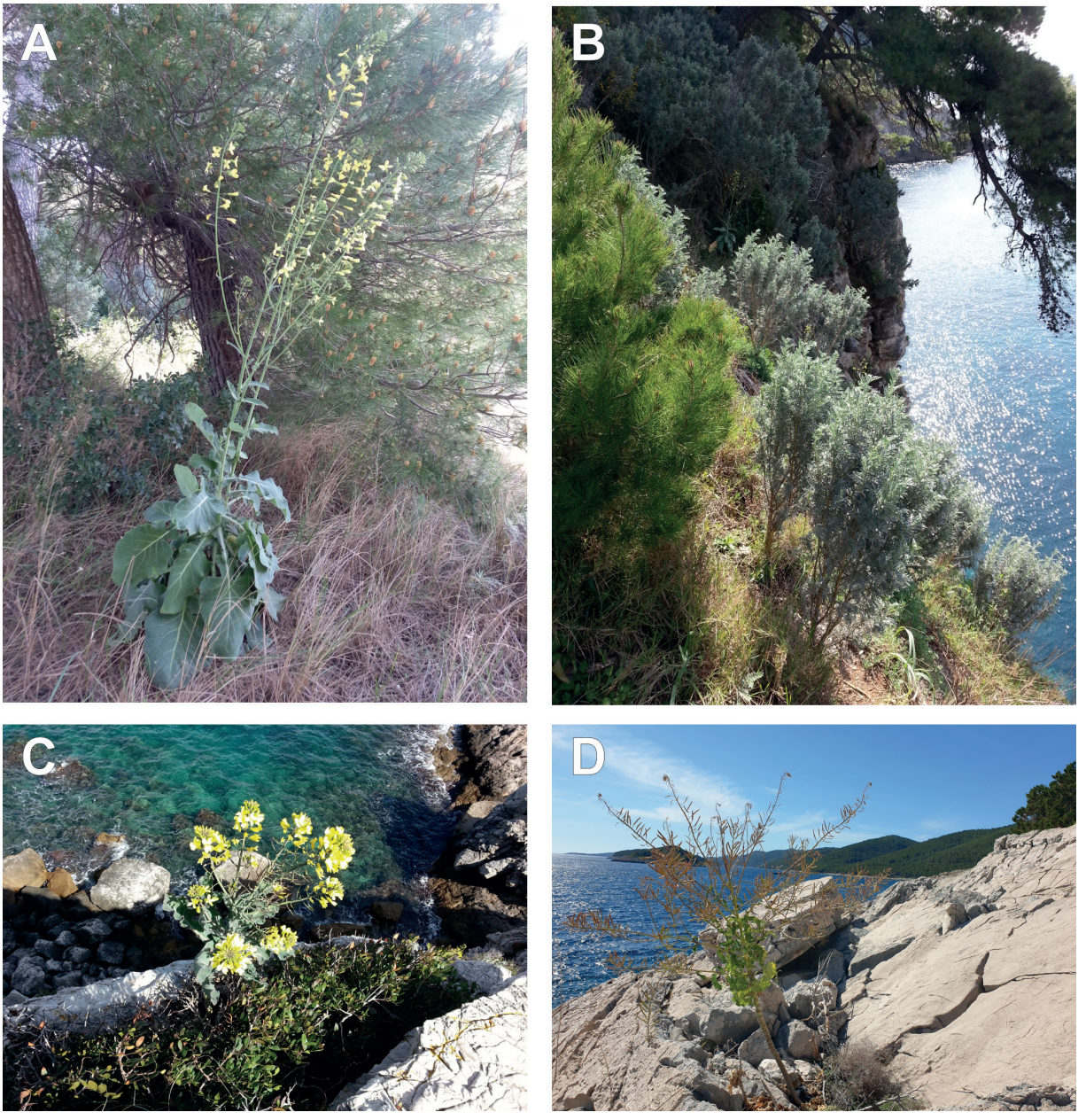

Figure 4: *Brassica mollis* Vis. occurs within the distinct vegetation typologies: A – Aleppo Pine forest of the *Pistacio lentisci-Pinion halepensis*, B – halotolerant vegetation of the *Anthyllidion barbae-jovis*, C – xerothermic vegetation of the *Oleo-Ceratonion siliquae*, D – halophilous vegetation on the low rocky coast of the *Limonion anfracti-cancellati*. A-C – the island of Koločep, D – the islet of Kosor, Korčula Archipelago (Photo by N. Jasprica).

Slika 4: *Brassica mollis* Vis. se pojavlja v različnih vegetacijskih tipih: A – gozd alepskega bora zveze *Pistacio lentisci-Pinion halepensis*, B – vegetaciji, tolerantni na morsko sol zveze *Anthyllidion barbae-jovis*, C – kserotermni vegetaciji zveze *Oleo-Ceratonion siliquae*, D – halofilni vegetaciji na nižje ležečih skalnatih obalah zveze *Limonion anfracti-cancellati*. A-C – otok Koločep, D – otoček Kosor, arhipelag Korčula (foto N. Jasprica).

ism which is an emerging industry in the area. However, the rarity of these communities and taxa (some of them statutorily strictly protected by Croatian laws) suggests the need for a combined in-situ and ex-situ conservation strategy, with collecting, multiplying and conserving ex-situ of the more threatened taxa. Additionally, coastal cliffs and small islets form important nesting sites to pelagic and coastal seabirds, especially where these are inaccessible to predators and undisturbed by human or animals (e.g. no grazing).

Unfortunately, from a phytosociological point of view, the lack of studies on remote south-eastern Adriatic islands is still evident and effort has to be made to acquire knowledge of the syntaxonomy and ecology of the islands' local communities. We believe that the most significant result of this paper lies in the information on the small islands' vegetation in this part of the NE Mediterranean. Nevertheless, given the relatively small area studied, the results should be read and analysed in the context of the anthropogenic influences that are occurring as a generalized phenomenon throughout the Mediterranean basin.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix 1

Holotypes of the new plant communities

Plantagino holostei-Limonietum cazzae ass. nov. hoc loco [Sušac Island, holotypus Table 2, relevé no. 11, altitude 40 m a.s.l., aspect S-SE, slope 80°, plot size 25 m^2, vegetation cover 25%, 2.9.2022.]: *Plantago holosteum* Scop. (1), *Limonium cazzae* Bogdanović et Brullo (2), *Crithmum maritimum* L. (1), *Lotus cytisoides* L. (1), *Silene vulgaris* (Moench) Garcke subsp. *angustifolia* Hayek (+), *Daucus carota* L. subsp. *hispanicus* (Gouan) Thell. (+), *Capparis orientalis* Veill. (+), *Aurinia leucadea* (Guss.) K. Koch (+), *Helichrysum italicum* (Roth) G. Don (1), *Allium commutatum* Guss. (+), *Brassica cazzae* Ginzb. et Teyber (1), *Inula verbascifolia* (Willd.) Hausskn. (+), *Parietaria judaica* L. (+), *Reichardia picroides* (L.) Roth (+), *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman (+), *Desmazeria marina* (L.) Druce (+), *Valantia muralis* L. (+), *Melilotus italica* (L.) Lam. (+).

Brassico mollis-Anthyllidetum barbae-jovis ass. nov. hoc loco [Koločep Island, holotypus Table 2, relevé no. 17, altitude 20 m a.s.l., aspect S, slope 90°, plot size 30 m^2, vegetation cover 40%, 10.3.2014.]: *Limonium dictyophorum* (Tausch) Degen (1), *Anthyllis barba-jovis* L. (3), *Crithmum maritimum* L. (+), *Lotus cytisoides* L. (+), *Silene vulgaris* (Moench) Garcke subsp. *angustifolia* Hayek (+), *Capparis orientalis* Veill (+), *Matthiola incana* (L.) R. Br. (+), *Elymus pycnanthus* (Godr.) Melderis (+), *Allium ampeloprasum* L. (1), *Brassica mollis* Vis. (1), *Smilax aspera* L. (+), *Asparagus acutifolius* L. (+), *Ephedra fragilis* Desf. subsp. *campylopoda* (C.A. Mayer) Asch. et Graeb. (+), *Rubus ulmifolius* Schott (+), *Juniperus phoenicea* L. (+), *Lonicera implexa* Aiton (+), *Phillyrea media* L. (+), *Umbilicus horizontalis* (Guss.) DC. (+), *Brachypodium retusum* (Pers.) P. Beauv. (1), *Pallenis spinosa* (L.) Cass. (r), *Euphorbia characias* L. subsp. *wulfenii* (Hoppe ex Koch) A. M. Sm. (r), *Bromus madritensis* L. (+), *Brachypodium distachyon* (L.) P. Beauv. (+), *Crupina crupinastrum* (Moris) Vis. (+), *Sonchus asper* (L.) Hill subsp. *glaucescens* (Jord.) Ball (1), *Carduus pycnocephalus* L. (r).

Centaureetum ragusinae limonietosum cazzae subass. nov. hoc loco [Sušac Island, holotypus Table 3, relevé no. 1, altitude 60 m a.s.l., aspect SE, slope 85°, plot size 25 m^2, vegetation cover 40%, 2.9.2022.]: *Centaurea ragusina* L. subsp. *ragusina* (3), *Limonium cazzae* Bogdanović et Brullo (+), *Inula verbascifolia* (Willd.) Hausskn. (1), *Allium ampeloprasum* L. (+), *Capparis orientalis Veill.* (+), *Aurinia leucadea* (Guss.) K. Koch (+), *Teucrium flavum L.* (r), *Sonchus asper* (L.) Hill subsp. *glaucescens* (Jord.) Ball (r), *Helichrysum italicum* (Roth) G. Don (2), *Lotus cytisoides* L. (2), *Silene vulgaris* (Moench) Garcke subsp. *angustifolia* Hayek (1), *Crithmum maritimum* L. (1), *Ficus carica* L. (+), *Senecio bicolor* (Willd.) Tod. (+), *Brassica cazzae* Ginzb. et Teyber (r), *Pistacia lentiscus* L. (+), *Asparagus acutifolius* L. (r), *Juniperus phoenicea* L. (+), *Brachypodium retusum* (Pers.) P. Beauv. (1), *Reichardia picroides* (L.) Roth (+), *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman (+).

Appendix 2

Syntaxa quoted in the text and tables (in alphabetical order), but not in scheme

Artemisia arborescens-Coronilla valentina community
Artemisietea vulgaris Lohmeyer et al. in Tx. ex von Rochow 1951
Artemisio arborescentis-Capparidion spinosae Biondi, Blasi et Galdenzi in Biondi et al. 2014
Cakiletea maritimae Tx. et Preising in Tx. ex Oberd. 1952
Capparo orientalis-Aurinion leucadeae Lovrić ex Terzi, Bogdanović, D'Amico et Jasprica 2020
Chenopodietea Br.-Bl. in Br.-Bl. et al. 1952
Crucianellion rupestris S. Brullo et Furnari 1990
Cymbalario-Parietarietea diffusae Oberd. 1969
Dittrichietea viscosae Trinajstić, B.Foucault et Jasprica 2019
Euphorbion pithyusae Biondi et Gehu in Gehu et Biondi 1994
Lygeo sparti-Stipetea tenacissimae Rivas-Mart. 1978 nom. conserv. propos. (*Thero-Brachypodietea* Br.-Bl. in Br.-Bl. et al. 1947)
Malcolmietalia ramosissimae Rivas Goday 1958
Papaveretea rhoeadis S. Brullo et al. 2001 nom. conserv. propos.
Pimpinello lithophyllae-Centaureetum issaeae Terzi, Bogdanović, D'Amico et Jasprica 2020
Quercetea pubescentis Doing-Kraft ex Scamoni et Passarge 1959
Saginetea maritimae Westhoff et al. 1962
Salicornietea fruticosae Br.-Bl. et Tx. ex A. Bolòs y Vayreda et O. de Bolòs in A. Bolòs y Vayreda 1950
Seslerio robustae-Putorietum calabricae Horvatić ex Birač 1973

Table 2: Phytosociological relevés of the halophilous and halotolerant plant communities with endemic Brassica taxa in southern Croatian islands and islets. Abbreviations: Kol – Koločep, Suš – Sušac, Stu – Stupa, Kos – Kosor, Ob – Obljak.

Tabela 2: Fitocenološki popisi slanoljubnih in slanotolerantnih rastlinskih združb z endemičnimi vrstami rodu Brassica na otokih in otočkih na južnem Hrvaškem. Okrajšave: Kol – Koločep, Suš – Sušac, Stu – Stupa, Kos – Kosor, Ob – Obljak.

Relevé number	1	2	3	4	5	6	7	8	9	10	11*	12	13	14	15	16	17*	18	19	20
Localities	Kol	Kol	Kol	Stu	Stu	Kos	Kos	Kos	Ob	Ob	Suš	Suš	Suš	Suš	Suš	Suš	Kol	Kol	Kol	Kol
Altitude (m a.s.l.)	10	5	5	2	2	2	3	3	2	2	40	40	50	50	25	25	20	30	30	25
Aspect	S	S	SW	S	N	S	S	S	NW	SW	S-SE	S-SE	S-SE	S-SE	NW	NW	S	S	E	E
Slope (°)	90	80	90	5	5	5	10	10	20	20	80	90	90	90	90	90	90	90	90	90
Plot size (mq)	25	25	25	20	20	20	20	20	20	20	25	20	20	20	25	25	30	25	30	25
Vegetation cover (%)	25	25	20	20	20	20	20	20	25	20	25	30	20	25	20	20	40	40	25	30
	Limonietum anfracti lava-teretosum arboreae			*Plantagino-Staticetum cancellatae*							*Plantagino holostei-Limonietum cazzae*						*Brassico mollis-Anthyllidetum barbae-jovis*			
Char. Ass.																				
Limonium dictyophorum (Tausch) Degen	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	+
Lavatera arborea L.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	r	.	+	.	.
Limonium cancellatum (Bernh. ex Bertol.) Kuntze	.	.	.	1	1	1	2	2	2	1	.	.	.	.	.	.	.	.	.	.
Plantago holosteum Scop.	+	.	.	+	.	.	+	.	.	+	1	2	.	2	+	r	.	.	.	.
Limonium cazzae Bogdanović et Brullo	.	.	.	.	.	.	.	.	.	.	2	3	2	3	1	2	.	.	.	.
Anthyllis barba-jovis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	2	1
Limonion anfracti-cancellati																				
Crithmum maritimum L.	2	2	2	2	1	+	+	+	1	+	1	1	2	2	2	2	+	.	+	+
Lotus cytisoides L.	1	1	1	2	2	+	+	+	2	+	1	1	1	1	1	1	+	.	.	.
Silene vulgaris (Moench) Garcke subsp. *angustifolia* Hayek	2	1	+	.	.	+	.	+	2	+	+	.	.	.	1	1	+	+	+	+
Silene sedoides Poir.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	+	.	.	.	.
Daucus carota L. subsp. *hispanicus* (Gouan) Thell.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	1	1	.	.	.	.
Capparo orientalis-Aurinion leucadeae																				
Capparis orientalis Veill.	+	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	+	.	.
Aurinia leucadea (Guss.) K. Koch	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Anthyllidion barbae-jovis																				
Matthiola incana (L.) R. Br.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Crithmo-Staticetea																				
Helichrysum italicum (Roth) G. Don	+	1	1	+	+	1	1	1	1	1	1	+	.	.	2	1	.	1	2	.
Allium commutatum Guss.	.	.	.	+	+	+	+	+	+	+	+	+	.	.	.	.	.	2	2	1
Elymus pycnanthus (Godr.) Melderis	1	1	+	1	1	.	1	1	.	1	.	.	.	.	.	.	+	+	.	.
Allium ampeloprasum L.	.	.	.	+	.	.	.	+	+	+	.	.	.	.	.	.	1	.	.	.
Brassica mollis Vis.	1	1	+	2	2	2	2	2	3	2	.	.	.	.	.	.	1	1	1	1
Brassica cazzae Ginzb. et Teyber	.	.	.	.	.	.	.	.	.	.	1	1	1	.	+	+	.	.	.	.
Quercetea ilicis																				
Coronilla valentina L.	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	+	.	.
Smilax aspera L.	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.
Asparagus acutifolius L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Ephedra fragilis Desf. subsp. *campylopoda* (C. A. Mayer) Asch. et Graeb.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+
Rubus ulmifolius Schott	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Juniperus phoenicea L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Lonicera implexa Aiton	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Euphorbia dendroides L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Phillyrea media L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Pistacia lentiscus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Olea europaea L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Teucrium flavum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

Relevé number	1	2	3	4	5	6	7	8	9	10	11*	12	13	14	15	16	17*	18	19	20
Ononido-Rosmarinetea																				
Rosmarinus officinalis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Erica manipuliflora Salisb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Asplenietea trichomanis																				
Inula verbascifolia (Willd.) Hausskn.	.	2	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+
Parietaria judaica L.	+	+	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Sedum ochroleucum Chaix	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Hyoscyamus albus L.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phagnalon rupestre (L.) DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.
Umbilicus horizontalis (Guss.) DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Lygeo sparti-Stipetea tenacissimae																				
Reichardia picroides (L.) Roth	1	1	+	.	.	.	.	.	.	.	+	+	+	+	+	1	.	.	1	1
Brachypodium retusum (Pers.) P. Beauv.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	1	+	2
Bromus erectus Huds.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pallenis spinosa (L.) Cass.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	1	.	.
Euphorbia characias L. subsp. *wulfenii* (Hoppe ex Koch) A. M. Sm.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	1
Bromus madritensis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Brachypodium distachyon (L.) P. Beauv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Crupina crupinastrum (Moris) Vis.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Orobanche minor Sm.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dittrichietea viscosae																				
Dittrichia viscosa (L.) Greuter	+	+	.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.
Cakiletea maritimae																				
Atriplex prostrata DC.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Saginetea maritimae																				
Desmazeria marina (L.) Druce	+	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.
Parapholis incurva (L.) C. E. Hubb.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisietea vulgaris																				
Sonchus asper (L.) Hill subsp. *glaucescens* (Jord.) Ball	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+
Salicornietea fruticosae																				
Arthrocnemum macrostachyum (Moric.) C. Koch	.	.	3	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuco-Brometea																				
Valantia muralis L.	1	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Papavereta rhoeadis																				
Carduus pycnocephalus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.
Melilotus italica (L.) Lam.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.

*Holotypus

Geographical coordinates of relevés. Koločep: Rels.: 1, 17 (10.3.2014.) 42.668876 N, 18.014574 E; Rels.: 2, 18 (10.3.2014.) 42.668147 N, 18.015144 E; Rel.: 3 (1.10.2021.) 42.668123 N, 18.015459 E; Rel.: 19 (7.7.2020.) 42.662381 N, 18.019255 E; Rel.: 20 (1.10.2021.) 42.669339 N, 18.014273 E; Sušac: Rels: 11-14 (2.9.2022.) 42.750716 N, 16.490454 E; Rel.: 15 (6.7.2022.) 42.752225 N, 16.491088 E; Rel.: 16 (6.7.2022.) 42.751368 N, 16.492643 E; Stupa: Rels.: 4, 5 (7.7.2020.) 42.894411 N, 16.786779 E; Kosor: Rel.: 6 (15.7.2022.) 42.901277 N, 16.762046 E; Rels: 7, 8 (15.7.2020.) 42.900151 E, 16.763470 E; Obljak: Rel: 9 (6.7.2022.) 42.904517 E, 16.749472 E; rel. 10 (6.7.2022.) 42.903721 N, 16.749435 E.

Table 3: *Centaureetum ragusinae limonietosum cazzae* on the island of Sušac (Suš).
Tabela 3: *Centaureetum ragusinae limonietosum cazzae* na toku Sušac (Suš).

Relevé number	1*	2	3	4
Localities	Suš	Suš	Suš	Suš
Altitude (m a.s.l.)	60	60	70	27
Aspect	SE	SE	E	NW
Slope (°)	85	90	90	90
Plot size (mq)	25	25	25	25
Vegetation cover (%)	40	40	45	60
Char. Ass.				
Centaurea ragusina L. subsp. *ragusina*	3	3	3	3
Phagnalon graecum Boiss. et Heldr.	.	r	+	.
Diff. subassociations				
Limonium cazzae Bogdanović et Brullo	+	+	+	+
Asplenietea trichomanis				
Inula verbascifolia (Willd.) Hausskn.	1	1	1	1
Allium ampeloprasum L.	+	.	.	+
Capparis orientalis Veill.	+	.	.	.
Aurinia leucadea (Guss.) K. Koch	+	.	.	.
Teucrium flavum L.	r	.	.	.
Sonchus asper (L.) Hill subsp. *glaucescens* (Jord.) Ball	r	.	.	.
Phagnalon rupestre (L.) DC.	.	.	+	.
Umbilicus horizontalis (Guss.) DC.	.	+	.	.
Crithmo-Staticetea				
Helichrysum italicum (Roth) G. Don	2	1	1	1
Lotus cytisoides L.	2	+	1	2
Silene vulgaris (Moench) Garcke subsp. *angustifolia* Hayek	1	+	+	2
Crithmum maritimum L.	1	2	.	+
Ficus carica L.	+	+	.	.
Allium commutatum Guss.	.	.	+	1
Silene sedoides Poir.	.	+	.	.
Daucus carota L. subsp. *hispanicus* (Gouan) Thell.	.	.	2	.
Senecio bicolor (Willd.) Tod.	+	.	.	.
Brassica cazzae Ginzb. et Teyber	r	+	+	+
Anthyllidion barbae-jovis				
Matthiola incana (L.) R. Br.	.	r	.	.
Quercetea ilicis				
Pistacia lentiscus L.	+	+	r	+
Asparagus acutifolius L.	r	1	+	+
Juniperus phoenicea L.	+	.	1	.
Smilax aspera L.	.	.	r	.
Lygeo sparti-Stipetea tenacissimae				
Brachypodium retusum (Pers.) P. Beauv.	1	1	1	1
Reichardia picroides (L.) Roth	+	1	1	.
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman	+	.	+	.
Valantia muralis L.	.	.	r	.
Centaurium erythraea Rafn	.	.	+	.
Hyparrhenia hirta (L.) Stapf	.	.	.	+
Ononido-Rosmarinetea				
Rosmarinus officinalis L.	.	.	.	1
Festuco-Brometea				
Petrorhagia saxifraga (L.) Link	.	.	+	+
Aethionema saxatile (L.) R. Br. subsp. *scopulorum* (Ronniger) I. A. Anderson, A. Carlström, Franzén, Karlenet H. Nybom	.	r	.	.
Desmazeria rigida (L.) Tutin	.	.	.	+

*Holotypus

Geographical coordinates of relevés. Sušac: Rels.: 1–3 (2.9.2022.) 42.750716 N, 16.490454 E, Rel. 4 (6.7.2022.) 42.752135 N, 16.489985 E.

Table 4: Phytosociological relevés of woody and small-tree vegetation, garrigue and grassland plant communities with endemic *Brassica* taxa in southern Croatian islands and islets. Abbreviations: Kol – Koločep, Suš – Sušac, Stu – Stupa, Kos – Kosor, Ob – Obljak.

Tabela 4: Fitocenološki popisi rastlinskih združb lesnate in nizke gozdne vegetacije, garige in travišč z endemičnimi vrstami rodu *Brassica* na otokih in otočkih na južnem Hrvaškem. Okrajšave: Kol – Koločep, Suš – Sušac, Stu – Stupa, Kos – Kosor, Ob – Obljak.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Localities	Kol	Kol	Kol	Kol	Kol	Kos	Kos	Suš	Suš	Suš	Suš	Stu	Stu	Suš	Suš	Ob	Ob	Kos	Kos	Suš	Suš	Kol	Kol	Kol	Kol	Ob	Ob
Altitude (m a.s.l.)	22	23	26	31	41	10	10	23	26	25	18	4	5	10	10	8	8	8	8	50	50	22	23	27	38	4	5
Aspect	.	.	.	E	E	S	S	.	.	.	SE	S	S	SW	SW	NW	SW	S	S	SE	SE	.	.	E	E	NW	SW
Slope (°)	.	.	.	5	5	5	10	.	.	.	5	10	10	5	5	5	5	10	10	90	90	.	.	5	10	2	2
Plot size (mq)	100	100	100	100	100	100	100	100	100	100	100	20	20	50	50	50	50	20	20	50	20	30	25	100	50	25	25
Vegetation cover (%)	100	100	100	90	90	80	80	90	90	100	90	90	90	80	90	80	80	80	80	70	70	70	90	90	90	60	70
	Pistacio lentisci-Pinetum halepensis					***Pistacio lentisci-Juniperetum turbinatae***						***Myrto communis-Pistacietum lentisci***				***Oleo-Euphorbietum dendroidis coronilletosum emeroidis***						***Erico manipuliflorae-Calicotometum infestae***				***Narcisso-Aspho-deletum***	
Char. Ass.																											
Pinus halepensis Mill.	5	4	4	4	4	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Pistacia lentiscus L.	2	3	3	3	4	1	1	2	2	2	1	4	4	3	4	2	2	2	2	.	.	1	1	+	+	.	.
Juniperus phoenicea L.	1	+	+	1	1	3	3	4	4	3	4	+	+	+	+	.	.	+	.	.	.	.	+	.	.	.	.
Myrtus communis L.	+	1	1	2	2	1	2	1	1	+	+	2	2	2	1	2	1	1	1	.	.	.	.	.	.	.	.
Euphorbia dendroides L.	r	.	.	.	.	.	r	.	r	.	.	.	.	.	.	3	2	3	3	3	3	.	.	.	.	.	r
Olea europaea L.	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	4	4	3	3	2	2	.	1	1	.	+	.
Erica manipuliflora Salisb.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	2	2	2	.	.
Calicotome villosa (Poiret) Link (incl. C. *infesta* (C. Presl) Guss.)	1	+	1	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	3	4	.	.
Narcissus tazetta L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	1	1	1	.	.	.	.	.	.	3	3
Asphodelus aestivus Brot.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	3	3
Quercetea ilicis																											
Prasium majus L.	1	+	1	1	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	+	+	1	.	.
Asparagus acutifoliusL.	1	1	1	+	2	+	+	1	1	+	+	+	+	1	+	+	+	1	1	+	.	.	.	.	.	.	.
Coronilla valentina L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.
Lonicera implexa Aiton	+	+	+	+	1	+	+	1	+	+	+	.	.	.	.	+	.	1	1	.	.	.	.	.	.	.	.
Phillyrea latifolia L.	+	1	1	1	1	+	+	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Smilax aspera L.	2	1	.	+	+	+	+	+	+	+	+	.	.	.	+	+	.	1	1	.	.	.	.	.	.	.	.
Juniperus oxycedrus L. subsp. *macrocarpa* (Sm.) Ball	+	1	.	+	1	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	1	1	1	.	.
Ephedra fragilis Desf. subsp. *campylopoda* (C. A. Mayer) Asch. et Graeb.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Laurus nobilis L.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ceratonia siliqua L.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Rhamnus alaternus L.	+	+	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubia peregrina L.	+	+	+	+	1	+	+	.	+	+	.	.	.	.	.	+	+	1	1	.	.	.	.	.	.	.	.
Juniperus oxycedrus L. subsp. *oxycedrus*	1	2	1	1	2	+	+	+	+	1	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Arbutus unedo L.	1	2	2	2	2	.	+	.	.	.	.	.	.	.	.	.	+	1	1	.	.	.	.	.	.	.	.
Quercus ilex L.	1	1	.	+	+	.	.	.	.	.	.	+	.	.	.	+	.	1	+	.	.	.	.	.	.	.	.
Clematis flammula L.	1	1	1	1	+	+	+	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Rosa sempervirens L.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Teucrium flavum L.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spartium junceum L.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pistacia terebinthus L.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	1	+	+	+	.	.	.	.	.	.	.	.
Viburnum tinus L.	2	1	2	2	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus ulmifolius Schott	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erica arborea L.	+	+	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex halleriana Asso	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ruscus aculeatus L.	+	+	.	+	1	.	.	.	.	.	.	.	.	.	.	+	.	+	1	.	.	.	.	.	.	.	.
Colutea arborescens L.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.
Arisarum vulgare O. Targ. Tozz.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2	1	+	.	+	+	+	+	.	.
Osyris alba L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Cyclamen repandum Sibth. et Sm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.
Quercetea pubescentis																											
Coronilla emerus L. subsp. *emeroides* Boiss. et Spruner	1	2	1	+	+	+	+	.	.	.	.	.	.	.	.	1	1	1	1	+	+	1	1	+	+	+	.
Calamintha nepetoides Jord.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tamus communis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	+	.	.	.
Ononido-Rosmarinetea																											
Rosmarinus officinalis L.	+	1	1	2	2	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	+	.	.	.	.	.	.
Dorycnium hirsutum (L.) Ser.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cistus incanus L.	1	1	1	1	1	1	+	1	1	1	1	r	.	.	.	.	.	.	.	.	.	1	1	1	+	.	.
Cistus salviifolius L.	.	.	.	.	.	1	1	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Micromeria juliana (L.) Benth. ex Rchb.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	2	.	.
Festuco-Brometea																											
Helichrysum italicum (Roth) G. Don	+	+	+	+	1	+	+	.	.	+	+	+	+	.	+	+	.	+	+	+	.	.	.	.	.	.	.
Koeleria splendens C. Presl	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3	.	.
Bituminaria bituminosa (L.) C.H. Stirt.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.
Stipa sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Lygeo sparti-Stipetea tenacissimae																											
Brachypodium retusum (Pers.) P. Beauv.	3	2	3	4	3	1	2	1	1	1	2	1	1	+	+	1	1	2	2	+	.	3	3	2	4	3	4

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Bromus erectus Huds.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
Reichardia picroides (L.) Roth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	1	1	.	.	.	.	.	.
Allium subhirsutum L.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	+	+	1	1	+	+	.	.	.	.	.	.
Hyparrhenia hirta (L.) Stapf	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2	.	.
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Teucrium polium L. subsp. *capitatum* (L.) Arcang.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	+	.
Carlina corymbosa L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.
Ferula communis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Opopanax chironium (L.) W. D. J. Koch	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Piptatherum miliaceum (L.) Coss.	+	1	.	1	1	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.
Avena sterilis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.
Euphorbia characias L. subsp. *wulfenii* (Hoppe ex W. D. J. Koch) Radcl.-Sm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.
Crithmo-Staticetea																											
Lotus cytisoides L.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Daucus carota L. subsp. *hispanicus* (Gouan) Thell.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.
Silene vulgaris (Moench) Garcke subsp. *angustifolia* Hayek	.	.	.	.	.	+	+	.	.	.	.	+	+	.	.	+	+	+	+	+	.	.	.	.	.	+	+
Inula crithmoides L.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Crithmum maritimum L.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium commutatum Guss.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum italicum (Roth) G. Don	+	+	+	1	1	1	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	1	2
Elymus pycnanthus (Godr.) Melderis	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Anthyllis barba-jovis L.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r
Limonium cancellatum (Bernh. ex Bertol.) Kuntze	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Capparis orientalis Veill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.
Vincetoxicum hirundinaria Medik. subsp. *adriaticum* (Beck) Markgr.	.	.	.	.	.	+	+	.	.	.	.	+	+	.	.	+	+	+	+	.	.	.	.	.	.	+	+
Brassica mollis Vis.	+	+	+	+	.	+	+	.	.	.	.	1	1	.	.	+	+	1	1	.	.	+	+	+	+	1	1
Brassica cazzae Ginzb. et Teyber	.	.	.	.	.			+	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Chenopodietea																											
Lavatera arborea L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	+	+
Papaveretea rhoeadis																											
Cynodon dactylon (L.) Pers.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
Sonchus tenerrimus L.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Melilotus italica (L.) Lam.	+	.	.	.	.	.	.	.	.	.	.	1	1	.	.	1	1	.	.	.	.	.	.	.	.	.	+

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Geranium purpureum Vill.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	+	.	.	+	.	+	.	+	.
Cakiletea maritimae																											
Atriplex prostrata DC.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	1	.	.	.	.	+	+
Asplenietea trichomanis																											
Parietaria judaica L.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Inula verbascifolia (Willd.) Hausskn.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	1	1	.	.	.	+	.	r
Frangula rupestris (Scop.) Schur	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hyoscyamus albus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	+	+	.	.	.
Asplenium ceterach L.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.
Dittrichietea viscosae																											
Dittrichia viscosa (L.) Greuter	.	.	.	+	+	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	+	+	+	+	.	+

Geographical coordinates of relevés. Koločep: Rels: 1, 22 (7.7.2020.) 42.668876 N, 18.014574 E; Rels. 2, 23 (7.7.2020.) 42.668281 N, 18.015391 E; Rel.: 3 (7.7.2020.) 42.668123 N, 18.015459 E; Rel. 4,5 (7.7. 2020.) 42.662532 N, 18.019047 E; Rel.: 24, 25 (7.7. 2020.) 42.663083 N, 18.019030 E; Kosor: Rels.: 6, 18 (27.5.2021.) 42.901277 N, 16.762046 E; Rels: 7, 19 (27.5.2021.) 42.900151 E, 16.763470 E; Sušac: Rel.: 8 (2.9.2022.) 42.752102 N, 16.489940 E; Rel.: 9 (2.9.2022.) 42.751939 N, 16.489735 E; Rel.: 10 (2.9.2022.) 42.752225 N, 16.491088 E; Rel.: 11 (2.9.2022.) 42.751368 N, 16.492643 E; Rels: 14, 15 (6.7.2022.) 42.749806 N, 16.493901 E; Rels. 20, 21 (6.7.2022.) 42.750744 N, 16.490554 E; Stupa: Rels.: 12, 13 (2.9.2022.) 42.894411 N, 16.786779 E; Obljak: Rels.: 16, 26 (6.7.2022.) 42.904517 E, 16.749472 E; Rels.: 17, 27 (6.7.2022.) 42.903721 N, 16.749435 E.