

PHYTOSOCIOLOGICAL STUDY OF THE SOUTHEASTERNMOST ISLETS IN CROATIA (SOUTHERN ADRIATIC, NE MEDITERRANEAN)

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This paper presents the results of a phytosociological study of the two southeasternmost islets in Croatia, Veliki Školj (0.16 km²) and Supetrić (0.88 ha), near the village and port of Molunat (Dubrovnik region). Drawing on 20 phytosociological relevés collected in 2023 and 2024 using the Braun-Blanquet approach, the study identified four plant associations (*Myrto communis*-*Pistacietum lentisci*, *Myrto communis*-*Quercetum ilicis*, *Limonietum anfracti*, and *Posidonietum oceanicae*), one subassociation (*Centaureetum ragusinae* *limonietosum anfracti*), and three communities (*Euphorbia dendroides*-*Quercus ilex*, *Dactylis glomerata* subsp. *hispanica*, and *Cynodon dactylon*), spanning six vegetation classes. The stands of the *Myrto-Quercetum ilicis* association covers more than 95% of Veliki Školj's area. Importantly, the islet is at the southeasternmost line of the distribution range of *Centaurea ragusina*. Intensive goat grazing has significantly impacted the floristic diversity of both the maquis and grassland ecosystems.

Keywords: coastal ecosystems, islets plant communities, distribution, habitat types, phytosociology, vegetation diversity

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Prikazani su rezultati fitocenološkog istraživanja dvaju otočića na krajnjem jugoistoku Hrvatske, Velikog Školja (0,16 km²) i Supetrića (0,88 ha), smještenih u blizini naselja i luke Molunat (dubrovačka regija). Na temelju 20 fitocenoloških snimaka prikupljenih 2023. i 2024. Braun-Blanquet metodom, određene su četiri biljne asocijacije (*Myrto communis*-*Pistacietum lentisci*, *Myrto communis*-*Quercetum ilicis*, *Limonietum anfracti* i *Posidonietum oceanicae*), jedna subasocijacija (*Centaureetum ragusinae* *limonietosum anfracti*) i tri zajednice (*Euphorbia dendroides*-*Quercus ilex*, *Dactylis glomerata* subsp. *Hispanica* and *Cynodon dactylon*), koji pripadaju u šest vegetacijskih razreda. Sastojine asocijacije *Myrto-Quercetum ilicis* prekrivaju više od 95% površine Velikog Školja. Važno je istaknuti da taj otočić predstavlja najju-goistočnije nalazište vrste *Centaurea ragusina*, dok intenzivna ispaša koza značajno utječe na florističku raznolikost makije i travnjačkih ekosustava.

Ključne riječi: biljne zajednice otočića, fitocenologija, obalni ekosustavi, rasprostranjenost, raznolikost vegetacije, tipovi staništa

INTRODUCTION

The Mediterranean Sea has in world terms a great number of islands and archipelagos. These numerous islands are a significant component of Mediterranean biodiversity, notably hosting range-restricted species and peculiar vegetation types (PARADIS *et al.*, 2021; MÉDAIL *et al.*, 2019; MÉDAIL, 2022, and references therein; TESTOLIN *et al.*, 2024).

The Mediterranean region comprises a complex network of islands varying in shape, size, age, isolation, geology, spatial arrangement, distance from the mainland, and history of human colonization (VOGIATZAKIS & GRIFFITHS, 2008). It is widely recognized that the biota of an island is shaped by the interplay of these factors (SPELLERBERG & SAWYER, 1999). Generally, Mediterranean islands host vegetation types typical of the region, including forests, open woodlands, maquis, garrigue, and grasslands (e.g. PARADIS & POZZO DI BORGO, 2015). These vegetation types often form a mosaic of communities, particularly on larger islands. However, substantial variation exists among islands, with some featuring unique assemblages of species and habitats.

The Greek and Croatian coasts rank among the most diverse in the Mediterranean region. Croatia can count 1,246 islands (with areas greater than 1 km²), islets (ranging from 0.01 to 1 km²), and skerries or reefs (<0.01 km²), along with approximately 80 additional reefs that periodically emerge above sea level depending on tidal conditions (DUPLANČIĆ LEDER *et al.*, 2004). Of these, only about 110 islands have been studied for their flora and/or vegetation, often only partially (NIKOLIĆ *et al.*, 2008). Research on the diversity of Mediterranean vegetation on Croatian islands has been relatively neglected or underrepresented compared to other regions (for review, see JASPRICA & DOLINA, 2025).

In the southern Croatian islands and islets (Dubrovnik region), vegetation studies using the Braun-Blanquet approach (WESTHOFF & VAN DER MAAREL, 1980) were conducted in the 1980s (ILIJANIĆ & HEĆIMOVIĆ, 1982; M. HEĆIMOVIĆ, 1984; S. HEĆIMOVIĆ, 1984) and, several decades later, on nearby islets (JASPRICA *et al.*, 2006; JASPRICA & RUŠČIĆ, 2013). More recently, JASPRICA & STAMENKOVIĆ (2023), as part of a broader study, examined calcareous rocky slopes with chasmophytic and halophytic vegetation on the island of Koločep near Dubrovnik.

The present study focuses on the two southernmost Croatian islets – Veliki Školj and Supetrić – which, until now, have not been explored. These islets are located near the port of Molunat in the Konavle region. The aims of this study are to (i) provide a phytosociological description and syntaxonomic classification of plant communities and (ii) assess their ecological significance in the context of vegetation diversity on islands along the eastern Adriatic coast.

MATERIAL AND METHODS

The study area

The study area encompasses two islets in Croatia, located 60 m southwest of the Molunat peninsula and 600 m from the port and settlement of Gornji Molunat, one of the most southerly settlements in the municipality of Konavle, Dubrovnik-Neretva County, and Croatia (Fig. 1).

These islets are:

- (1) Veliki Školj (coordinates: 42.443330 N, 18.431390 E; surface area: 0.164 km²; perimeter: 1.834 km; maximum altitude: 45 m a.s.l., Fig. 2A), and
- (2) Supetrić (coordinates: 42.445642 N, 18.435353 E; surface area: 0.008 km², equivalent to 0.8883 ha; perimeter: 357 m; maximum altitude: 5 m a.s.l., Fig. 2B).

The distance between the two islets is 135 m. The coasts are predominantly low and rocky, except for the southwestern part of Veliki Školj, where a steep coastal cliff rises to approximately 60 m. Sea depths around Veliki Školj range from 45 to 107 m, while the sea depth around Supetrić is approximately 7 m.

Geomorphologically, the area belongs to the Dinaric Karst (PIKELJ & JURAČIĆ, 2013). Tectonically, it is part of the External Dinarides (KORBAR, 2009), a NW–SE striking fold-and-thrust belt composed of deformed, exhumed, and eroded Palaeozoic to Cenozoic rocks (mainly Upper Triassic to Quaternary), predominantly carbonate, most of which are deposits of the Adriatic Carbonate Platform (VLAHOVIĆ *et al.*, 2005; POTRLJAN *et al.*, 2012). The most common soil types in the study area are cambisol on limestone (BOGUNOVIĆ *et al.*, 1996).

The climate is Mediterranean, with an average annual air temperature of 13.9 °C (data for Molunat from 1991–2021, source: <https://en.climate-data.org/>). The highest average monthly temperature occurs in August (23.1 °C), while the lowest is in January (5.6 °C). The average annual rainfall is 1,632 mm. The highest average monthly precipitation, ranging from 186 to 264 mm, occurs between October and December, while the lowest amounts, between 39 and 59 mm, are recorded from June to August. The area receives approximately 3,233 hours of sunshine per year. SSE (*jugo*) and NNE (*burin*) winds are the most frequent in this region (MAZALIN JOVIĆ & FARIČIĆ, 2013, for the period 2000–2011). Monthly relative humidity ranges between 68% (August) and 74% in May, October, and November, with an annual average of 71%. According to Köppen's climate classification (KÖPPEN & GEIGER, 1954; STRÄSSER, 1998), the study area has a temperate humid climate with warm summers, or a *Csa* type of climate (ŠEGOTA & FILIPČIĆ, 2003: 35).

According to the adopted biomes typology and the occurrence of thermotypes in each of the climatic zones (see LOIDI *et al.*, 2022), the area belongs to the temperate aridietival ecozone, the biome of temperate aridietival evergreen (Mediterranean) forests and shrublands, and oceanic sclerophyllous-microphyllous evergreen forests and shrublands (Mediterranean s.str.) subbiome. From a phytogeographic point of view, the area is covered by stands of meso-Mediterranean evergreen vegetation of the *Fraxino orni-Quercion ilicis* alliance.

The islets are part of the NATURA 2000 network of protected sites under the designation "Akvtorij uz Konavoske stijene" (site code HR3000170) due to the presence of sandbanks that are slightly covered by sea water all the time (habitat type 1110), large shallow inlets and bays (1160), reefs (1170), *Posidonia* beds (*Posidonium oceanicae*) (priority habitat type 1120*), and submerged or partially submerged caves (8330) (OFFICIAL GAZETTE, 2019).

On Veliki Školj, although it is uninhabited, there is a large herd of goats all the year round, significantly impacting the vegetation. However, the exact number of goats remains unknown. Both islets are popular tourist destinations during the summer season.

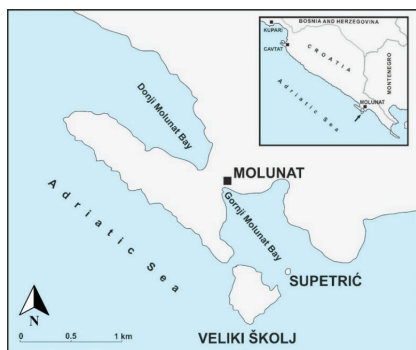


Fig. 1. The investigated islets of Veliki Školj (0.16 km²) and Supetrić (0.88 ha) are located near the port of Molunat in the southeastern Adriatic Sea.

Data collection and analysis

Field data were collected from 20 vegetation sample plots (relevés) in November 2023 and April 2024. Vegetation was studied according to the principles of the Braun-Blanquet approach (BRAUN-BLANQUET, 1964; WESTHOFF & VAN DER MAAREL, 1980). The geographical coordinates of the relevés are provided in Appendix 1, while the amose quoted in the text and tables but not included in the scheme are listed in Appendix 2.

The nomenclature of high-rank vegetation units follows the syntaxonomical system (EuroVegChecklist, EVC, <https://www.synbiosys.alterra.nl/evc/>) proposed by MUCINA *et al.* (2016) and adopted by ŠKVORC *et al.* (2017). The nomenclature of plant taxa follows the Plants of the World Online (POWO, 2024). EUNIS habitat types were determined according to CHYTRÝ *et al.* (2020) and using the Database of European Flora and Vegetation (<https://www.floraveg.eu>; CHYTRÝ *et al.*, 2024). For marine habitats, the EUNIS marine habitat classification 2022 is applied, using EEA (2022). The classification of vegetation units (alliances) into habitat types listed in Annex I of the Habitats Directive 92/43/EEC was conducted according to the List of NATURA 2000 habitats published by the Croatian Government (OFFICIAL GAZETTE, 2019).

RESULTS AND DISCUSSION

Out of the total 20 relevés, three were conducted on Supetrić (1 relevé on halophilous bare or very shallow soils, 2 relevés on maquis vegetation) and 17 on Veliki Školj (4 relevés on halophilous bare or very shallow soils, 8 relevés on maquis vegetation). These are presented in Tables 1 and 2. The remaining five single relevés on Veliki Školj, attributed to different vegetation types, are described and discussed in the following section. Some plant taxa were found outside the relevés, and the floristic inventory of the two islets is summarized in Appendix 3. Altogether, ninety vascular plant taxa were recorded across both islets. On Supetrić and Veliki Školj, 34 and 77 taxa were noted, respectively, with only 21 taxa common to both islets.

Short description of the associations and stands

Myrto communis-Pistacietum lentisci

The stand of this association occurs exclusively on Supetrić (Tab. 1, rel. 1), where it develops as a dense shrub formation, with a height ranging from 1 to 1.5 meters. Due to the small surface area of the islet, which is entirely exposed to salt-spray influence, species of the *Crithmo-Staticetea* class also contribute to the vegetation. Additionally, the presence of *Arundo plinii* is observed, although it does not form a distinct community. These observations also apply to the small stand of *Myrto-Quercetum ilicis* on Supetrić (Tab. 1, rel. 2). In general, the *Myrto-Pistacietum lentisci* association is found along the eastern Adriatic, occupying the open southern coasts beyond the halophytic belt, and extending towards the island interiors (JASPRICA & RUŠČIĆ, 2013; JASPRICA & STAMENKOVIĆ, 2023; PANDŽA *et al.*, 2023, and references therein).

Tab. 1. *Myrto communis*-*Pistacietum lentisci* (rel. 1) and *Myrto communis*-*Quercetum ilicis* (rels. 2-10) on the islets of Supetrić (S) and Veliki Školj (VŠ).

Relevé number	1	2	3	4	5	6	7	8	9	10
Islet	S	S	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ
Altitude (m)	1	1	5	13	17	28	24	22	13	20
Slope (°)	.	5	6	3	3	2	2	3	2	5
Aspect	.	N	NW	SE	NW	SE	NE	N	N	N
Plot size (m2)	30	50	200	200	200	200	200	200	200	200
Vegetation cover (%)	100	100	90	95	95	100	90	90	80	100
No of taxa	14	19	29	15	13	15	14	19	21	16

Quercetea ilicis, *Quercetalia ilicis*

Fraxino orni-Quercion ilicis

<i>Pistacia lentiscus</i>	4	3	3	+	2	.	.	1	1	2
<i>Myrtus communis</i>	4	3	3	2	2	3	1	2	2	2
<i>Quercus ilex</i>	.	4	5	5	5	4	3	4	2	3
<i>Smilax aspera</i>	+	2	2	+	+	+	+	+	+	+
<i>Arisarum vulgare</i>	.	2	2	1	1	1	2	+	1	+
<i>Erica arborea</i>	r	3	+	1	+	1	.	1	2	1
<i>Arbutus unedo</i>	.	+	3	1	+	.	3	2	3	3
<i>Rubia peregrina</i>	.	2	+	+	+	.	.	r	+	+
<i>Laurus nobilis</i>	.	.	2	.	3	3	1	2	+	1
<i>Rubus ulmifolius</i>	.	.	+	+	.	.	+	+	+	+
<i>Viburnum tinus</i>	.	.	1	.	+	.	.	r	+	1
<i>Viola dehnhardtii</i>	.	.	2	2	+	.	.	.	.	.
<i>Spartium junceum</i>	+	2	.	.	.	.	.	.	.	.
<i>Lonicera implexa</i>	.	+	.	.	.	.	.	.	.	1
<i>Rosa sempervirens</i>	.	.	+	.	.	.	.	.	+	.
<i>Ruscus aculeatus</i>	.	.	.	.	.	+	.	+	.	.
<i>Asparagus acutifolius</i>	.	2	.	.	.	.	.	.	.	.
<i>Asplenium onopteris</i>	.	.	+	.	.	.	.	.	.	.
<i>Carex hallerana</i>	.	.	+	.	.	.	.	.	.	.
<i>Cupressus sempervirens</i>	.	.	.	.	.	.	.	.	3	.
<i>Phillyrea latifolia</i>	.	.	.	.	.	.	.	.	+	.
<i>Juniperus oxycedrus</i>	.	.	.	.	.	.	.	.	r	.

Pistacio lentisci-Rhamnetalia alaterni, *Oleo-Ceratonion*

<i>Olea europaea</i>	.	.	3	2	.	.	.	.	.	2
<i>Pinus pinaster</i>	.	.	.	.	.	.	.	.	3	3
<i>Ceratonia siliqua</i>	.	.	.	.	.	.	2	.	.	.
<i>Pinus pinea</i>	.	.	.	.	.	.	.	+	.	.

Companions

Carpino-Fagetea sylvaticae

<i>Hedera helix</i>	.	.	+	+	+	1	2	+	1	+
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Relevé number	1	2	3	4	5	6	7	8	9	10
Islet	S	S	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ
Altitude (m)	1	1	5	13	17	28	24	22	13	20
Slope (°)	.	5	6	3	3	2	2	3	2	5
Aspect	.	N	NW	SE	NW	SE	NE	N	N	N
Plot size (m2)	30	50	200	200	200	200	200	200	200	200
Vegetation cover (%)	100	100	90	95	95	100	90	90	80	100
No of taxa	14	19	29	15	13	15	14	19	21	16

Quercetea pubescentis

Quercus pubescens . + . + + 1 3 2 . .

Hippocrepis emerus subsp. *emeroides* . . + + . . + +

Dioscorea communis + + . .

Cornus domestica +

Festuco-Brometea

Centaureum erythraea . . + + .

Lotus herbaceus +

Gladiolus illyricus . +

Arabis hirsuta . . +

Teucrium chamaedrys . . +

Koeleria splendens . . +

Melica ciliata 1 .

Lygeo sparti-Stipetea tenacissimae

Arundo plinii 3 2

Reichardia picroides +

Brachypodium retusum . 3

Crithmo-Staticetea

Silene vulgaris subsp. *angustifolia* + 2

Allium commutatum 1

Euphorbia segetalis var. *pinia* . +

Papaveretea rhoeadis

Sonchus oleraceus . +

Stellaria media . . + . . + 1 . . .

Viola arvensis + +

Artemisietea vulgaris

Daucus carota + 3 +

Sonchus asper subsp. *glaucescens* . . +

Chenopodietea

Geranium purpureum + + + . .

Sisymbrietea

Geranium molle . . + +

Geranium lucidum +

Stipo-Trachynietea distachyae

Relevé number	1	2	3	4	5	6	7	8	9	10
Islet	S	S	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ	VŠ
Altitude (m)	1	1	5	13	17	28	24	22	13	20
Slope (°)	.	5	6	3	3	2	2	3	2	5
Aspect	.	N	NW	SE	NW	SE	NE	N	N	N
Plot size (m2)	30	50	200	200	200	200	200	200	200	200
Vegetation cover (%)	100	100	90	95	95	100	90	90	80	100
No of taxa	14	19	29	15	13	15	14	19	21	16
<i>Catapodium rigidum</i>	.	.	+	.	.	.	.	.	.	.
<i>Valantia muralis</i>	.	.	.	.	.	+	.	.	.	.
<i>Dittrichietea viscosae</i>										
<i>Dittrichia viscosa</i>	1	.	.	.	.	.	.	.	.	.
<i>Polygono-Poetea annuae</i>										
<i>Cynodon dactylon</i>	+	.	.	.	.	.	.	.	.	.
<i>Polypodietea</i>										
<i>Selaginella denticulata</i>	.	.	+	.	.	.	.	.	.	.
<i>Other</i>										
<i>Taraxacum</i> sp.	.	.	+	.	.	.	+	.	.	.
<i>Viola suavis</i> subsp. <i>austrodalmatica</i>	.	.	.	.	.	+	+	+	.	.

Myrto communis-Quercetum ilicis

In the holm-oak woody vegetation along the eastern Adriatic, the *Myrto-Quercetum ilicis* association is found in warmer and drier areas (Horvatić, 1963). It occupies the majority of Veliki Školj covering 98% of its area, with vegetation cover ranging from 80% to 100% (Tab. 1, rels. 2–10, Fig. 2C, Fig. 3). The number of species per relevé ranged from 13 to 29 (average 17.8). This association is dominated by *Quercus ilex*, *Arbutus unedo*, *Myrtus communis*, *Erica arborea*, and *Laurus nobilis*.

The vegetation generally reaches heights of up to 5-8 meters, with some stands on the islet reaching as high as 12-15 meters. The herbaceous layer is characterized by high rockiness and low cover (mostly ≤5%), with the most prominent species being *Arisarum vulgare*, *Rubia amosee*, and *Hedera helix* (Fig. 2C). This stand has significant aesthetic and ecological value.

***Euphorbia dendroides-Quercus ilex* community**

A stand of this community was found in a very limited area in the southern part of Veliki Školj, occupying the upper half of the rocky cliffs (Fig. 2D). The floristic composition was as follows *Euphorbia dendroides*, 3; *Quercus ilex*, 3; *Arbutus unedo*, 1; *Pistacia lentiscus*, 1; *Juniperus phoenicea*, +; *Reichardia picroides*, +; *Asparagus acutifolius*, +; *Centaurea ragusina*, +; *Limonium dictyophorum*, +; *Olea europaea*, +. The typical physiognomy and the floristic composition of the macchia with *Euphorbia dendroides* (i.e. *Oleo-Euphorbietum dendroidis coronilletosum emeroidis*) is absent here. The lack of certain species characteristic of the *Oleo-Ceratonion* alliance (e.g., *Calicotome villosa*, *Prasium majus*, etc.) is notable (cf. JASPRICA & STAMENKOVIĆ, 2023).

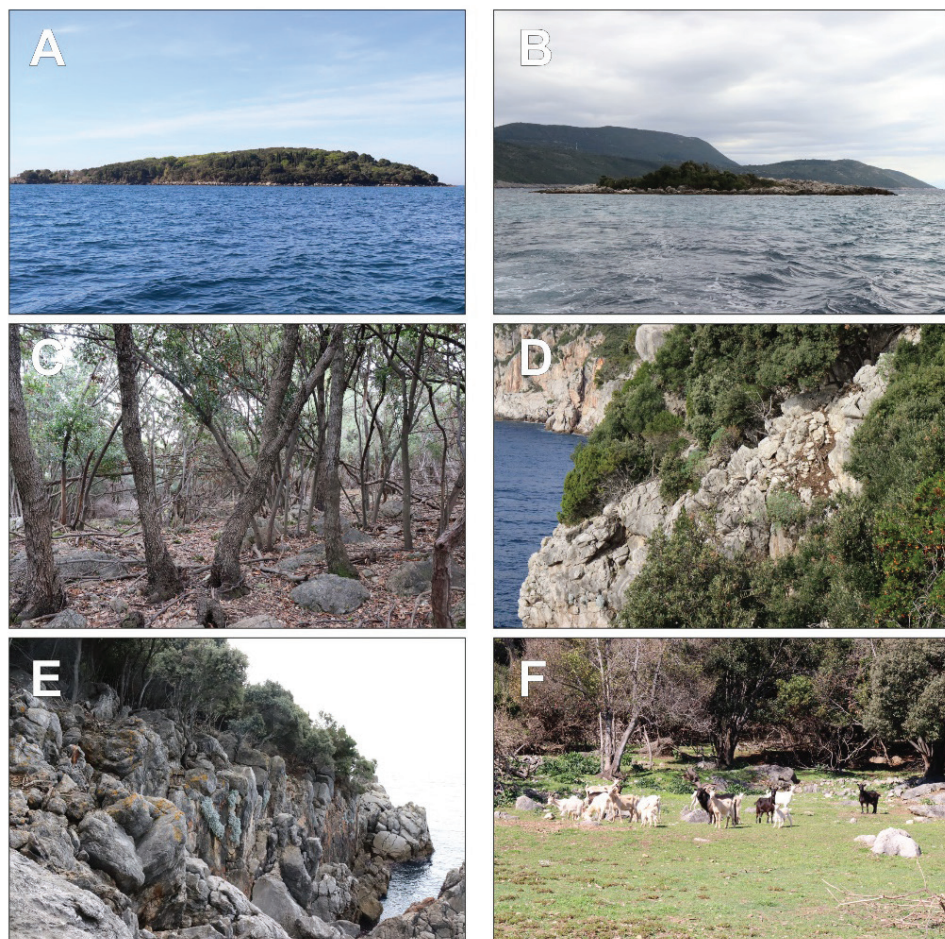


Fig. 2. The investigated islets are the southeasternmost tip of Croatian territory: A – Veliki Školj (surface area of 0.16 km²), B – Supetrić (0.88 ha). Physiognomy of the some vegetation types on Veliki Školj: C – the holm-oak woodland of the *Myrta communis-Quercetum ilicis* association; D – the *Euphorbia dendroides-Quercus ilex* community occurs on a cliff-top; E – the stand of the *Centaureetum ragusinae limonietosum anfracti* subassociation grows in the upper part of the vertical cliff; F – the open space on Veliki Školj constitutes approximately 1.8% of its total area (photos: N. Jasprica).

Dactylis glomerata subsp. *hispanica* community

The only open area on Veliki Školj, covering approximately 2% of its total area, is a grassland dominated by *Dactylis glomerata* subsp. *hispanica* – the characteristic species of the *Lygeo sparti-Stipetea tenacissimae* class. This grassland is subject to intensive goat grazing (Fig. 2F). However, overgrowth is evident at the edges of the grassland. Floristic composition includes *Dactylis glomerata* subsp. *hispanica*, 4; *Sonchus bulbosus*, 3; *Ranunculus neapolitanus*, 3; *Torilis nodosa*, 2; *Draba verna*, 1; *Lysimachia arvensis*, 1; *Arisarum vulgare*, +; *Bellis annua*, +; *Carex divulsa*, +; *Cerastium glomeratum*, +; *Convolvulus arvensis*, +; *Dioscorea communis*, +; *Geranium purpureum*, +; *Geranium molle*, +; *Hedera*

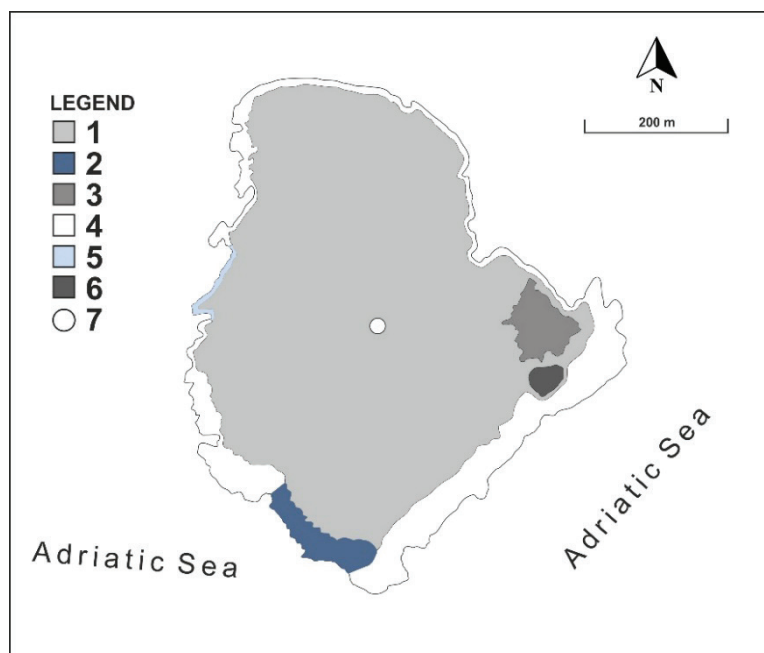


Fig. 3. Vegetation map of the islet Veliki Školj based on the phytosociological survey: 1 – *Myrto communis-Quercetum ilicis*; 2 – *Euphorbia dendroides-Quercus ilex* community; 3 – *Dactylis glomerata* subsp. *Hispanica* community; 4 – *Limonietum anfracti*; 5 – *Centaureetum ragusinae limonietosum anfracti*; 6 – *Cynodon dactylon* community; 7 – stand with *Asplenium ceterach* on the drystone wall.

helix, +; *Laurus nobilis*, +; *Myrtus communis* juv., +; *Pistacia lentiscus* juv., +; *Plantago amosees*, +; *Ranunculus sardous*, +; *Serapias lingua*, +; *Sideritis romana* subsp. *Purpurea*, +; *Stachys arvensis*, +; *Taraxacum* sp., +; *Theligionum cynocrambe*, +; *Ulmus minor* juv., +; *Verbena officinalis*, +; *Veronica arvensis*, +.

Limonietum anfracti

Both islets feature rocky coasts inhabited by stands of the *Limonietum anfracti* association, which is characterized by *Limonium dictyophorum*, a species endemic to the southern coast of the eastern Adriatic (NIKOLIĆ *et al.*, 2015). This species forms sparse, low-spreading formations that colonize cracks in the rocks. On Veliki Školj, the overall floristic composition is relatively poor, with only 4 to 8 species per relevé (Tab. 2). In contrast, the total number of species in a single relevé on Supetrić was 14. This may be at least partly attributed to the size of the relevé plots. Between the rocks, slightly deeper soil has developed, allowing for the presence of other species, such as *Dittrichia viscosa*, *Arundo plinii*, and taxa from the *Festuco-Brometea* class (*Gladiolus illyricus*, *Lotus amosees*, *Helichrysum italicum*), which are absent on Veliki Školj. However, among the companion species, those from the *Juncetea amosee* and *Ammophiletea arundinaceae* classes (e.g., *Elytrigia juncea*, *E. pungens*, etc.) can also be found on some islands and islets in the southeastern Adriatic (HEĆIMOVIĆ, 1984; JASPRICA *et al.*, 2006; JASPRICA & RUŠČIĆ, 2013). Although Veliki Školj has a small pebble beach, it lacks developed vegetation.

Relevé number	1	2	3	4	5
Islet	S	VŠ	VŠ	VŠ	VŠ
Altitude (m)	1	1	1	2	1
Slope (°)	.	10	2	2	2
Aspect	.	SE	SE	N	N
Plot size (m2)	30	16	16	16	16
Vegetation cover (%)	10	10	10	5	15
Number of taxa	14	5	8	5	4

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Relevé number	1	2	3	4	5
Islet	S	VŠ	VŠ	VŠ	VŠ
Altitude (m)	1	1	1	2	1
Slope (°)	.	10	2	2	2
Aspect	.	SE	SE	N	N
Plot size (m2)	30	16	16	16	16
Vegetation cover (%)	10	10	10	5	15
Number of taxa	14	5	8	5	4
Char. Ass.					
<i>Robinieta</i>					
<i>Parthenocissus quinquefolia</i>	+	.	.	.	.
<i>Nerio-Tamaricetea</i>					
<i>Vitex agnus-castus</i>	+	.	.	.	.
<i>Saginetea maritimae</i>					
<i>Catapodium marinum</i>	.	.	+	.	.
<i>Polygono-Poetea annuae</i>					
<i>Cynodon dactylon</i>	.	.	+	.	.

Centaureetum ragusinae limonietosum anfracti

The community was found on the vertical cliff in the western part of the islet of Veliki Školj. The subassociation includes *Centaurea ragusina*, 3; *Allium commutatum*, 1; *Limonium dictyophorum*, 1; *Crithmum maritimum*, +. In fact, the islet represents the southeasternmost limit of the distribution range of *Centaurea ragusina*. Some individuals of *C. ragusina* were also found within the *Euphorbia dendroides-Quercus ilex* community.

Vegetation of the drystone walls

The thermophilic chasmophytic vegetation of Mediterranean walls (*Cymbalario-Parietarietea diffusae*), at least in part, is absent from the islets. Instead, stands with *Asplenium ceterach* occupy small areas under low light conditions on the drystone walls within the holm-oak woodland on Veliki Školj. The floral composition of the stand includes: *Asplenium ceterach*, 2; *Asplenium ruta-muraria*, +; *Geranium purpureum*, +; *Theligonum cynocrambe*, +.

Posidonietum oceanicae

The sea surrounding the islets is characterized by seagrass meadows, primarily associated with sandy or semi-sandy substrates. These meadows are predominantly composed of monophytic stands of *Posidonia oceanica*, which typically occurs in the infralittoral zone, extending from the islets to the mainland throughout Gornji Molunat Bay at sea-water depths between 7 and 14 m. Although the structural and functional roles of *P. oceanica* meadows are well-documented, these communities are declining at alarming rates due to climate change, alien species invasions, and direct human activities in coastal areas (for review, see TELESCA *et al.*, 2015).

Cynodon dactylon community

It occurs in areas with dry soils near the belt of coastal salt-spray vegetation (*Crithmo-Staticetea*) on Veliki Školj. In comparison with the community reported from the islet of Vrnik (JASPRICA *et al.*, 2018), this community contains an exceptionally low number of taxa. The floristic composition includes *Cynodon dactylon*, 4; *Lysimachia arvensis*, +; *Sonchus bulbosus*, +.

The syntaxonomic scheme is presented below:

Syntaxonomic scheme

QUERCETEA ILICIS Br.-Bl. Ex A. Bolós et O. de Bolòs in A. Bolòs y Vayreda 1950
Quercetalia ilicis Br.-Bl. Ex Molinier 1934

Fraxino orni-Quercion ilicis Biondi, Casavecchia et Gigante in Biondi *et al.* 2013

Myrto communis-Quercetum ilicis (Horvatić 1963) Trinajstić (1976) 1985

Pistacio lentisci-Rhamnetalia alaterni Rivas-Mart. 1975

Oleo-Ceratonion siliquae Br.-Bl. Ex Guinochet et Drouineau 1944

Myrto communis-Pistacietum lentisci (Molinier 1954) Rivas-Mart. 1975

Euphorbia dendroides-Quercus ilex community

LYGEO SPARTI-STIPETEA TENACISSIMAE Rivas-Mart. 1978

Cymbopogono-Brachypodietalia amose Horvatić 1963

Dactylis glomerata subsp. *Hispanica* community

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

Limonietum anfracti Ilijanić et S. Hećimović 1982

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 anfracti Hećimović ex Terzi, Jasprica et Caković 2017

ZOSTERETEA Pignatti 1953

Posidonietalia oceanicae Den Hartog ex Mucina in Mucina *et al.* 2016

Posidonion oceanicae Br.-Bl. Ex Molinier 1960

Posidonietum oceanicae (Funk 1927) Molinier 1958

POLYGONO-POETEA ANNUAE Rivas-Mart. 1975

Cynodon dactylon community

Five alliances were assigned to five of the EUNIS habitat types: (1) *Fraxino orni-Quercion ilicis* [EUNIS2020 habitat code: T21, habitat type name: Mediterranean evergreen *Quercus* forest]; (2) *Oleo-Ceratonion siliquae* [S51, Mediterranean maquis and arborescent matorral]; (3) *Limonion anfracti-cancellati* [N32, Mediterranean and Black Sea rocky sea cliff and shore]; (4) *Centaureo cuspidatae-Portenschlagiellion ramosissimae* [U38, Mediterranean base-rich inland cliff]; (5) *Posidonion oceanicae* [MB252, Biocenosis of *Posidonia oceanica*].

The aforementioned alliances are also associated with five habitat types listed in Annex I habitat types (Habitats Directive 92/43/EEC): (1) vegetated sea cliffs of the

Mediterranean coasts with endemic *Limonium* spp. [habitat code 1240]; (2) *Posidonia* beds (*Posidonium oceanicae*) [priority habitat 1120*]; (3) Calcareous rocky slopes with chasmophytic vegetation [habitat code 8210]; (4) *Olea* and *Ceratonia* forests [habitat code 9320]; and (5) *Quercus ilex* and *Quercus rotundifolia* forests [habitat code 9340].

CONCLUSION

The study highlights the ecological significance of the southeasternmost Croatian islets as reservoirs of biodiversity and endemism. The vegetation is influenced by habitat degradation and overgrazing and is associated with habitat types of conservation interest in Europe. Gathering vegetation data from unsampled or under-sampled Croatian islands and islets is crucial for understanding the distribution of vegetation and plant species diversity. This is key to addressing island- and habitat-specific dynamics and formulating effective conservation and management strategies.

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Appendix 1

Coordinate and date of sampling vegetation relevés.

Tab. 1. *Myrto communis*-*Pistacietum lentisci*. Supetrić, rel. 1: 42.445543 N, 18.435311 E, 14.11.2023; *Myrto communis*-*Quercetum ilicis*. Supetrić, rel. 2: 42.445757 N, 18.435237 E, 14.11.2023; Veliki Školj, rel. 3: 42.446004 N, 18.429668 E, 14.11.2023; rel. 4: 42.443031 N, 18.429503 E, 14.11.2023; rel. 5: 42.4452310 N, 18.4300050 E, 14.11.2023; rel. 6: 42.443263 N, 18.432878 E, 9.4.2024; rel. 7: 42.443930 N, 18.431675 E, 9.4.2024; rel. 8: 42.444812 N, 18.431137 E, 9.4.2024; rel. 9: 42.445351 N, 18.431091 E, 9.4.2024; rel. 10: 42.445859 N, 18.430639 E, 9.4.2024.

Tab. 2. *Limonetum anfracti*. Supetrić, rel. 1: 42.445661 N, 18.435626 E, 14.11.2023; Veliki Školj, rel. 2: 42.443628 N, 18.434049 E, 9.4.2024; rel. 3: 42.442950 N, 18.433171 E, 9.4.2024; rel. 4: 42.445671 N, 18.431853 E, 9.4.2024; rel. 5: 42.445487 N, 18.429233 E, 9.4.2024.

***Euphorbia dendroides*-*Quercus ilex* community.** Veliki Školj: 14.11.2023; coordinate: 42.442475 N, 18.428917 E; altitude: 4–5 m a.s.l.; aspect: S; slope: 90°; plot size: 16 m²; vegetation cover: 70%].

***Dactylis glomerata* subsp. *hispanica* community.** Veliki Školj: 9.4.2024; coordinate: 42.443770 N, 18.433296 E; altitude: 2 m a.s.l.; aspect: -; slope: -; plot size: 25 m²; vegetation cover: 80%.

***Centaureetum ragusinae limonietosum anfracti*.** Veliki Školj: 14.11.2023; coordinate: 42.444904 N, 18.429352 E; altitude: 4 m a.s.l.; aspect: SW; slope: 90°; plot size: 16 m²; vegetation cover: 30%.

Stand with *Asplenium ceterach*. Veliki Školj: 9.4.2024; coordinate: 42.444631 N, 18.431408 E; altitude: 4

m a.s.l.; aspect: N; slope: 90°; plot size: 10 m²; vegetation cover: 10%.

***Cynodon dactylon* community.** Veliki Školj; 9.4.2024; coordinate: 42.443300 N, 18.433259 E; altitude: 2 m a.s.l.; aspect: S; slope: 5°; plot size: 10 m²; vegetation cover: 70%.

Appendix 2

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

Ammophiletea arundinaceae Br.-Bl. et Tx. ex Westhoff et al. 1946; *Artemisietea vulgaris* Lohmeyer et al. in Tx. ex von Rochow 1951; *Carpino-Fagetea sylvaticae* Jakucs ex Passarge 1968; *Chenopodietea* Br.-Bl. in Br.-Bl. et al. 1952; *Cymbalario-Parietarietea diffusae* Oberd. 1969; *Dittrichietea viscosae* Trinajstić; B.Foucault et Jasprica 2019; *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947; *Juncetea maritimi* Br.-Bl. in Br.-Bl. et al. 1952; *Lygeo sparti-Stipetea tenacissimae* Rivas-Mart. 1978 nom. conserv. propos. (*Thero-Brachypodietea* Br.-Bl. in Br.-Bl. et al. 1947); *Nerio-Tamaricetea* Br.-Bl. et O. de Bolòs 1958; *Oleo-Euphorbietum dendroidis* Trinajstić 1973 *coronilletosum emeroidis* Trinajstić 1973; *Papaveretea rhoeadis* S. Brullo et al. 2001 nom. conserv. propos.; *Polygono-Poetea annuae* Rivas-Mart. 1975; *Polypodietea* Jurko et Peciar ex Boşcaiu, Gergely et Codoreanu in Raţiu et al. 1966; *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959; *Robinietea* Jurko ex Hadač et Sofron 1980; *Saginetea maritimae* Westhoff et al. 1962; *Sisymbrietea* Gutte et Hilbig 1975; *Stipo-Trachynietea distachyae* S. Brullo in S. Brullo et al. 2001.

Appendix 3

The plant taxa (in alphabetical order) recorded on the islets of **Supetřić (S)** and **Veliki Školj (VŠ)**, including those found both within and outside the relevés, are listed. The taxa names followed the POWO nomenclature (2024).

<i>Allium ampeloprasum</i> (VŠ)	<i>Geranium robertianum</i> (VŠ)	<i>Rubus ulmifolius</i> (S, VŠ)
<i>Arabis hirsuta</i> (VŠ)	<i>Gladiolus illyricus</i> (S, VŠ)	<i>Ruscus aculeatus</i> (VŠ)
<i>Arbutus unedo</i> (S, VŠ)	<i>Hedera helix</i> (VŠ)	<i>Sanguisorba minor</i> subsp. <i>bale-</i>
<i>Arenaria serpyllifolia</i> (VŠ)	<i>Helichrysum italicum</i> (S)	<i>arica</i> (S)
<i>Arisarum vulgare</i> (S, VŠ)	<i>Hippocrepis emerus</i> subsp. <i>em-</i>	<i>Scaligeria napiformis</i> (VŠ)
<i>Arundo plinii</i> (S)	<i>eroides</i> (VŠ)	<i>Selaginella denticulata</i> (VŠ)
<i>Asparagus acutifolius</i> (S, VŠ)	<i>Juniperus oxycedrus</i> (VŠ)	<i>Silene vulgaris</i> subsp. <i>angustifolia</i>
<i>Asplenium onopteris</i> (VŠ)	<i>Koeleria splendens</i> (VŠ)	(S, VŠ)
<i>Brachypodium retusum</i> (S)	<i>Lamium purpureum</i> (VŠ)	<i>Smilax aspera</i> (S, VŠ)
<i>Cardamine hirsuta</i> (VŠ)	<i>Laurus nobilis</i> (VŠ)	<i>Sonchus asper</i> subsp. <i>glaucescens</i>
<i>Carex flacca</i> (VŠ)	<i>Limonium dictyophorum</i> (S, VŠ)	(S, VŠ)
<i>Carex hallerana</i> (VŠ)	<i>Lonicera implexa</i> (S, VŠ)	<i>Sonchus oleraceus</i> (S)
<i>Catapodium marinum</i> (VŠ)	<i>Lotus cytisoides</i> (VŠ)	<i>Spartium junceum</i> (S)
<i>Catapodium rigidum</i> (VŠ)	<i>Lotus herbaceus</i> (S)	<i>Stellaria media</i> (VŠ)
<i>Centaureum erythraea</i> (VŠ)	<i>Melica ciliata</i> (VŠ)	<i>Stellaria media</i> (VŠ)
<i>Cerantonia siliqua</i> (VŠ)	<i>Myrtus communis</i> (S, VŠ)	<i>Taraxacum</i> sp. (VŠ)
<i>Cormus domestica</i> (VŠ)	<i>Oenanthe pimpinelloides</i> (VŠ)	<i>Teucrium capitatum</i> (VŠ)
<i>Crithmum maritimum</i> (S, VŠ)	<i>Olea europaea</i> (VŠ)	<i>Teucrium chamaedrys</i> (VŠ)
<i>Cupressus sempervirens</i> (VŠ)	<i>Oxalis dillenii</i> (VŠ)	<i>Thymus longicaulis</i> (VŠ)
<i>Cynodon dactylon</i> (S, VŠ)	<i>Parthenocissus quinquefolia</i> (S)	<i>Trifolium subterraneum</i> (VŠ)
<i>Daucus carota</i> (S, VŠ)	<i>Phillyrea latifolia</i> (VŠ)	<i>Urospermum picroides</i> (VŠ)
<i>Dioscorea communis</i> (VŠ)	<i>Pinus pinaster</i> (VŠ)	<i>Valantia muralis</i> (VŠ)
<i>Dittrichia viscosa</i> (S)	<i>Pinus pinea</i> (VŠ)	<i>Veronica agrestis</i> (VŠ)
<i>Erica arborea</i> (S, VŠ)	<i>Pistacia lentiscus</i> (S, VŠ)	<i>Viburnum tinus</i> (VŠ)
<i>Erigeron sumatrensis</i> (VŠ)	<i>Plantago subulata</i> (VŠ)	<i>Vincetoxicum hirundinaria</i> subsp.
<i>Euphorbia peplus</i> (VŠ)	<i>Poa annua</i> (VŠ)	<i>adriaticum</i> (VŠ)
<i>Euphorbia segetalis</i> var. <i>pinia</i> (S)	<i>Posidonia oceanica</i> (S, VŠ)	<i>Viola arvensis</i> (VŠ)
<i>Galium verrucosum</i> (VŠ)	<i>Quercus ilex</i> (S, VŠ)	<i>Viola dehnhardtii</i> (VŠ)
<i>Gastidium ventricosum</i> (VŠ)	<i>Quercus pubescens</i> (S, VŠ)	<i>Viola kitaibeliana</i> (VŠ)
<i>Geranium lucidum</i> (S)	<i>Reichardia picroides</i> (S, VŠ)	<i>Viola suavis</i> subsp. <i>australalmat-</i>
<i>Geranium molle</i> (VŠ)	<i>Rosa sempervirens</i> (VŠ)	<i>ica</i> (VŠ)
<i>Geranium purpureum</i> (VŠ)	<i>Rubia peregrina</i> (S, VŠ)	<i>Vitex agnus-castus</i> (S)