Plant Sociology, Vol. 53, No. 1, June 2016, pp. 55-81
DOI 10.7338/pls2016531/04

PLANT SOCIOLOGY
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Phytocoenotic diversity of the NE-Adriatic island of Olib

N. Jasprica[1], M. Milović[2], S. Kovačić[3], V. Stamenković[3]
[1]Institute for Marine and Coastal Research, University of Dubrovnik, P.O. Box 83, HR-20000 Dubrovnik, Croatia.
[2]"Antun Vrančić" Grammar School, Put Gimnazije 64, HR-22000 Šibenik, Croatia.
[3]Botanical Garden, Department of Biology, Faculty of Science, University of Zagreb, Marulićev trg 9a, HR-10000 Zagreb, Croatia.

Abstract
The vegetation of the north-eastern Adriatic island of Olib (26.13 km^2) was studied in 2015. From a total of 99 phytosociological relevés, 33 floristically and ecologically distinctive vegetation communities were identified and described (30 associations and 3 stands) within 28 alliances, 27 orders and 23 vegetation classes. Altogether, 18 NATURA 2000 habitat types were recognized. The study revealed the great phytocoenotic diversity and the high biogeographical value of the study area.

Key words: biodiversity, Croatia, Directive 92/43/EEC, NE Mediterranean, phytosociology, syntaxonomy.

Introduction

All Mediterranean islands, of varying sizes and with unique characteristics, are considered to be hotspots of biodiversity at the global scale (Médail & Quézel, 1997; Davis *et al*., 1994). However, they are susceptible to natural and cultural drivers of change and the islands provide reinforcing evidence of such dynamics which have operated for most of the last 10,000 years (Vogiatzakis *et al*., 2007). Human pressure modifies the structure and the composition of the plant communities causing: (i) change in species composition (increase of ruderal and alien species), (ii) increase of community fragmentation, (iii) loss of vegetation zonation and (iv) local or regional extinction of some habitats (Stanisci *et al*., 2014, and references therein). Finally, some plant species with a small number of individuals within a single population (Bogdanović *et al*., 2014) or community may disappear before they are even recognised to exist and, from a purely scientific standpoint, it is intriguing to identify plant communities in sufficient detail to permit the provision of a precise reference in terms of the associations. In the Adriatic Basin, excluding its south-western part (e.g. De Marco *et al*., 1984), phytosociological characterization of the most of the islands and islets has not been done.

Although floristic investigations on the eastern Adriatic islands have a long tradition (e.g. Fortis, 1774; Host, 1802; de Visiani, 1842, 1847, 1852, 1872-1881), the vegetation of only a few islands has been investigated in detail (Horvatić, 1939, 1963a; Trinajstić, 1965, 1992, 1995; Pavletić, 1973, 1983; M. Hećimović, 1980; S. Hećimović, 1984; Pandža, 2003). Knowledge of the vegetation of different islands is inconsistent because of three basic reasons. First, the Croatian archipelago consists of a high number of islands and islets (1,231 islands, islets and reefs), many of which are located far from the mainland. Second, in general there is lack of funding for phytosociological studies, and third, a shortage of scientists is evident.

More recently, Jasprica & Ruščić (2013) and Jasprica *et al*. (2006, 2015a) have studied the plant communities of the south-eastern Adriatic islets. The vegetation of the small islets of the northern part of the Zadar archipelago, north Adriatic, was investigated by Pandža (2010) and Pandža & Krpina (2010).

However, in practice the current state of the diversity in plant communities on the eastern Adriatic islands remains to be determined. The aims of the present study were: i) to investigate the vegetation of the island of Olib for the first time, ii) to provide a contribution towards a better understanding of the phytocoenoses that have colonised the eastern Adriatic islands, and iii) to evaluate their levels of biodiversity in relation to phytogeographical position and geomorphological characteristics.

Study area

The island of Olib (surface area 26.13 km^2; perimeter 34.5 km; max. altitude 74 m a.s.l.) belongs to the North-Adriatic group of islands and the western part of the Zadar archipelago (Fig. 1). It is located 23.5 km from the mainland. The island is 9.5 km long, stretching in a N-S direction and only 1.4 km wide in the middle, increasing to 5.8 km. It is predominantly built up of Upper Cretaceous carbonates of an age ran-

Corresponding author: Nenad Jasprica. *Institute for Marine and Coastal Research, University of Dubrovnik, P.O. Box 83, HR-20000 Dubrovnik, Croatia; e-mail: nenad.jasprica@unidu.hr*

ge from Cenomanian to Senonian, and belongs to the Dinaric karst belt (Moro & Jelaska, 1994; Vlahović & Munda, 2012). Although there are some sand and gravel beaches on the island, the coast is predominantly low and rocky. Sea depths around the island are 1-30 m. Red Mediterranean Soil or Terra Rossa is mostly developed on this geological substrate (Magaš & Faričić, 2002). Precipitation drains almost exclusively through the underground, and surface water flows appear only after extremely heavy rains. Surface retention of rainwater is very rare and related to the locally pronounced limestone dolomitisation processes. Contrarily to the most Adriatic islands in Croatia, Olib has favourable hydrological conditions to accumulate significant quantities of groundwater in the karst aquifer, which fully complies with the sanitary quality of drinking water (Vlahović & Munda, 2012).

The average annual air temperature is 15.8°C and precipitation averages 937.6 mm yr-1 (data from the Croatian Meteorological and Hydrological Service for 1985-2014 from the nearest station at the town of Mali Lošinj on the island of M. Lošinj). The highest daily average temperature is 24.9°C in July, and the lowest falls below 7.9°C in February. The absolute minimum temperature (-4.4°C) was recorded on both 7th February 1991 and 26th December 1996, and the absolute maximum (37.4°C) on 3rd August 1998. The greatest rainfall is in October and November (average in each 122 mm), and in December (average 102.8 mm). In the period from June to August the total rainfall is 151.9 mm. Northern winds prevail throughout the year. The sum of the per mille frequencies of each of these directions is: for N - 64.7, NNE - 135.4 and NE - 74.0. The highest winds speed is in December (average 2.5 m s^{-1}). This area has 2651.3 hours of sunshine per year. On average the relative air humidity is 71% (Penzar *et al*., 2001). These data agree well with those reported for the neighbouring island of Silba for 1991-2000 (Bogdanović *et al*., 2013), while differing slightly from the city of Zadar for 1976-2006 (the average annual air temperature being 15.0°C and precipitation averages 860.4 mm yr^{-1}) (Pandža, 2010).

The only settlement and harbour, Olib (44°22'46.9" N, 14°46'39.9" E), has existed since Roman times (Magaš & Faričić, 2002). The human population is low, with only 140 inhabitants in 2011, increasing up to 2,000 in the summer season. Current human activity, including tourism, is limited and restricted to the port area and sandy beaches, while cutting of aging Holm Oak trees is evident over the entire island surface area. Sheep were reared in the period between the two World Wars, but for the last two decades there have been none on the island. This, accompanied by abandonment of agriculture and a strong depopulation (emigration), has caused the grasslands to become overgrown with woody vegetation (Magaš & Faričić, 2002).

Phytoclimatic indices were calculated according to Rivas-Martínez *et al*. (1999, 2004): annual positive temperature (Tp) is 1,891; continentality index (Ic) is 17.0, i.e. oceanic - euoceanic type; thermicity index (It) is 322; ombrothermic index (Io) is 4.95. On the basis of these indices, the area is included in the Mediterranean pluviseasonal-oceanic bioclimatic region, lower meso-Mediterranean phytoclimatic belt (Lmme), upper subhumid ombrotype (Ushu).

From a biogeographic viewpoint (Fig. 1), the study area is included in the Epiro-Dalmatian sector of the Adriatic province (Rivas-Martínez *et al*., 2004). Phytogeographically, the island belongs to the Mediterranean vegetation zone of the *Fraxino orni-Quercion ilicis* alliance. The island of Olib is part of the NATURA 2000 European Ecological Network (Anonymous 2013, 2015) of sites important for birds (site code HR1000034 North part of the Zadar Archipelago) as well as much important for species and habitats (HR2001280 Olib - land and HR3000052 Olib - under seawater). In the outer zones of the island there are extensively managed olive groves and abandoned fields, whereas within the village of Olib traditional gardening is practiced. Gardens and lands in the outer zones are bordered by traditional dry stone walls (Purger *et al*., 2012).

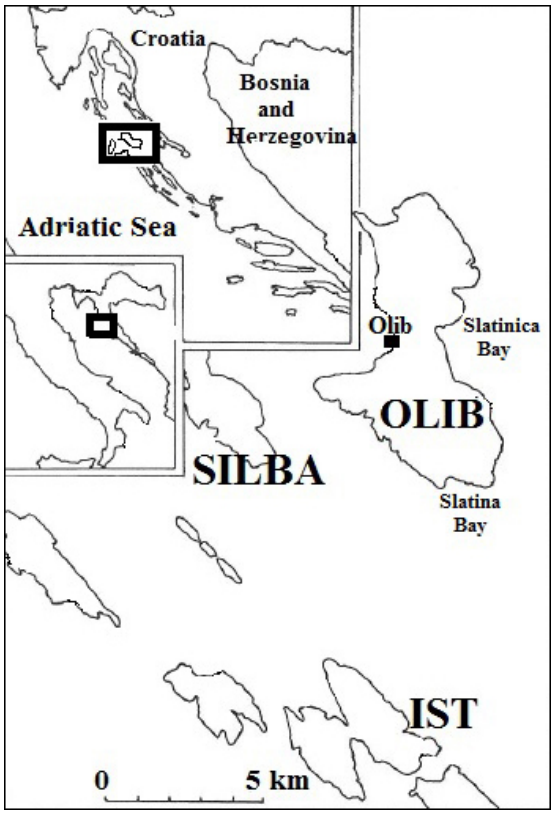

Fig. 1 - Geographical position of the island of Olib in the north-eastern Adriatic.

Materials and Methods

A total of 99 vegetation surveys were performed at 50 locations on the island, according to the Zürich-Montpellier phytosociological method (Braun-Blanquet, 1964). The survey covers the entire surface of the island and all habitat types.

Phytosociological analysis allowed the observation of some associations, an understanding of their ecological characteristics and defining of their syntaxonomic position. The plot size used to sample vegetation was established such as to represent full floristic composition, depending on plant density and homogeneity of vegetation cover. Geographical coordinates, elevation above sea level, aspect and slope were noted for each relevé. Place and date of relevés are listed in the Appendicies II and III.

Plant nomenclature follows Nikolić (2015), except for *Zannichellia pedunculata* Rchb. and *Juniperus phoenicea* L. ssp. *turbinata* (Guss.) Nyman, where the Euro+Med Plantbase were applied (Uotila, 2009; Raab-Straube, 2014). Syntaxonomy is based on the Third Edition of the International Code of Phytosociological Nomenclature (Weber *et al*., 2000; see also Dengler *et al*., 2008). The syntaxonomical system proposed by Biondi *et al*. (2014a) for Italy was mainly followed. Classification of the distinguished vegetation units into habitat types of Annex I of the Habitats Directive 92/43/EEC were done according to List of NATURA 2000 habitats declared by Croatian Government (Anonymous, 2014). Priority habitats are denoted by an asterisk (*).

In order to verify the traditional syntaxonomic system, the relevés were classified by numerical methods. Two classification procedures were perfomed on ecologically homogeneous aspects such as the brackish and halophilous vegetation, and forests and shrublands. The matrices consist of 85 species × 37 samples (relevés) and 129 species × 38 samples, respectively. Braun-Blanquet (1964) values were transformed according to van der Maarel (1979). An hierarchical agglomerative clustering was used based on Bray-Curtis similarity and group linkage as the method for grouping the formation. Monospecific and/or submerged associations are not included in the numerical analyis.

Results and Discussion

Through the analysis of the relevés 33 plant communities (30 associations and 3 stands) were identified and classified in 28 alliances, 27 orders and 23 classes. Below these communities are described and discussed in the same order of the syntaxonomical scheme.

Description of the associations

The hierarchical classification identified seven groups of brackish and halophilous vegetation (Fig. 2). Four submerged communities have been also identified and discussed.

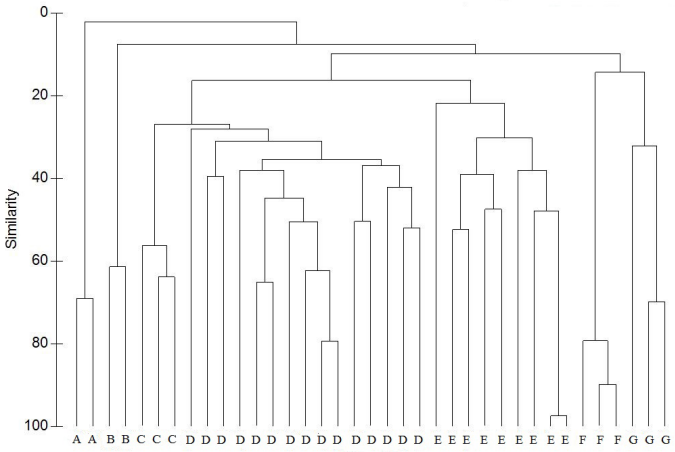

Fig. 2 - Dendrogram of the 37 relevés of brackish and halophilous vegetation (group link, similarity ratio, cover data). Monospecific submerged communities are not included. The capital letters indicate the cluster membership of each releve. A: *Scirpetum compacti*; B: *Spergularia salina* community; C: *Salsola soda-Cakile maritima community*; D: *Plantagini holostei-Limonietum cancellati*; E: *Euphorbio pineae-Glaucietum flavi*; F: *Puccinellio festuciformis-Sarcocornietum fruticosae*; G: *Juncetum maritimo-acuti*.

Freshwater vegetation

CHARETUM VULGARIS Corillion 1957

[NATURA 2000 habitat code 3140 – Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (*Charetea fragilis*)]

Occupies shallow standing water in the abandoned artificial rainwater reservoir with a silty deposit, from 0.2 to 1 m in depth. *Charetum vulgaris* is found elsewhere in Croatia (Blaženčić *et al*., 1998), but also in Europe in general (Biondi *et al*., 2002; Hrivnák *et al*., 2005; Felzines & Lambert, 2012, and references therein). However, recent knowledge on the coenology of macroscopic algae of *Charales*, as well as information on their ecology and distribution in the territory of Croatia is incomplete (cf. Trinajstić, 2008).

ZANNICHELLIETUM PEDICELLATAE Nordhagen 1954 em. Pott 1992

In our case, the association includes monodominant stands of *Zannichellia pedunculata* Rchb. [=*Zannichellia palustris* L. ssp. *pedicellata* (Wahlenb. & Rosén) Arcang., *sensu* Uotila, 2009]. *Zannichellia pedunculata* was also found in the neighbouring N-Croatian islands (Wallnöfer, 2008) and on the western Adriatic coast (Biondi *et al*., 2012). The association develops in small standing water bodies, e.g. shallow depressions with water depths of 10-50 cm, which are nourished by

rainfall (Fig. 3). These habitats are dry in summer. This association is common in warm areas in Central Europe (e.g. Šumberová, 2011) and also in Italy (Biondi *et al*., 2002; Pirone *et al*., 2003).

SCIRPETUM COMPACTI Van Langendonck 1931 corr. Bueno & F. Prieto in Bueno 1997
(=*Bolboschoenetum maritimi* Van Langendonck 1931)
(Tab. 1; Fig. 2, Cluster A)

Scirpetum compacti is a low marshy reed thicket with a dominance of *Scirpus maritimus*. It appears on the edge of a shallow (0.5 m) water depression in an intermediate belt between the *Zannichellietum pedicellatae* and *Rubo ulmifolii-Viticetum agni-casti* associations. These topographic contacts are indicated in the transect of Fig. 3. In general, the *Scirpion* communities occur in those areas where the water salinity shows significant values (Tomaselli *et al*., 2011). Taxonomy of *Scirpus* (*Bolboschoenus*) *maritimus* and the nomenclature of the association, accompanied by interpretation their different ecological conditions, has been drawn by Hroudová *et al*. (2007, 2009) and Fanelli *et al*. (2015).

Submerged marine cormophyte vegetation

CYMODOCEETUM NODOSAE Feldman 1937

This submerged grassland grows over a gently mobile sandy substrate with temporary emersion during low tide in the shallow (0.5 m) village bay. In the Adriatic Basin, the association was found in both clean (Obradović *et al*., 1989, Jasprica *et al*., 2015a) and altered or polluted environments (Pirone *et al*., 2014).

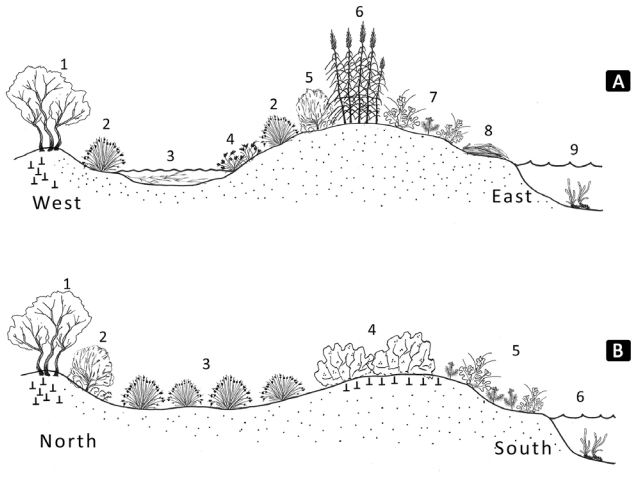

Fig. 3 - Transect of the vegetation in the Slatinica (A) and Slatina bays (B).
A: 1. *Myrto-Quercetum ilicis*, 2. *Juncetum maritmo-acuti*, 3. *Zannichellietum pedicellatae*, 4. *Scirpetum compacti*, 5. *Rubo ulmifolii-Viticetum agni-casti*, 6. *Arundo donax* comm., 7. *Euphorbio pineae-Glaucietum flavi*, 8. Organic (*Posidonia* leaves and rhizomes) and waste material deposited by the sea, 9. *Posidonietum oceanicae*. **B**: 1. *Myrto-Quercetum ilicis*, 2. *Rubo ulmifolii-Viticetum agni-casti*, 3. *Juncetum maritmo-acuti*, 4. *Myrto communis-Pistacietum lentisci*, 5. *Euphorbio pineae-Glaucietum flavi*, 6. *Posidonietum oceanicae*.

POSIDONIETUM OCEANICAE (Funk 1927) Molinier 1958
[NATURA 2000 habitat code 1120* - *Posidonia* beds (*Posidonion oceanicae*)]

Occurs on various stations around the island and develops on the moving seabed in depths between 1 and 15(-20) m (Fig. 3). This seagrass community (endemic to the Mediterranean) represents the breeding site for many species. Moreover, it is one of the main sources of oxygenation of the environment. Extensive descriptions of the structure and the functioning of *Posidonia* beds have been produced by Buia *et al*. (2000) and Den Hartog (2003). Boudouresque *et al*. (1994) reviewed the significance of Mediterranean seagrass beds, particularly those of *Posidonia*, from the viewpoint of their protection.

Brackish and halophilous vegetation

[NATURA 2000 habitat code 1210 – Annual vegetation of drift lines (*Euphorbion peplis*)]

EUPHORBIO PINEAE-GLAUCIETUM FLAVI Horvatić 1934 (Tab. 2; Fig. 2, Cluster E)

On the island of Olib this is represented by the therophytic halo-nitrophilous vegetation that has colonised the sandy pebbled beach, rich in organic matter, between the strip devoid of vegetation next to the shoreline and the nitrophilous tall-herb community with *Arundo* or the *Myrto communis-Pistacietum lentisci* macchia (Fig. 3). The association is very common along the whole eastern Adriatic in the midlittoral zone on sandy and gravel substrates (Horvatić, 1963a). The association shows some similarity with those (e.g. *Raphano maritimi-Glaucietum flavi* on gravel) found along the mid-western Adriatic (Biondi *et al*., 1992; Pirone *et al*., 2014).

Tab. 1 - *Scirpetum compacti* Van Langendonck 1931 corr. Bueno & F. Prieto in Bueno 1997.

Releve No.	1	2
No. of taxa	3	2
Plot size (m^2)	10	5
Altitude (m a.s.l.)	1	1
Water depth (cm)	20	25
Vascular plant cover (%)	100	100
Char. and diff. species of the ass.		
Scirpus maritimus L.	5	5
Other taxa		
Atriplex prostrata Boucher ex DC. in Lam. et DC.	+	.
Juncus acutus L.	+	.
Zannichellia pedunculata Rchb.	.	+

Tab. 2 - *Euphorbio pineae-Glaucietum flavi* Horvatić 1934.

Releve No.	1	2	3	4	5	6	7	8	9	
No. of taxa	16	10	8	10	10	7	9	8	8	
Plot size (m^2)	10	20	30	25	25	20	20	20	20	
Altitude (m a.s.l.)	1	1	1	1	0.5	1	1	1	1	
Aspect	N	W	.	.	N	.	.	.	.	Presences
Slope (°)	1	1	.	.	2	.	.	.	.	
Vascular plant cover (%)	50	20	40	30	20	10	20	70	60	
Char. and diff. species of the ass.										
Glaucium flavum Crantz	3	+	3	r	+	+	+	2	3	9
Euphorbia pinea L.	+	+	1	+	+	.	+	+	+	8
Charact. and diff. taxa of the upper units										
Cakile maritima Scop.	r	.	.	.	+	+	+	+	1	6
Salsola kali L.	.	+	+	.	+	.	.	.	.	3
Euphorbia peplis L.	.	+	.	.	.	.	.	.	.	1
Atriplex prostrata Boucher ex DC. in Lam. et DC.	.	+	.	.	.	.	.	.	.	1
Other taxa										
Limbarda crithmoides (L.) Dumort.	2	+	.	.	2	.	1	.	2	5
Euphorbia paralias L.	+	1	+	+	.	.	+	.	.	5
Sonchus tenerrimus L.	+	.	.	.	+	.	.	.	+	3
Calystegia sepium (L.) R. Br.	.	+	+	.	+	.	.	.	.	3
Valantia muralis L.	.	.	+	.	.	.	1	1	.	3
Beta vulgaris L. ssp. maritima (L.) Arcang.	.	.	+	.	+	.	.	.	+	3
Helichrysum italicum (Roth) G.Don	.	.	r	2	.	.	+	.	.	3
Crithmum maritimum L.	.	.	.	.	+	+	+	.	.	3
Vitex agnus-castus L.	+	.	.	.	.	.	.	+	.	2
Limonium narbonense Mill.	+	.	.	.	.	.	.	3	.	2
Limonium oleifolium Miller	+	.	.	.	.	+	.	.	.	2
Parapholis incurva (L.) C.E.Hubb.	+	.	.	.	.	.	.	1	.	2
Rumex crispus L.	+	.	.	.	.	.	.	.	+	2
Elymus pycnanthus (Godr.) Melderis	+	.	.	r	.	.	.	.	.	2
Juncus acutus L.	.	+	.	.	.	+	.	.	.	2
Dittrichia viscosa (L.) Greuter	.	.	.	1	.	+	.	.	.	2
Geranium purpureum Vill.	.	.	.	.	.	.	+	1	.	2
Sporadic species	4	1	0	4	1	1	0	0	1	

SALSOLA SODA AND *CAKILE MARITIMA* COMMUNITY (Tab. 3, Fig. 2, Cluster C)
[NATURA 2000 habitat code 1210]

On the coastal deposits of gravel, on flat and elevated surfaces, usually very narrow, between the *Juncetum maritimo-acuti* or the coastal chasmophytic vegetation and the coastline, halo-nitrophilous stands of *Cakile maritima* are found. This community is characterized by the dominance of *Cakile maritima* together with succulent shrubs, such as *Salsola soda* and *Crithmum maritimum*. It appears mostly on the eastern and western part of the island. The highly anthropogenic impact determined by developing of tourism and intensive usage, does not permit the provision of a precise syntaxonomical reference in terms of association. The community may be related with the *Salsoletum sodae* (cf. Kamenjarin & Pavletić, 2002; Biondi *et al*., 2004; Biondi & Casavecchia, 2010) or the *Salsolo kali-Cakiletum maritimae* associations (Merloni, 2007; Tomaselli *et al*., 2010), but both were not found in this study. Although these two associations have a different ecology, the compenetration of annuals with perennial species, makes it possible to assume that the community is a micro-mosaic of different associations. However, further comparable research is required for a more complete understanding of this community.

PLANTAGINI HOLOSTEI-LIMONIETUM CANCELLATI Horvatić (1934) 1939 (Tab. 4; Fig. 2, Cluster D)
[NATURA 2000 habitat code 1240 – Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp. (*Crithmo maritimi-Staticion*)]

The rocky shores are home to the *Plantagini holostei-Limonietum cancellati* plant association, characterised by *Limonium cancellatum*, a species endemic to the northern and middle part of the eastern Adriatic coast (Nikolić *et al*., 2015), which forms dense low-spreading formations that colonise cracks in the rocks. In our relevés, *Plantago holosteum* had only a low presence. According to Pandža (pers. comm.), frequencies of *Plantago holosetum* in the association on the Middle Adriatic islands (Kornati and the islets of the Zadar Archipelago) were between 28 and 89%. This variation can be explained by different degree of en-

Tab. 3 - *Salsola soda* and *Cakile maritima* community.

Releve No.	1	2	3
No. of taxa	8	9	10
Plot size (m^2)	10	15	20
Altitude (m a.s.l.)	1	1	1
Aspect	.	.	NW
Slope (°)	.	.	2
Vascular plant cover (%)	40	40	50
Charact. and diff. taxa of the ass.			
Cakile maritima Scop.	3	4	4
Charact. and diff. taxa of the upper units			
Salsola soda L.	+	1	1
Atriplex prostrata Boucher ex DC. in Lam. et DC.	+	+	+
Other species			
Crithmum maritimum L.	2	1	+
Cynodon dactylon (L.) Pers.	1	+	+
Drypis spinosa L. ssp. jacquiniana Murb.et Wettst.	+	.	.
Parietaria judaica L.	+	.	.
Reichardia picroides (L.) Roth	+	.	.
Chenopodium strictum Roth	.	+	.
Plantago coronopus L.	.	+	.
Chaenorhinum minus (L.) Lange ssp. litorale (Willd.) Hayek	.	+	.
Limbarda crithmoides (L.) Dumort.	.	+	.
Elymus pycnanthus (Godr.) Melderis	.	.	1
Dittrichia viscosa (L.) Greuter	.	.	+
Euphorbia paralias L.	.	.	r
Vitex agnus-castus L.	.	.	r
Asparagus acutifolius L.	.	.	r

vironmental factors (storms, wave-action) and human influences or interference, which even of a low intensity can considerably affect the structure of vegetation.

JUNCETUM MARITIMO-ACUTI Horvatić 1934 (Tab. 5; Fig. 2, Cluster G)

[NATURA 2000 habitat code 1410 – Mediterranean salt meadows (*Juncetalia maritimi*)]

This association occurs on mud and smaller brackish ponds not far from the sea that are periodically flooded by stagnant brackish water (Fig. 3). It is characterized by the dominance of *Juncus acutus*, among which grow others such as *Suaeda maritima*, *Juncus gerardi, Sarcocornia fruticosa*, *Limonium narbonense*, etc. The floristic composition matches to some extent the *Puccinellio festuciformis-Sarcocornietum fruticosae*, the only distinction being the presence of an upper layer dominated by *Juncus acutus*. This association is widespread in the Mediterranean basin and along the Southern Atlantic coasts (Molinier & Tallon, 1965), with a fairly constant composition. In the Adriatic Basin, it is reported with similar aspects both from western (Biondi, 1986; Poldini, 1989; Biondi *et al*., 2012) and eastern coasts (Horvatić, 1934, 1963a; Imeri *et al*., 2010; Jasprica *et al*., 2015b; Fanelli *et al*., 2015). Stands dominated by either *J. maritimus*, *J. acutus*, or both,

Tab. 4 - *Plantagini holostei-Limonietum cancellati* Horvatić (1934) 1939.

Releve No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
No. of taxa	7	15	5	11	11	14	7	4	17	13	17	12	10	7	8	
Plot size (m^2)	25	25	25	25	15	10	10	20	20	20	20	20	30	20	20	
Altitude (m a.s.l.)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Aspect	NE	W	NW	NW	S	E	W	N	N	N	NE	N	SW	.	.	
Slope (°)	2	2	2	2	2	2	2	2	5	5	2	2	5	.	.	
Vascular plant cover (%)	10	10	5	5	5	10	10	20	20	10	30	70	20	60	60	Presences
Charact. and diff. taxa of the ass.																
Limonium cancellatum (Bernh. ex Bertol.) Kuntze	+	+	+	+	1	2	1	+	+	1	+	3	+	4	1	15
Plantago holosteum Scop.	.	.	.	.	.	.	.	.	.	.	.	2	+	.	.	2
Charact. and diff. taxa of the upper units																
Crithmum maritimum L.	+	+	+	+	+	+	+	+	+	+	+	+	1	3	+	15
Silene vulgaris (Moench) Garcke ssp. angustifolia Hayek	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Lotus cytisoides L.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1
Other species																
Limbarda crithmoides (L.) Dumort.	2	.	+	+	+	+	.	2	2	.	2	+	+	.	+	11
Cynodon dactylon (L.) Pers.	+	+	+	.	+	+	+	.	1	1	.	.	+	1	.	10
Cakile maritima Scop.	+	+	+	.	+	+	.	.	+	+	+	.	.	.	.	8
Helichrysum italicum (Roth) G.Don	.	.	.	.	.	+	+	.	+	.	+	.	.	+	.	5
Dittrichia viscosa (L.) Greuter	.	.	.	.	.	.	+	+	+	.	+	+	.	.	.	5
Elymus pycnanthus (Godr.) Melderis	.	.	.	.	.	+	.	.	1	.	.	.	+	1	.	4
Juncus acutus L.	.	.	.	+	+	.	.	.	1	+	.	.	.	.	.	4
Sarcocornia fruticosa (L.) A.J. Scott	.	.	.	+	.	.	.	.	+	+	.	.	.	.	+	4
Euphorbia paralias L.	.	.	.	+	.	.	.	.	.	+	1	+	.	.	.	4
Salsola kali L.	1	+	.	.	.	.	.	.	.	.	+	.	.	.	.	3
Calystegia sepium (L.) R. Br.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	3
Elymus farctus (Viv.) Runemark ex Melderis	.	1	.	.	+	.	+	.	.	.	.	.	.	.	.	3
Arthrocnemum macrostachyum (Moric.) C. Koch	.	.	.	+	.	.	.	.	.	.	.	.	r		3	3
Lotus corniculatus L. ssp. hirsutus Rothm.	.	.	.	.	.	.	.	.	+	+	.	1	.	.	.	3
Atriplex prostrata Boucher ex DC. in Lam. et DC.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	3
Sporadic species	0	7	0	4	4	7	1	0	5	5	7	4	2	2	3	

are occasionally treated in the literature as representative segments of the *Juncetum maritimo-acuti* (e.g. Kaligarič & Škornik, 2006), whereas in some other cases they have been considered as either the *Juncetum maritimi* or as the *Juncetum acuti* (Molinier & Tallon, 1970; Karagianni *et al*., 2008). We agree with Sarika (2012) that all these stands should be considered as belonging to *Juncetum maritimo-acuti*.

SPERGULARIA SALINA COMMUNITY (Tab. 6; Fig. 2, Cluster B)

This nitrophilous annual community grows on sandy soils that are completely dry in summer. We assign this community to the class *Saginetea maritimae*. The community is subjected to intense trampling, and is often in mosaic with communities of the class *Cakiletea maritimae*. The community shows some similarities with the association *Spergulario salinae-Hordeetum marini* described from Sardinia (Biondi *et al*., 2001; Brullo & Giusso del Galdo, 2003; Farris *et al*., 2007, Pisanu *et al*., 2014) and France (de Foucault & Bioret, 2010), while *Hordeum marinum* is completely absent on the island. However, *Spergularia salina* is an annual nitro-halophilous species of coastal and continental marshes that is usually reported as a character and diagnostic species of the *Juncetea maritimi* (Costa *et al*., 2009), *Sarcocornietea fruticosae* or *Thero-Suaedetea splendentis* (Peinado *et al*., 1995). In addition, this species has also been included in *Crithmo maritimi-Staticetalia* (Janković & Stevanović, 1983) and *Cakiletea maritimae* (Kaligarič & Škornik, 2006).

PUCCINELLIO FESTUCIFORMIS-SARCOCORNIETUM FRUTICOSAE (Braun-Blanquet 1928) Géhu 1976 (Tab. 7; Fig. 2, Cluster F)

[NATURA 2000 habitat code 1420 – Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornietea fruticosae*]

This semi-shrub community is related to salty soils subject to not too prolonged submersion. It appears in the low levels of salty depressions on hyperhaline clay soils being wet in summer. This vegetation is characterized by a dominance of *Sarcocornia fruticosa* which forms dense populations and can be ascribed to the *Puccinellio festuciformis-Sarcocornietum fruticosae* association. Floristically this community is characterized by the co-occurrence of *Halimione portulacoides*. Our relevés are similar to the *Puccinellio festuciformis-Sarcocornietum fruticosae* reported from the eastern (Kaligarič & Škornik, 2007; Pandža *et al*., 2007, Jasprica *et al*., 2015b) and western (Biondi & Casavecchia, 2010; Sciandrello & Tomaselli, 2014) Adriatic coasts, and Sardinia (Biondi *et al*., 2004), although *Puccinellia festuciformis* is lacking. This may be attributed to anthropic pressures. According to Biondi (1999), the association is present along all of the Italian coastal territory in the hypersaline depressions at medium and higher levels.

Tab. 5 - *Juncetum maritimo-acuti* Horvatić 1934.

Releve No.	1	2	3
No. of taxa	9	11	7
Plot size (m^2)	12	25	20
Altitude (m a.s.l.)	0.5	1	1
Vascular plant cover (%)	100	90	90
Charact. and diff. taxa of the ass.			
Juncus acutus L.	5	4	3
Juncus maritimus Lam.	.	1	2
Other taxa			
Atriplex prostrata Boucher ex DC. in Lam. et DC.	+	+	+
Dittrichia viscosa (L.) Greuter	+	r	.
Suaeda maritima (L.) Dumort.	.	3	2
Juncus gerardi Loisel.	.	1	2
Sarcocornia fruticosa (L.) A.J. Scott	.	2	+
Limonium narbonense Mill.	.	+	1
Salsola soda L.	+	.	.
Aster squamatus (Spreng.) Hieron.	+	.	.
Cynodon dactylon (L.) Pers.	+	.	.
Avena sterilis L.	+	.	.
Elymus pycnanthus (Godr.) Melderis	+	.	.
Calystegia sepium (L.) R. Br.	+	.	.
Centaurium spicatum (L.) Fritsch	.	1	.
Halimione portulacoides (L.) Aellen	.	+	.
Limbarda crithmoides (L.) Dumort.	.	+	.

Tab. 6 - *Spergularia salina* community.

Releve No.	1	2
No. of taxa	9	6
Plot size (m^2)	10	10
Altitude (m a.s.l.)	0.5	0.5
Vascular plant cover (%)	60	40
Charact. and diff. taxa of the comm. and the upper units		
Spergularia salina J. & C. Presl	4	3
Polypogon monspeliensis (L.) Desf.	+	+
Plantago coronopus L. ssp. coronopus	1	.
Parapholis incurva (L.) C.E. Hubb.	+	.
Other taxa		
Salsola kali L.	+	+
Chenopodium album L.	+	+
Lolium perenne L	+	+
Bromus hordeaceus L. ssp. hordeaceus	1	.
Cakile maritima Scop.	+	.
Limbarda crithmoides (L.) Dumort.	.	+

SALICORNIETUM EMERICI O. Bolós ex Brullo & Furnari 1976

[NATURA 2000 habitat code 1310 – *Salicornia* and other annuals colonizing mud and sand (*Thero-Salicornietalia*)]

This association was found close to the sea water, on mud-flats where inundation is prolonged and remain slightly wet in summer. The vegetation of *Salicornia procumbens* ssp. *procumbens* (=*S. emerici* Duval-Jouve, *sensu* Kaligarič *et al*., 2008; Kadereit *et al*., 2012)

Tab. 7 - *Puccinellio festuciformis-Sarcocornietum fruticosae* (Braun-Blanquet 1928) Géhu 1976.

Releve No.	1	2	3
No. of taxa	6	7	6
Plot size (m^2)	20	20	20
Altitude (m a.s.l.)	0.5	0.5	0.5
Vascular plant cover (%)	90	70	30
Charact. and diff. taxa of the ass.			
Sarcocornia fruticosa (L.) A.J. Scott	4	3	2
Charact. and diff. taxa of the upper units			
Limbarda crithmoides (L.) Dumort.	+	+	+
Limonium narbonense Mill.	+	+	+
Arthrocnemum macrostachyum (Moric.) C. Koch	+	+	+
Halimione portulacoides (L.) Aellen	1	1	.
Suaeda maritima (L.) Dumort.	.	+	+
Other taxa			
Limonium oleifolium Miller	+	+	+

is represented by dense populations 20-30 cm tall. It is usually mono/paucispecific (e.g. Biondi *et al*., 2004). In our study, the floristic composition was as follows: Char. Ass.: *Salicornia procumbens* ssp. *procumbens* (5), Comp.: *Juncus acutus* (+), *Juncus bufonius* (+), *Salsola soda* (+), *Elymus pycnanthus* (+), *Aster squamatus* (+), *Dittrichia viscosa* (+). In the northern Adriatic, the association has already been reported from the Gulf of Trieste (Italy) and along the N-Croatian islands (Šajna *et al*., 2103). However, difficulties in the taxonomy of annual *Salicornia* and its consequences on the syntaxonomy of the annual halophilous vegetation have been discussed by Fanelli *et al*. (2015).

The wall vegetation

[NATURA 2000 habitat code 8210 – Calcareous rocky slopes with chasmophyic vegetation]

The wall vegetation is included in the chasmophytic synanthropic vegetation of the *Parietarietea judaicae* class. On the island, this vegetation was only found at a few sites within the village. In general, some characteristic taxa of the thermophilous vegetation mainly linked to *Parietarion judaicae* or upper syntaxa (*Umbilicus horizontalis*, *Cymbalaria muralis*, etc.) were not found on the island. This habitat is very rare on the island. Additionally, traditional dry stone walls also contain *Asplenium hybridum* (Milde) Bange, stenoendemic and near-threatened species restricted to the NE-Adriatic islands (Nikolić *et al*., 2015).

OXALIDO-PARIETARIETUM JUDAICAE (Braun-Blanquet 1952) Segal 1969 (Tab. 8, Rel. 1)

This is sciaphilous and nitrophilous association mainly spreaded on N-facing or shady walls (Brullo & Guarino, 1998). In its typical aspect it forms a belt in the lower part of the wall.

RESEDO ALBAE-ANTIRRHINETUM MAJORIS Trinajstić 2008 (Tab. 8, Rel. 2)

The association is linked to cement or mortar-jointed walls, growing in only slightly humified narrow crevices. It grows mainly on the top of S-exposed walls.

Synanthropic, ruderal herbaceous vegetation and tall-herb communities

ARUNDINETUM MICRANTHAE Jasprica, Bogdanović & Dolina 2014

The nitrophilous community, recently described for south Croatia (Jasprica *et al*., 2014a), has developed as a low (2-4 m) and dense shrub formation mostly on soils that remain humid for most of the year. This community is rare on the island but has been found within the village. It has a high vegetation cover and relatively small number of species with even poorer, almost monospecific aspects. In the case of Olib, the floristic composition was as follows: Char. Ass.: *Arundo micrantha* (5), Charact. and diff. taxa of the upper units *Foeniculum vulgare* (+), *Daucus carota* ssp. *major* (+), *Silene latifolia* (+), *Dactylis glomerata* ssp. *hispanica* (+), Comp.: *Carex divulsa* (3), *Rubus ulmifolius* (2), *Hedera helix* (1), *Ulmus minor* (+), *Celtis australis* (+), *Asparagus acutifolius* (+), *Galium mollugo* (+), *Allium ampeloprasum* (+).

Tab. 8 - *Parietarion judaicae* Segal 1969: *Oxalido-Parietarietum judaicae* (Braun-Blanquet 1952) Segal 1969 (rel. 1), *Resedo albae-Antirrhinetum majoris* Trinajstić 2008 (rel. 2).

Releve No.	1	2
No. of taxa	12	8
Plot size (m^2)	5	10
Altitude (m a.s.l.)	2	3
Aspect	N	S
Slope (°)	90	90
Vascular plant cover (%)	20	40
Charact. and diff. taxa of the ass.		
Oxalis corniculata L.	+	.
Antirrhinum majus L.	.	2
Reseda alba L.	.	+
Charact. and diff. taxa of the upper units		
Parietaria judaica L.	3	1
Asplenium ceterach L.	+	.
Other taxa		
Convolvulus arvensis L.	+	+
Picris hieracioides L.	+	+
Foeniculum vulgare Mill.	+	.
Euphorbia peplus L.	+	.
Fumaria officinalis L.	+	.
Mercurialis annua L.	+	.
Geranium purpureum Vill.	+	
Conyza canadensis (L.) Cronquist	+	.
Cynodon dactylon (L.) Pers.	+	.
Hedera helix L.	.	+
Bromus madritensis L.	.	+
Veronica arvensis L.	.	+

URTICO DIOICAE-SAMBUCETUM EBULI Braun-Blanquet in Braun-Blanquet, Roussine et Nègre (Tab. 9)

This large herbaceous community grows on fresh and nitrified soils within the village. It represents a dense and closed, floristically poor, formation characterized by high cover of *Sambucus ebulus*. The community is common in the Mediterranean and sub-Mediterranean, and it has been detected in surrounding areas where it is common (Jasprica & Carić, 2002; Biondi *et al*., 2003).

TRIBULO TERRESTRI-AMARANTHETUM GRAECIZANS Hodak 1962 ex Pandža, Franjić & Škvorc 2005

It occurs especially at trampled sites with nitrogen-poor soils in the village yards. The floristic composition is: Char. Ass.: *Tribulus terrestris* (2), *Amaranthus graecizans* (3), Charact. and diff. taxa of the upper units *Diplotaxis muralis* (1), *Chondrilla juncea* (1), *Heliotropium europaeum* (+), *Amaranthus cruentus* (+), Comp.: *Convolvulus arvensis* (+), *Setaria verticillata* (+), Comp.: *Beta vulgaris* ssp. *vulgaris* (+). With reference to Olib, the vegetative optimum is in late summer. *Tribulo-Amaranthetum* is a relatively frequent community along the coasts of Croatia (Pandža *et al*., 2005, and references therein; Jasprica & Kovačić, 2011) and of Bosnia and Herzegovina (Redžić, 2011).

PORTULACETUM OLERACEAE Felföldy 1942

This community occurs in village flower beds and along local pathways. It is floristically poor and composed of species which demand high soil nitrogen content. Soils are very dry, usually with a sand or gravel admixture. It is dominated by *Portulaca oleracea*, while the total coverage of other taxa is low. The floristic composition was as follows: *Portulaca oleracea* (4), *Polygonum aviculare* (+), *Eragrostis cilianensis* (+), *Digitaria sanguinalis* (+), *Chenopodium album* (+), *Amaranthus retroflexus* (+), *Sonchus asper* (+), *Diplotaxis tenuifolia* (+), *Setaria viridis* (r), *Parietaria judaica* (r), *Senecio vulgaris* (r). It is considered as thermophilous ruderal and segetal community, but no data exists on its presence and composition in Croatia (cf. Hulina, 2002). However, structure, ecology and dynamics of the association has been extensively described elswhere (e.g. Kropáč, 2006; Šilc, 2009; etc.). Phenological optimum of this vegetation type is in warm summer period (Lososová, 2009).

Tab. 9 - *Urtico dioicae-Sambucetum ebuli* Braun-Blanquet in Braun-Blanquet, Roussine et Nègre.

Releve No.	1	2
No. of taxa	6	5
Plot size (m^2)	15	12
Altitude (m a.s.l.)	17	2
Vascular plant cover (%)	100	100
Charact. and diff. taxa of the ass.		
Sambucus ebulus L.	5	4
Charact. and diff. taxa of the upper units		
Urtica dioica L.	+	+
Galium aparine L.	r	.
Geranium robertianum L.	.	+
Ballota nigra L. ssp. foetida Hayek	.	r
Other taxa		
Rubus ulmifolius Schott	r	1
Verbena officinalis L.	+	.
Clematis vitalba L.	r	.

HORDEETUM LEPORINI Braun-Blanquet 1936

This nitrophilous vegetation, with ecological optimum in the territories of a Mediterranean climate of a dry type (Brullo, 1982, 1983), occurs in sunny sites at the edge of paths or on abandoned land where the soil formation is embryonic and human disturbance is a significant factor. It is characterized by species of predominantly annual spring development. The floristic composition on the island was as follows: Char. Ass. *Hordeum murinum* ssp. *leporinum* (4), *Malva sylvestris* (1), Charact. and diff. taxa of the upper units *Bromus sterilis* (2), *Rumex pulcher* (1), *Chenopodium album* (1), *Lolium perenne* (1), *Rumex crispus* (+), *Plantago coronopus* (+), *Ecbalium elaterium* (+), *Conyza canadensis* (+), *Polycarpon tetraphyllum* (+), *Lavatera arborea* (+), *Ballota nigra* ssp. *foetida* (+), *Avena sterilis* (+), *Fumaria officinalis* (+), *Euphorbia peplus* (+), *Plantago coronopus* ssp. *coronopus* (+), Comp.: *Parietaria officinalis* (1), *Elymus repens* (+), *Parapholis incurva* (+), *Allium commutatum* (+), *Medicago orbicularis* (+), *Atriplex patula* (+), *Veronica arvensis* (+). The floristic and ecological characters of *Hordeum murinum* ssp. *leporinum* populations justify their classification within the *Hordeion leporini* alliance. The association has already been described for ruderal areas of the eastern (Pandža *et al*., 2005; Pandža, 2010; Trinajstić, 2002) and western Adriatic (De Marco *et al*., 1984), and also reported for the W. Mediterranean (Ceschin *et al*., 2003, and references therein).

ARUNDINI DONACIS-CONVOLVULETUM SEPIUM Tüxen & Oberdorfer ex O. Bolòs 1962 [NATURA 2000 habitat code 6430 – Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (*Convolvulion sepii*)]

This community has developed as 6 m high and dense shrub formations mostly on wet and nitrogen-rich soils with vegetation cover. The habitat is exposed to disturbances. This mostly riparian association usually occupies level surfaces along permanent watercourses,

optimal for thermo-Mediterranean and lower meso-Mediterranean zones, is characterized by a smaller number of species and a significant presence of ruderals (Jasprica *et al*., 2014a). In the case of Olib, the floristic composition was as follows: Char. Ass. *Arundo donax* (4), *Calystegia sepium* (2), Comp.: *Foeniculum vulgare* (2), *Rubus ulmifolius* (2), *Mentha spicata* (1), *Galium corrudifolium* (1), *Parietaria officinalis* (1), *Urtica dioica* (+), *Piptatherum miliaceum* (+), *Chondrilla juncea* (+), *Picris hieracioides* (+), V*erbena officinalis* (+), *Cirsium vulgare* (+), *Ballota nigra* ssp. *foetida* (+), *Vitex agnus-castus* (+), *Potentilla reptans* (+), *Brachypodium pinnatum* (+), *Scolymus hispanicus* (+), *Elymus repens* (+), *Ficus carica* (+), *Daucus carota* ssp. *major* (+). The association is closely related to the *Calystegio silvaticae-Arundinetum donacis* association from Siciliy (Brullo & Sciandrello, 2006; Fici & Gianguzzi, 2011) and the *Clematido vitalbae-Arundinetum donacis* association from the Central Italian Adriatic coast (Biondi & Allegrezza, 2004).

DAUCO MAJORI-FOENICULETUM VULGARIS Trinajstić 2008 (Tab. 10, rels. 1-2)

This community grows on deep soils in abandoned vineyards. The vegetation is dominated by *Foeniculum vulgaris* and *Daucus carota* ssp. *major*. Some ruderals show high cover values (e.g. *Aster squamatus*, *Conyza canadensis* and *Elymus repens*). With reference to Olib, the vegetative optimum is in August and September. According to Trinajstić (2008), *Dauco-Foeniculetum* would exhibit a circum-Dalmatian distribution, while this finding is the most northerly.

HELICHRYSO ITALICI-INULETUM VISCOSAE Trinajstić 1965 (Tab. 10, Rel. 3)

The association occurs on abadoned weedy vegetation on skeletal and more or less de-calcified brown soils. The vegetation is dominated by low or semi-shrubs with their optimum development during late summer. Some *Quercetea ilicis* species can be found and this may indicates a succession of vegetation tending towards the development of holm oak forest communities (Trinajstić, 2008). The community has been described along the eastern Adriatic (Trinajstić, 1987, 2008; Pandža, 2003), but a comprehensive analysis is still lacking.

Tab. 10 - *Inulion viscosae* Trinajstić (1965) 1978: *Dauco majori-Foeniculetum vulgaris* Trinajstić 2008 (rels. 1-2), *Helichryso italici-Inuletum viscosae* Trinajstić 1965 (rel. 3).

Releve No.	1	2	3
No. of taxa	17	13	28
Plot size (m^2)	20	20	100
Altitude (m a.s.l.)	10	15	5
Vascular plant cover (%)	100	100	90
Charact. and diff. taxa of the ass.			
Daucus carota L. ssp. major (Vis.) Arcang.	1	1	+
Foeniculum vulgare Mill.	3	2	.
Dittrichia viscosa (L.) Greuter	.	.	4
Helichrysum italicum (Roth) G.Don	.	.	1
Charact. and diff. taxa of the upper units			
Avena sterilis L.	+	.	.
Daucus carota L. ssp. carota	.	.	1
Other taxa			
Prunus spinosa L.	+	+	+
Conyza canadensis (L.) Cronquist	+	1	.
Dactylis glomerata L. ssp. hispanica (Roth) Nyman	+	+	.
Rubus ulmifolius Schott	2	.	+
Brachypodium pinnatum (L.) P.Beauv.	2	.	1
Clematis flammula L.	+	.	+
Quercus ilex L.	+	.	1
Plantago coronopus L.	.	+	+
Elymus repens (L.) Gould	.	1	1
Picris hieracioides L.	.	+	+
Vitis vinifera L.	1	.	.
Tragopogon porrifolius L.	+	.	.
Asparagus acutifolius L.	+	.	.
Anacamptis pyramidalis (L.) Rich.	+	.	.
Plantago lanceolata L.	+	.	.
Hypericum perforatum L.	+	.	.
Nigella damascena L.	+	.	.
Aster squamatus (Spreng.) Hieron.	.	4	.
Chondrilla juncea L.	.	+	.
Rumex pulcher L.	.	+	.
Cirsium vulgare (Savi) Ten.	.	+	.
Cynodon dactylon (L.) Pers.	.	+	.
Cladonia spp.	.	.	1
Cichorium intybus L.	.	.	+
Bromus erectus Huds.	.	.	+
Melilotus officinalis (L.) Lam.	.	.	+
Pistacia lentiscus L.	.	.	+
Juniperus phoenicea L. ssp. turbinata (Guss.) Nyman	.	.	+
Dorycnium herbaceum Vill.	.	.	+
Dorycnium hirsutum (L.) Ser.	.	.	+
Rosa sempervirens L.	.	.	+
Juniperus oxycedrus L. ssp. oxycedrus	.	.	+
Smilax aspera L.	.	.	+
Rubia peregrina L.	.	.	+
Sanguisorba minor Scop. ssp. muricata Briq.	.	.	+
Lotus corniculatus L. ssp. hirsutus Rothm.	.	.	+
Agrostis capillaris L.	.	.	+
Peucedanum sp.	.	.	r

Grassland vegetation

PIPTATHERETUM MILIACEAE Horvatić (1956) 1958 (=*Oryzopsetum miliaceae*)

[NATURA 2000 habitat code 6220* – Pseudosteppe with grasses and annuals *Thero-Brachypodietea*]

The association is rare and mostly localized on sites within the village. It is developed on deep and wet soil, usually where densely shaded by a canopy of Aleppo pine or some other cultivated trees (e.g. *Celtis australis*, *Cupressus sempervirens*). In our relevé the floristic composition was as follows: Char. Ass. *Piptatherum miliaceum* (4), *Calamintha nepetoides* (+), *Verbascum sinuatum* (+), Charact. and diff. taxa of the upper units *Brachypodium pinnatum* (2), *Allium sphaerocephalon* (+), *Carlina corymbosa* (+), *Lagurus ovatus* (+), *Stipa bromoides* (+), Comp.: *Potentilla reptans* (1), *Rubus ulmifolius* (1), *Galium corrudifolium* (+), *Foeniculum*

vulgare (+), *Elymus repens* (2), *Asparagus acutifolius* (+), *Allium subhirsutum* (+), *Picris hieracioides* (+), *Convolvulus arvensis* (+), *Vitex agnus-castus* (+), *Rubia peregrina* (+), *Ficus carica* (+), *Daucus carota* ssp. *carota* (+), *Pinus halepensis* juv. (+). The community has been described in Dalmatia (Horvatić, 1958) and, at least partly, shows some similarities with the *Sixalix atropurpurea-Piptatherum miliaceum* community reported for Rome and its countryside, but is distinguished by the lack of the characteristic species of the association and the presence of a significant number species of the *Tortulo-Cymbalarietalia* order (Fanelli, 2002; Lucchese & Pignatti, 2009).

NARCISSO TAZETTAE-ASPHODELETUM MICROCARPI Šegulja 1969 (Tab. 11)

[NATURA 2000 habitat code 62A0 – Eastern sub-Mediterranean dry grasslands (*Scorzoneretalia villosae*)]

This community is characterized by the dominance of *Asphodelus aestivus* that is accompanied by relatively few species of dry grasslands, in particular *Chrysopogon gryllus*, *Helichrysum italicum*, *Koeleria splendens* and *Brachypodium pinnatum*, often with low cover or frequency. *Dactylis glomerata* ssp. *hispanica* is sometimes rather abundant, whereas therophytes are relatively poorly represented. The community occurs on sunny flat surfaces, where stones and rocks have an average cover of about 50-60%. This dry grassland association is considered as the most thermophilous along the eastern Adriatic coast (cf. Šegulja, 1969, 1970; Hećimović, 1984; Jasprica & Ruščić, 2013).

Tab. 11 - *Narcisso tazettae-Asphodeletum microcarpi* Šegulja 1969.

Releve No.	1	2	3
No. of taxa	13	10	11
Plot size (m^2)	20	20	25
Altitude (m a.s.l.)	22	70	20
Vascular plant cover (%)	50	50	40
Charact. and diff. taxa of the ass.			
Narcissus tazetta L.	+	+	+
Asphodelus aestivus Brot.	2	2	2
Charact. and diff. taxa of the upper units			
Chrysopogon gryllus (L.) Trin.	+	.	1
Helichrysum italicum (Roth) G.Don	+	.	+
Koeleria splendens C.Presl	.	+	+
Brachypodium pinnatum (L.) P.Beauv.	.	+	+
Bromus erectus Huds. ssp. erectus	+	.	.
Lotus corniculatus L. ssp. hirsutus Rothm.	+	.	.
Hypericum perforatum L.	+	.	.
Anacamptis pyramidalis (L.) Rich.	+	.	.
Gladiolus illyricus W.D.J.Koch	.	+	.
Teucrium polium L. ssp. capitatum (L.) Arcang.	.	.	+
Dichanthium ischaemum (L.) Roberty	.	.	+
Other taxa			
Dactylis glomerata L. ssp. hispanica (Roth) Nyman	1	+	+
Brachypodium retusum (Pers.) P.Beauv.	+	+	.
Reichardia picroides (L.) Roth	+	+	.
Trifolium campestre Schreber	+	+	.
Trifolium angustifolium L.	.	+	+
Tragopogon porrifolius L.	+	.	.
Trifolium stellatum L.	.	.	+

LOLIO PERENNIS-PLANTAGINETUM MAJORIS Beger 1930 (Tab. 12)

This community grows mainly in moist sites and nutrient-rich soils within the village. It is characterised by frequent mowing and slight or moderate trampling. The association is dominated by *Lolium perenne* and *Plantago major*, both of which are adapted to survival in habitats that are exposed to moderate or high trampling and to soil compaction. In the case of Olib, it reaches its maximum development in late spring, followed by drying up in summer. From the syntaxonomic point of view, the attribution of the association to higher levels has been the subject of several interpretations (for review see Lancioni & Taffetani, 2012). In our study, the association is currently included in the *Molinio-Arrhenatheretea* class (Rivas-Martínez,

Tab. 12 - *Lolio perennis-Plantaginetum majoris* Beger 1930.

Releve No.	1	2	3
No. of taxa	21	18	25
Plot size (m^2)	15	10	7
Altitude (m a.s.l.)	24	6	5
Vascular plant cover (%)	100	100	100
Charact. and diff. taxa of the ass.			
Lolium perenne L.	4	3	4
Plantago major L.	1	2	1
Charact. and diff. taxa of the upper units			
Trifolium repens L. ssp. repens	1	1	1
Convolvulus arvensis L.	+	+	+
Medicago arabica (L.) Huds.	+	+	+
Polygonum aviculare L.	+	+	+
Potentilla reptans L.	+	+	+
Cynodon dactylon (L.) Pers.	+	+	.
Dactylis glomerata L. ssp. glomerata	+	.	+
Plantago lanceolata L.	+	.	+
Setaria viridis (L.) P.Beauv.	+	.	+
Rumex crispus L.	+	.	.
Verbena officinalis L.	.	.	+
Other taxa			
Malva sylvestris L.	+	+	+
Cichorium intybus L.	+	+	+
Medicago sativa L.	+	+	+
Picris hieracioides L.	+	+	.
Medicago lupulina L.	.	+	+
Dittrichia viscosa (L.) Greuter	.	+	+
Aster squamatus (Spreng.) Hieron.	.	+	+
Hordeum murinum L. ssp. leporinum (Link) Arcang.	.	+	+
Cirsium vulgare (Savi) Ten.	.	+	+
Salvia verbenaca L.	.	+	+
Sonchus asper (L.) Hill ssp. glaucescens (Jord.) Ball	+	.	+
Bromus hordeaceus L. ssp. hordeaceus	+	.	.
Avena sterilis L.	+	.	.
Conyza canadensis (L.) Cronquist	+	.	.
Anagallis arvensis L.	+	.	.
Silene latifolia Poir.	.	.	+
Elymus repens (L.) Gould	.	.	+
Agrimonia eupatoria L.	.	.	+
Daucus carota L. ssp. carota	.	.	+

1975; Andreucci, 2006), due to the predominance of perennial hemicryptophyte species that belong to this syntaxon. In addition, species from the *Stellarietea mediae* class are also well represented and emphasise the ruderal character of the association.

Forest and shrub vegetation

The hierarchical classification identified six groups (Fig. 4). They include xerothermophilous forests and shrubs described hereafter.

MYRTO COMMUNIS-QUERCETUM ILICIS (Horvatić 1963) Trinajstić (1976) 1985 (Tab. 13; Fig. 4, Cluster C)

[NATURA 2000 habitat code 9340 – *Quercus ilex* and *Quercus rotundifolia* forests]

The association covers more than 80% of the island's surface area. In this study, the association is developed as macchia of 3 to 12 meters height. The ground layer has variable vegetation cover (10-90%) and, in general, consists of a low number of species, of which the most common was *Brachypodium pinnatum*. Among characteristic species of the *Quercetea ilicis* and lower syntaxa, alongside *Myrtus communis* and *Quercus ilex*, five other species displayed the greatest presence (>57%): *Pistacia lentiscus*, *Rubia peregrina*, *Asparagus acutifolius*, *Smilax aspera* and *Clematis flammula*. *Quercus ilex* has high economic value to local communities due to intensive timber operations. In general, this association is common in the warmer and drier areas along the eastern Adriatic coast and islands (Horvatić, 1963b; Pandža *et al*., 2004, and references therein).

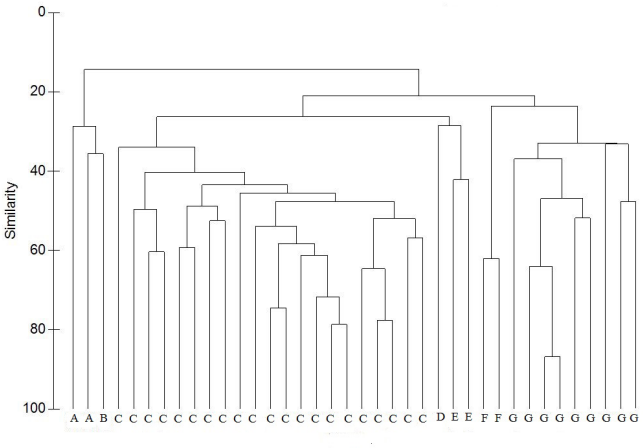

Fig. 4 - Dendrogram of the 38 relevés of forest and shrub vegetation (group link, similarity ratio, cover data).
The capital letters indicate the cluster membership of each releve. A: *Rubo ulmifolii-Viticetum agni-casti*; B: *Paliuro australis-Viticetum agni-casti*; C: *Myrto communis-Quercetum ilicis*; D: *Pistacio lentisci-Pinetum halepensis*; E: *Pistacio lentisci-Juniperetum turbinatae*; F: *Myrto communis-Pistacietum lentisci*; G: *Erico manipuliflorae-Cistetum cretici*.

MYRTO COMMUNIS-PISTACIETUM LENTISCI (Molinier 1954) Rivas-Martínez 1975 (Tab. 14, rels. 1-2; Fig. 4, Cluster F)

The association forms small patches between halophytic vegetation (*Euphorbio pineae-Glaucietum flavi*) and the *Juncetum maritimo-acuti* association (Fig. 3). It is developed as low (mostly between 1 and 1.5 m) and dense shrub formation on the southern part of the island. Due to the influences of the strong southern winds, it is composed of a small number of species. The association has been described for some islets in south Croatia (Jasprica *et al*., 2014b, 2015a), and it is probably more widespread than the scanty reports in literature may suggest.

PISTACIO LENTISCI-JUNIPERETUM TURBINATAE Trinajstić 1987 ex Asensi, Díez-Garretas & Quézel 2007 (Tab. 14, rels. 3-4; Fig. 4, Cluster E)

[NATURA 2000 habitat code 5210 – Arborescent matorral with *Juniperus* spp.]

This rare community on the island is developed as xerothermic macchia. The vegetation is dominated by *Juniperus phoenicea* L. ssp. *turbinata* (Guss.) Nyman (=*J. turbinata* Guss.) that forms stands 1-2 m tall. The herb layer is occupied mainly by *Brachypodium retusum*. According to Trinajstić (1995), it commonly indicates a succession of vegetation tending towards the development of the *Querco ilicis-Pinetum halepensis* forests, frequently after wildfires. Phoenician juniper macchia covers large surface areas throughout the entire southern coastal region of Croatia (Kovačić *et al*., 2001; Pandža *et al*., 2004).

PISTACIO LENTISCI-PINETUM HALEPENSIS De Marco, Veri & Caneva 1984 (Tab. 14, Rel. 5; Fig. 4, Cluster D)

[NATURA 2000 habitat code 9540 – Mediterranean pine forests with endemic Mesogean pines]

The Aleppo pine forest refers to the *Pistacio lentisci-Pinetum halepensis* association. This forest develops locally in small fragments near the village and it is strongly affected by human disturbance. The vegetation is dominated by *Pinus halepensis* and *Pistacia lentiscus*. The herb layer is occupied mainly by *Brachypodium retusum* and some ruderals. The association is widespread along the Adriatic coasts (De Marco *et al*., 1984; Trinajstić & Kamenjarin, 1998, 2001; Kamenjarin & Pavletić, 2003; Russo & Strizzi, 2013) and it is floristically partly related to communities present in Greece (Konstantinidis *et al*., 2012).

RUBO ULMIFOLII-VITICETUM AGNI-CASTI Paradis 2006 (Tab. 15, rels. 1-2; Fig. 4, Cluster A)

[NATURA 2000 habitat code 92D0 – Southern riparian galleries and tickets (*Nerio-Tamaricietea* and *Securinegion tinctoriae*]

Tab. 13 - *Myrto communis-Quercetum ilicis* (Horvatić 1963) Trinajstić (1976) 1985.

Releve No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
No. of taxa	25	16	14	24	26	16	17	20	18	16	8	11	22	10	22	9	16	14	9	11	18	
Plot size (m^2)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Altitude (m a.s.l.)	16	18	22	27	5	35	1	1	22	3	2.3	1	70	2	2	3	11	23	27	53	51	
Aspect	S	S	.	.	W	.	.	.	.	SW	SW	.	.	N	.	NE	.	.	.	.	.	
Slope (°)	5	5	.	.	5	.	.	.	.	5	10	.	.	2	.	5	.	.	.	.	.	
Vegetation height (m)	5	7	12	7	4	6.5	4.5	5	3	3	4	4	7	3	7	5	4	5	6	8	8	
Vascular plant cover (%)	100	100	100	90	80	100	100	90	80	95	100	100	100	90	90	90	100	100	100	100	100	Presences
Charact. and diff. taxa of the ass.																						
Myrtus communis L.	1	2	2	1	1	+	+	2	+	+	1	+	+	1	+	+	+	+	+	+	+	21
Charact. and diff. taxa of the upper units																						
Quercus ilex L.	4	4	4	4	3	5	4	4	3	2	4	3	4	3	4	5	4	5	5	5	5	21
Pistacia lentiscus L.	+	+	+	1	3	+	+	1	2	.	1	2	1	.	3	3	3	+	1	+	1	19
Rubia peregrina L.	+	+	+	1	+	1	3	+	+	+	.	+	+	.	+	+	+	.	+	+	+	18
Asparagus acutifolius L.	+	+	+	+	1	+	+	.	+	+	+	+	+	1	1	+	.	+	.	.	+	17
Smilax aspera L.	1	+	2	1	+	1	+	+	.	1	.	.	.	.	+	1	.	+	+	1	1	15
Clematis flammula L.	+	+	+	+	+	1	+	.	+	.	.	.	+	.	+	.	.	.	.	+	+	12
Juniperus oxycedrus L. ssp. oxycedrus	1	.	.	+	+	.	+	.	.	.	.	.	1	2	1	.	+	+	.	.	+	10
Arbutus unedo L.	+	1	.	.	2	.	.	+	.	.	.	.	.	.		1	+	+	+	+	.	9
Tamus communis L.	+	+	+	+	.	1	+	.	+	+	.	.	2	.	.	.	.	.	.	.	.	9
Phillyrea latifolia L.	.	.	+	+	1	+	+	.	.	3	2	.	.	.	.	.	+	+	.	.	.	9
Cyclamen repandum Sibth. et Sm.	+	+	+	+	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	7
Juniperus phoenicea L. ssp. turbinata (Guss.) Nyman	.	.	.	.	.	.	.	1	.	1	+	1	+	.	1	.	+	.	.	.	.	7
Lonicera implexa Aiton	+	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Phillyrea media L.	.	.	.	+	.	.	.	+	.	1	+	+	.	.	.	.	.	.	.	.	.	5
Rosa sempervirens L.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.		.	.	.	1	4
Viburnum tinus L.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Olea europaea L. var. sylvestris Brot.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1
Ruscus aculeatus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1
Other taxa																						
Rubus ulmifolius Schott	+	+	+	+	+	+	+	1	.	.	.	.	.	+	+	+	.	.	+	+	+	14
Brachypodium pinnatum (L.) P.Beauv.	+	+	.	+	.	.	2	.	2	+	.	.	3	.	2	3	+	.	.	.	.	10
Hedera helix L.	.	.	1	1	+	1	2	1	.	.	.	.	.	.	1	.	+	+	.	.	1	10
Cistus creticus L. ssp. eriocephalus (Viv.) Greuter et Burdet.	+	.	.	+	+	.	+	.	1	+	.	.	.	.	+	.	.	+	+	.	.	9
Blackstonia perfoliata (L.) Huds.	+	.	.	+	+	.	.	.	+	.	.	+	.	+	+	.	.	+	.	.	.	8
Allium subhirsutum L.	+	.	.	+	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	6
Dorycnium hirsutum (L.) Ser.	.	.	.	.	+	.	.	+	1	.	.	.	+	.	+	.	+	.	.	.	.	6
Brachypodium sylvaticum (Huds.) P.Beauv.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	1	6
Centaurium pulchellum (Sw.) Druce	.	.	.	.	+	.	.	.	+	+	.	+	.	.	+	.	.	.	.	.	.	5
Asplenium ceterach L.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Brachypodium retusum (Pers.) P.Beauv.	+	.		+	3	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	4
Geranium purpureum Vill.	+	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	4
Helichrysum italicum (Roth) G.Don	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	4
Dactylis glomerata L. ssp. hispanica (Roth) Nyman	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	+	.	.	.	.	4
Sporadic species	6	1	0	2	4	0	0	7	5	1	1	1	9	3	5	0	2	0	0	2	5	

Tab. 14 - *Myrto communis-Pistacietum lentisci* (Molinier 1954) Rivas-Martínez 1975 (rels. 1-2), *Pistacio lentisci-Juniperetum turbinatae* Trinajstić 1987 ex Asensi, Díez-Garretas & Quézel 2007 (rels. 3-4), *Pistacio lentisci-Pinetum halepensis* De Marco, Veri & Caneva 1984 (rel. 5).

Releve No.	1	2	3	4	5
No. of taxa	8	10	18	19	31
Plot size (m^2)	100	20	100	50	100
Altitude (m a.s.l.)	1	1	3	1	5
Aspect	.	.	E	.	.
Slope (°)	.	.	10	.	.
Vegetation height (m)	1	1.5	2	1	10
Vascular plant cover (%)	95	100	80	80	90
Charact. and diff. taxa of the ass.					
Pistacia lentiscus L.	4	4	2	+	1
Juniperus phoenicea L. ssp. turbinata (Guss.) Nyman	+	.	3	4	r
Myrtus communis L.	2	1	.	.	.
Pinus halepensis Mill.	.	.	.	.	4
Charact. and diff. taxa of the upper units					
Asparagus acutifolius L.	+	+	+	+	+
Quercus ilex L.	+	.	+	+	+
Smilax aspera L.	.	.	+	+	+
Juniperus oxycedrus L. ssp. oxycedrus	+	.	2	.	.
Phillyrea latifolia L.	.	.	+	.	.
Rubia peregrina L.	.	.	.	.	+
Clematis flammula L.	.	.	.	.	+
Viburnum tinus L.	.	.	.	.	+
Other taxa					
Vitex agnus-castus L.	+	1	+	.	.
Dittrichia viscosa (L.) Greuter	1	r	.	+	.
Helichrysum italicum (Roth) G.Don	.	.	+	1	+
Brachypodium retusum (Pers.) P.Beauv.	.	.	2	.	1
Cistus creticus L. ssp. eriocephalus (Viv.) Greuter et Burdet.	.	.	+	+	.
Dorycnium hirsutum (L.) Ser.	.	.	+	+	.
Teucrium chamaedrys L.	.	.	+	.	+
Rubus ulmifolius Schott	.	.	.	1	+
Dactylis glomerata L. ssp. hispanica (Roth) Nyman	.	.	.	1	1
Carlina corymbosa L.	.	.	.	+	+
Hypericum perforatum L.	.	.	.	+	+
Juncus acutus L.	.	+	.	.	.
Euphorbia paralias L.	.	+	.	.	.
Elymus pycnanthus (Godr.) Melderis	.	+	.	.	.
Cirsium vulgare (Savi) Ten.	.	r	.	.	.
Campanula pyramidalis L.	.	r	.	.	.
Chrysopogon gryllus (L.) Trin.	.	.	+	.	.
Blackstonia perfoliata (L.) Huds.	.	.	+	.	.
Centaurium pulchellum (Sw.) Druce	.	.	+	.	.
Anacamptis pyramidalis (L.) Rich.	.	.	+	.	.
Convolvulus althaeoides L. ssp. tenuissimus (Sibth. et Sm.) Stace	.	.	+	.	.
Daucus carota L.	.	.	.	+	.
Thymus longicaulis C.Presl	.	.	.	+	.
Lotus corniculatus L. ssp. hirsutus Rothm.	.	.	.	+	.
Hieracium praealtum Vill. ex Gochnat ssp. bauhinii (Besser) Petunn.	.	.	.	+	.
Brachypodium phoenicoides (L.) Roem. et Schult.	.	.	.	+	.
Eryngium amethystinum L.	.	.	.	+	.
Hedera helix L.	.	.	.	.	+
Calamintha nepetoides Jord.	.	.	.	.	+
Euphorbia characias L. ssp. wulfenii (Hoppe ex Koch) A. M. Sm.	.	.	.	.	+
Prunella laciniata (L.) L.	.	.	.	.	+
Melica ciliata L.	.	.	.	.	+
Trifolium campestre Schreber	.	.	.	.	+
Sanguisorba minor Scop. ssp. muricata Briq.	.	.	.	.	+
Eryngium campestre L.	.	.	.	.	+
Carex sp.	.	.	.	.	+
Bryophyta coll.	.	.	.	.	+
Cladonia spp.	.	.	.	.	+
Salvia pratensis L.	.	.	.	.	r
Dorycnium herbaceum Vill.	.	.	.	.	r
Cynosurus echinatus L.	.	.	.	.	r
Paliurus spina-christi Mill.	.	.	.	.	r

This community has been recorded in an intermediate position between *Juncetum maritmo-acuti* and *Myrto-Quercetum ilicis* (Slatina Bay) or *Arundo donax* community (Slatinica Bay), in correspondence with conditions almost as wet as those favouring *Vitex agnus-castus* (Fig. 3). It consists of typical tall shrublands (3 m) which are characterised by the dominance of both *Vitex agnus-castus* and *Rubus ulmifolius*. A number of communities with *Vitex agnus-castus* have been described from former Yugoslavia, mainly with illegitimate names and/or syntaxonomic status (e.g. Muratspahić *et al*., 1984). However, the species variability is poorly known mainly because this vegetation is usually heavily degraded (Jasprica *et al*., 2008, 2009).

PALIURO AUSTRALIS-VITICETUM AGNI-CASTI Jasprica, Ruščić & Kovačić 2011 (Tab. 15, Rel. 3; Fig. 4, Cluster B)
[NATURA 2000 habitat code 92D0]

The associations occurs in heavily disturbed areas where limestone is in contact with mud flats mostly near artificial rainwater reservoirs. In addition, the community forms a narrow belt between *Rubo ulmifolii-Viticetum agni-casti* and evergreen forests with significant presence of ruderals. This was also shown in association along the mediterranean and sub-Mediterranean areas of the Balkans (Jasprica & Kovačić, 2011).

ERICO MANIPULIFLORAE-CISTETUM CRETICI Horvatić 1958 (Tab. 16; Fig. 4, Cluster G)

Garrigue is an important stage in secondary successions on abandoned terraced olive groves or over cleared holm oak forests on the island. Actually, if soils are deep and there is little disturbance, garrigues are substituted by shrublands within a few years. In our case, from a syntaxonomic point of view, *Erico manipuliflorae-Cistetum cretici* is an association which for a major part is related to nanophanerophytic vegetation dominated by genus *Cistus*, with a significant participation of Mediterranean macchia genera such as *Pistacia*, *Quercus*, *Juniperus*, *Asparagus* and, for a minor part, to chamaephytic vegetation (e.g. *Helichrysum italicum*). Structurally, it is a relatively open community that develops mainly on flat surfaces and allows many Mediterranean therophytes to be found in the herb layer. The association is widespread along the eastern Adriatic coast (Horvatić, 1958), but some similar communities within the *Cisto cretici-Ericion manipuliflorae* alliance have been reported from the Apulia region, SE Italy (Brullo *et al*., 1987; Di Pietro & Misano, 2010). In our study, *Erica manipuliflora* is completely missing in the relevés and on the island generally (Milović *et al*., 2016). It is also found to be absent from the neighbouring Ist and Škarda islets (Pandža, 2010). Similarly, again in Apulia, *E. manipuliflora* did not occur in the newly discovered association within the *Cisto cretici-Ericion manipuliflorae* alliance (Galié *et al*., 2015). However, it should be also noted that presence of the *E. manipuliflora* (as *E. forskalii* Vitm.) and other characteristic species of the alliance (cf. Tomaselli *et al*., 2010) in the southern Apulia has already been reported by Conti *et al*. (2005). In addition, *E. arborea* is a co-dominant species in the association on

Tab. 15 - *Rubo ulmifolii-Nerion oleandri* O.Bolòs 1985: *Rubo ulmifolii-Viticetum agni-casti* Paradis 2006 (rels. 1-2), *Paliuro australis-Viticetum agni-casti* Jasprica, Ruščić & Kovačić 2011 (rel. 3).

Releve No.	1	2	3
No. of taxa	23	8	16
Plot size (m^2)	20	100	20
Altitude (m a.s.l.)	70	1	10
Vegetation height (m)	3	3	3
Vascular plant cover (%)	70	100	80
Charact. and diff. taxa of the ass.			
Vitex agnus-castus L.	3	5	5
Paliurus spina-christi Mill.	.	.	2
Charact. and diff. taxa of the upper units			
Rubus ulmifolius Schott	2	3	+
Other taxa			
Rumex pulcher L. ssp. pulcher	+	+	.
Cynodon dactylon (L.) Pers.	+	.	+
Eryngium campestre L.	+	.	+
Hypericum perforatum L.	+	.	+
Convolvulus arvensis L.	+	.	+
Myrtus communis L.	.	+	+
Prunus spinosa L.	.	+	+
Juncus gerardi Loisel.	+	.	.
Oenanthe pimpinelloides L.	+	.	.
Gastridium ventricosum (Gouan) Schinz et Thell.	1	.	.
Juncus compressus Jacq.	+	.	.
Filago vulgaris Lam.	+	.	.
Prunella laciniata (L.) L.	+	.	.
Blackstonia perfoliata (L.) Huds.	+	.	.
Bromus erectus Huds. ssp. condensatus (Hack.) Asch. et Graebn.	+	.	.
Rosa sempervirens L.	+	.	.
Trifolium squamosum L.	+	.	.
Agrimonia eupatoria L.	+	.	.
Potentilla reptans L.	+	.	.
Trifolium lappaceum L.	+	.	.
Medicago orbicularis (L.) Bartal.	+	.	.
Polygonum aviculare L.	+	.	.
Vicia villosa Roth ssp. varia (Host) Corb.	+		.
Juncus acutus L.	.	+	.
Juncus maritimus Lam.	.	1	.
Juniperus phoenicea L. ssp. turbinata (Guss.) Nyman	.	+	.
Pistacia lentiscus L.	.	.	+
Piptatherum miliaceum (L.) Coss.	.	.	+
Verbascum sinuatum L.	.	.	+
Dittrichia viscosa (L.) Greuter	.	.	+
Brachypodium pinnatum (L.) P.Beauv.	.	.	+
Hedera helix L.	.	.	+
Foeniculum vulgare Mill.	.	.	+

Tab. 16 - *Erico manipuliflorae-Cistetum cretici* Horvatić 1958.

Releve No.	1	2	3	4	5	6	7	8	9	
No. of taxa	13	15	20	19	18	18	32	14	10	
Plot size (m^2)	25	25	25	25	100	15	30	50	20	
Altitude (m a.s.l.)	24	23	22	34	22	70	5	65	3	Presences
Vegetation height (m)	1.5	2	1.5	1.5	2	1	2	1	0.5	
Vascular plant cover (%)	60	80	90	90	90	80	100	80	90	
Charact. and diff. taxa of the ass.										
Cistus creticus L. ssp. creticus	3	3	3	4	3	3	3	4	5	9
Charact. and diff. taxa of the upper units										
Dorycnium hirsutum (L.) Ser.	2	1	1	+	+	+	+	.	.	7
Cistus salvifolius L.	.	+	+	.	2	1	.	.	.	4
Cistus monspeliensis L.	.	.	.	.	+	.	.	.	.	1
Other taxa										
Pistacia lentiscus L.	1	1	+	1	1	.	+	+	+	8
Quercus ilex L.	+	+	+	1	1	.	+	.	+	7
Helichrysum italicum (Roth) G.Don	+	+	+	+	.	+	+	+	.	7
Juniperus oxycedrus L. ssp. oxycedrus	+	+	+	.	+	.	r	.	+	6
Juniperus phoenicea L. ssp. turbinata (Guss.) Nyman	+	+	+	+	+	.	.	+	.	6
Asplenium ceterach L.	+	+	+	+	+	.	.	.	.	5
Dactylis glomerata L. ssp. hispanica (Roth) Nyman	.	.	.	+	+	+	.	1	+	5
Asparagus acutifolius L.	.	.	.	.	+	+	+	+	+	5
Myrtus communis L.	+	1	2	.	.	.	+	.	.	4
Dactylis glomerata L. ssp. glomerata	+	+	+	.	.	.	1	.	.	4
Centaurium pulchellum (Sw.) Druce	.	.	+	+	+	.	r	.	.	4
Brachypodium pinnatum (L.) P.Beauv.	.	.	.	+	.	1	4	.	1	4
Brachypodium retusum (Pers.) P.Beauv.	.	.	.	2	.	2	+	2	.	4
Sanguisorba minor Scop. ssp. muricata Briq.	.	.	.	+	.	+	+	+	.	4
Arbutus unedo L.	1	1	+	.	.	.	.	.	.	3
Teucrium chamaedrys L.	+	+	.	.	.	.	r	.	.	3
Carex hallerana Asso	.	+	+	.	.	.	+	.	.	3
Hypericum perforatum L.	.	.	+	+	.	.	+	.	.	3
Olea europaea L.	+	+	.	.	.	.	.	.	.	2
Anacamptis pyramidalis (L.) Rich.	.	.	+	.	+	.	.	.	.	2
Rosa sempervirens L.	.	.	.	+	+	.	.	.	.	2
Carlina corymbosa L.	.	.	.	+	.	.	+	.	.	2
Clematis flammula L.	.	.	.	.	.	+	+	.	.	2
Lophochloa cristata (L.) Hyl.	.	.	.	.	.	+	.	+	.	2
Melica ciliata L.	.	.	.	+	.	.	.	.	+	2
Smilax aspera L.	.	.	.	.	.	.	+	+	.	2
Trifolium striatum L.	.	.	.	.	.	.	r	1	.	2
Cladonia spp.	.	.	.	.	.	.	1	2	.	2
Sporadic species	0	0	4	3	4	7	11	2	2	

the NE-Adriatic islets (Pandža, 2010), but in our study, its distribution is more or less represented by a few individuals scattered in isolated sites on the island.

RUBUS ULMIFOLIUS AND *PRUNUS SPINOSA* COMMUNITY

This community occurs in contact with holm oak forests. It has developed as a low (2-3 m) and dense shrub formation dominated by *Rubus ulmifolius* and *Prunus spinosa*, with many Mediterranean species. This single relevé has been carried out on an almost flat surface on deep and wet soil: *Rubus ulmifolius* (5), *Prunus spinosa* (4), *Vitis vinifera* ssp. *sylvestris* (1), *Brachypodium sylvaticum* (1), *Rubia peregrina* (+), *Hedera helix* (+), *Olea europea* (+), *Asparagus acutifolius* (+), *Clematis flammula* (+), *Quercus ilex* (+), *Rhamnus alaternus* (+), *Pistacia lentiscus* (r). The community can be referred to the *Pruno spinosae-Rubion ulmifolii* alliance (Biondi *et al*., 2014b, and references therein), but in our case, a formal description of the community requires more detailed investigation. For this reason it has not been included in the numerical analysis.

Conclusions

This phytosociological analysis has revealed a great phytocoenotic diversity and the high biogeographical value of the study area. The coastal area of the island is characterised by marine phanerogams dominated by *Posidonia oceanica*. The 34.5 km of mainly rocky coastal line is the site of a very particular *Crithmo maritimi-Staticetea* community namely the *Plantagini holostei-Limonietum cancellati*. The sandy substrates of some parts of the coastline also contain *Euphorbio pineae-Glaucietum flavi*. Spatial distribution analysis of halophilous plant communities (Fig. 3) allows highlighting the variation in salinity gradient due to the microtopography, and this confirms what already observed in Biondi *et al*. (2004). Not far from the sea and on more evolved soils, there are evergreen holm-oak woods, which can be considered as the potential vegetation type (*Myrto-Quercetum ilicis*). These woodlands in the area are characterised by a complete dominance of sclerophyllic component and mostly by the absence of thermophilous deciduous trees such as *Fraxinus ornus*, *Carpinus orientalis*, *Acer monspessulanum*, etc. If we exclude just a few restricted sites with shrubby communities of *Pistacio-Rhamnetalia alaterni*, the whole study area exhibits a strong dynamic tendency for woodlands. In general, the vegetation of the island is not under significant anthropogenic influence.

In the study, some associations are described by only one sample (relevé). This was the case for: i) monospecific communities, ii) very rare associations on the island, or iii) communities that require significant additional investigation, and for the latter the results may be treated as an approximation rather than definitive.

We did not sample communities of the terraced olive groves where the traditional methods of olive cultivation have remained more or less unchanged over the centuries. In our opinion the community types that occur in the abandoned olive groves allow the potential vegetation types of the whole area to be hypothesized (Di Pietro & Blasi, 2002; Maccherini *et al*., 2013). Further studies must be carried out to estimate the importance of olive groves as a habitat types or for the conservation of plant diversity thoughout the coastal area of Croatia.

Classification of the distinguished vegetation units into habitat types according to Habitats Directive 92/43/EEC revealed 18 habitat types, excluding the community with *Spergularia salina* which is still not well characterized. These communities are an important part of the region's natural heritage and they must in fact be protected according to international obligation. In fact, management plans must ensure that land of these types of is used in a sustainable way.

In sum, this paper makes a contribution to the interpretation, at least in terms of syntaxonomical discussion, of the phytocoenotic diversity of the Croatian islands which is largely unknown.

Syntaxonomic scheme

CHARETEA FRAGILIS F. Fukarek ex Krausch 1964
CHARETALIA HISPIDAE Sauer ex Krausch 1964
Charion vulgaris (Krause ex Krause & Lang 1977) Krause 1981
Charetum vulagris Corillion 1957

POTAMETEA PECTINATI Klika in Klika & Novák 1941
POTAMETALIA PECTINATI Koch 1926
Zannichellion pedicellatae Schaminée, Lanjouw & Schipper 1990 em. Pott 1992
Zannichellietum pedicellatae Nordhagen 1954 em. Pott 1992

PHRAGMITO AUSTRALIS-MAGNOCARICETEA ELATAE Klika in Klika & Novák 1941
SCIRPETALIA COMPACTI Hejny in Holub, Hejny, Moravec & Neuhäusl 1967 corr. Rivas-Martínez, Costa, Castroviejo & E.Valdés 1980
Scirpion compacti Dahl & Hadač 1941 corr. Rivas-Martínez, Costa, Castroviejo & E.Valdés 1980
Scirpetum compacti Van Langendonck 1931 corr. Bueno & F. Prieto in Bueno 1997 (=*Bolboschoenetum maritimi* Van Langendonck 1931)

HALODULO WRIGTHII-THALASSIETEA TESTUDINUM Rivas-Martínez, Fernández-González & Loidi 1998
THALASSIO TESTUDINUM-SYRINGODIETALIA FILIFORMIS Knapp in Borhidi, Muňiz & Del Risco 1983
Syringodio filiformis-Thalassion testudinum Borhidi in Borhidi, Muňiz & Del Risco 1983
Cymodoceetum nodosae Feldman 1937

POSIDONIETEA OCEANICAE Hartog 1976 ex Géhu in Bardat, Bioret, Botineau, Boullet, Delpech, Géhu, Haury, Lacoste, Rameau, Royer, Roux & Touffet 2004

POSIDONIETALIA OCEANICAE Hartog 1976
Posidonion oceanicae Braun-Blanquet, Roussine & Nègre 1952
Posidonietum oceanicae (Funk 1927) Molinier 1958

CAKILETEA MARITIMAE Tüxen & Preising ex Braun-Blanquet & Tüxen 1952
EUPHORBIETALIA PEPLIS Tüxen 1950
Euphorbion peplis Tüxen 1950
Euphorbio pineae-Glaucietum flavi Horvatić 1934
Salsola soda and *Cakile maritima* community

CRITHMO MARITIMI-STATICETEA Braun-Blanquet in Braun-Blanquet, Roussine & Nègre 1952 em. Biondi 2007
CRITHMO MARITIMI-STATICETALIA Molinier 1934
Crithmo maritimi-Staticion Molinier 1934
Plantagini holostei-Limonietum cancellati Horvatić (1934) 1939

JUNCETEA MARITIMI Braun-Blanquet in Braun-Blanquet, Roussine & Nègre 1952
JUNCETALIA MARITIMI Braun-Blanquet ex Horvatić 1934
Juncion maritimi Braun-Blanquet ex Horvatić 1934
Juncetum maritimo-acuti Horvatić 1934

SAGINETEA MARITIMAE Westhoff, Leeuwen & Adriani 1962
FRANKENIETALIA PULVERULENTAE Rivas-Martínez ex Castroviejo & Porta 1976
Frankenion pulverulentae Rivas-Martínez ex Castroviejo & Porta 1976
Spergularia salina community

SARCOCORNIETEA FRUTICOSAE Braun-Blanquet & Tüxen ex A. Bolòs & O. Bolòs in A. Bolòs 1950 *nom. mut. propos*. Rivas-Martínez, T.E. Díaz, Fernandez-Gonzales, Izco, Loidi, Lousã & Penas 2002
SARCOCORNIETALIA FRUTICOSAE Braun-Blanquet 1933 *nom. mut. propos*. Rivas-Martínez, T.E. Díaz, Fernandez-Gonzales, Izco, Loidi, Lousã & Penas 2002
Sarcocornion fruticosae Braun-Blanquet 1933 *nom. mut. propos*. Rivas-Martínez, T.E. Díaz, Fernandez-Gonzales, Izco, Loidi, Lousã & Penas 2002
Puccinellio festuciformis-Sarcocornietum fruticosae (Braun-Blanquet 1928) Géhu 1976

THERO-SUAEDETEA SPLENDENTIS Rivas-Martínez 1972
THERO-SALICORNIETALIA Tüxen in Tüxen & Oberdorfer ex Géhu & Géhu -Franck 1984
Salicornion patulae Géhu & Géhu-Franck ex Rivas-Martínez 1990
Salicornietum emerici O. Bolós ex Brullo & Furnari 1976)

PARIETARIETEA JUDAICAE Oberdorfer 1977
TORTULO-CYMBALARIETALIA Segal 1969
Parietarion judaicae Segal 1969
Oxalido-Parietarietum judaicae (Braun-Blanquet 1952) Segal 1969
Resedo albae-Antirrhinetum majoris Trinajstić 2008

ARTEMISIETEA VULGARIS Lohmeyer, Preising & Tüxen ex von Rochow 1951
AGROPYRETALIA PUNGENTIS Géhu 1968
Agropyrion pungentis Géhu 1968 em. 1973
Arundinetum micranthae Jasprica, Bogdanović & Dolina 2014

STELLARIETEA MEDIAE Tüxen, Lohmeyer & Preising in Tüxen ex von Rochow 1951
CHENOPODIO-STELLARIENEA Rivas Goday 1956
CHENOPODIETALIA MURALIS Braun-Blanquet in Braun-Blanquet, Gajewski, Wraber & Walas 1936
Chenopodion muralis Braun-Blanquet in Braun-Blanquet, Gajewski, Wraber & Walas 1936
Urtico dioicae-Sambucetum ebuli Braun-Blanquet in BraunBlanquet, Roussine et Nègre 1952
STELLARIENEA MEDIAE [*Secalino-Stellarienea* Rivas Goday 1964]

SOLANO NIGRI-POLYGONETALIA CONVOLVULI (Sissingh in Westhoff, Dijk, Passchier & Sissingh 1946) O. Bolòs 1962
Diplotaxion erucoidis Braun-Blanquet in Braun-Blanquet, Gajewski, Wraber &Walas 1936 em. Brullo & Marcenò 1980
Tribulo terrestri-Amaranthetum graecizans Hodak 1962 ex Pandža, Franjić & Škvorc 2005
Digitario ischaemi-Setarion viridis Sissingh in Westhoff, Dijk, Passchier & Sissingh 1946
Portulacetum oleraceae Felföldy 1942
SISYMBRIETALIA OFFICINALIS J. Tüxen ex W. Matuszkiewicz 1962
Hordeion leporini Braun-Blanquet in Braun-Blanquet, Gajewski, Wraber & Walas 1936 corr. O. Bolòs 1962
Hordeetum leporini Braun-Blanquet 1936

GALIO APARINES-URTICETEA DIOICAE Passarge ex Kopecký 1969
CONVOLVULETALIA SEPIUM Tüxen ex Mucina 1993
Convolvulion sepium Tüxen ex Oberdorfer 1957
Arundini donacis-Convolvuletum sepium Tüxen & Oberdorfer ex O. Bolòs 1962

INULETEA VISCOSAE Trinajstić (1965) 1978
INULETALIA VISCOSAE Trinajstić (1965) 1978
Inulion viscosae Trinajstić (1965) 1978
Dauco majori-Foeniculetum vulgaris Trinajstić 2008
Helichryso italici-Inuletum viscosae Trinajstić 1965

THERO-BRACHYPODIETEA RAMOSI Braun-Blanquet 1947
CYMBOPOGONO HIRTI-BRACHYPODIETALIA RAMOSI Horvatić 1963
Cymbopogono hirti-Brachypodion ramosi Horvatić 1963
Piptatheretum miliaceae Horvatić (1956) 1958 (=*Oryzopsetum miliaceae*)

FESTUCO VALESIACAE-BROMETEA ERECTI Braun-Blanquet & Tüxen ex Klika & Hadač 1944
SCORZONERETALIA VILLOSAE Kovačević 1959
KOELERIENALIA SPLENDENTIS (Horvatić 1973) Terzi 2015
Chrysopogono grylli-Saturejion subspicatae Horvat & Horvatić ex Černjavski, Grebenščikov & Pavlović 1949
Narcisso tazettae-Asphodeletum microcarpi Šegulja 1969

MOLINIO-ARRHENATHERETEA Tüxen 1937
PLANTAGINETALIA MAJORIS Tüxen ex von Rochow 1951
Lolio perennis-Plantaginion majoris Sissingh 1969
Lolio perennis-Plantaginetum majoris Beger 1930

QUERCETEA ILICIS Braun-Blanquet in Braun-Blanquet, Roussine & Nègre 1952
QUERCETALIA ILICIS Braun-Blanquet ex Molinier 1934
Fraxino orni-Quercion ilicis Biondi, Casavecchia & Gigante ex Biondi, Casavecchia & Gigante in Biondi, Allegrezza, Casavecchia, Galdenzi, Gigante & Pesaresi 2013
Myrto communis-Quercetum ilicis (Horvatić 1963) Trinajstić (1976) 1985
PISTACIO LENTISCI-RHAMNETALIA ALATERNI Rivas-Martínez 1975
Oleo sylvestris-Ceratonion siliquae Braun-Blanquet ex Guinochet & Drouineau 1944
Myrto communis-Pistacietum lentisci (Molinier 1954) Rivas-Martínez 1975
Pistacio lentisci-Juniperetum turbinatae Trinajstić 1987 ex Asensi, Díez-Garretas & Quézel 2007
PINETALIA HALEPENSIS Biondi, Blasi, Galdenzi, Pesaresi & Vagge in Biondi, Allegrezza, Casavecchia, Galdenzi, Gasparri, Pesaresi, Vagge & Blasi 2014
Pistacio lentisci-Pinion halepensis Biondi, Blasi, Galdenzi, Pesaresi & Vagge in Biondi, Allegrezza, Casavecchia, Galdenzi, Gasparri, Pesaresi, Vagge & Blasi 2014
Pistacio lentisci-Pinetum halepensis De Marco, Veri & Caneva 1984

NERIO OLEANDRI-TAMARICETEA AFRICANAE Braun-Blanquet & O.Bolòs 1958
NERIO OLEANDRI-VITICETALIA AGNI-CASTI de Foucault, Bensettiti, Noble & Paradis 2012
Rubo ulmifolii-Nerion oleandri O.Bolòs 1985
Rubo ulmifolii-Viticetum agni-casti Paradis 2006
Paliuro australis-Viticetum agni-casti Jasprica, Ruščić & Kovačić 2011

ERICO-CISTETEA Trinajstić 1985
CISTO CRETICI-ERICETALIA MANIPULIFLORAE Horvatić 1958
Cisto cretici-Ericion manipuliflorae Horvatić 1958
Erico manipuliflorae-Cistetum cretici Horvatić 1958

RHAMNO CATHARTICAE-PRUNETEA SPINOSAE Rivas Goday & Borja ex Tüxen 1962
PYRO SPINOSAE-RUBETALIA ULMIFOLII Biondi, Blasi & Casavecchia in Biondi, Allegrezza, Casavecchia, Galdenzi, Gasparri, Pesaresi, Vagge & Blasi 2014
Pruno spinosae-Rubion ulmifolii O. Bolòs 1954
Rubus ulmifolius and *Prunus spinosa* community

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C*alystegio silvaticae-Arundinetum donacis* Brullo, Scelsi & Spampinato 2001; *Clematido vitalbae-Arundinetum donacis* Biondi & Allegrezza ex Biondi & Allegrezza 2013; *Querco ilicis-Pinetum halepensis* Loisel 1971; *Raphano maritimi-Glaucietum flavi* Biondi, Brugiapaglia, Allegrezza & Ballelli 1992; *Salsolo kali-Cakiletum maritimae* Costa & Mansanet 1981 corr. Rivas-Martínez *et al*. 1992; *Salsoletum sodae* Pignatti 1953; *Spergulario salinae-Hordeetum marini* Biondi, Filigheddu & Farris 2001.

Author contributions

S.K. planned the research; M.M. performed the analyses of flora; N.J. analysed the vegetation data, N.J. led the writing, while all authors conducted the field sampling and critically revised the manuscript.

Acknowledgments

Research funding came from the Public Institution for Management of Protected Natural Values in the Zadar County, Zadar, Croatia. The authors thank Prof. Edoardo Biondi (I) whose observations improved the quality of the final version of the manuscript and Steve Latham (UK) for improving the English. Thanks are also extended to Croatian Meteorological and Hydrological Service for providing the meteorological data from the Mali Lošinj station.

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Appendix I: Sporadic species

Tab. 2 – Rel.1: Carduus micropterus (Borbás) Teyber ssp. micropterus 1, Asparagus acutifolius L. +, Eryngium amethystinum L. +, Dactylis glomerata L. ssp. hispanica (Roth) Nyman +; Rel. 2: Parietaria judaica L. +; Rel. 4: Polygonum maritimum L. +, Scolymus hispanicus L. +, Bromus madritensis L. r, Cirsium vulgare (Savi) Ten. +; Rel. 5: Cynodon dactylon (L.) Pers. +; Rel. 6: Chaenorhinum minus (L.) Lange ssp. litorale +; Rel. 9: Allium commutatum Guss. +. Tab. 4 – Rel 2: Limonium narbonense Mill. 1, Halimione portulacoides (L.) Aellen 1, Plumbago europaea L. +, Silene latifolia Poir. ssp. alba (Mill.) Greuter et Bourdet +, Rumex conglomeratus Murray +, Erodium malacoides (L.) L' Hér. +, Rubus ulmifolius Schott +; Rel. 4: Anagallis arvensis L. +, Medicago lupulina L. +, Dorycnium hirsutum (L.) Ser. +, Eryngium amethystinum L. +; Rel. 5: Anagallis arvensis L. +, Carex distans L. +, Euphorbia pinea L. +, Beta vulgaris L. ssp. maritima (L.) Arcang. +; Rel. 6: Carex distans L. +, Euphorbia pinea L. +, Vitex agnus-castus L. +, Brachypodium retusum (Pers.) P.Beauv. +, Sedum sexangulare L. 1, Dactylis glomerata L. ssp. glomerata +, Petrorhagia saxifraga (L.) Link +; Rel. 7: Vitex agnus-castus L. +; Rel. 9: Valantia muralis L. +, Taraxacum officinale Weber +, Trifolium scabrum L. +, Desmazeria marina (L.) Druce +, Carlina corymbosa L. +; Rel. 10: Plumbago europaea L. +, Parietaria judaica L. +, Cirsium vulgare (Savi) Ten. +, Asparagus acutifolius L. +, Picris hieracioides L. +; Rel. 11: Valantia muralis L. 1, Parietaria judaica L. 1, Cirsium vulgare (Savi) Ten. +, Drypis spinosa L. ssp. jacquiniana Murb.et Wettst. +, Biscutella cichoriifolia Loisel. +, Geranium purpureum Vill. 1, Glaucium flavum Crantz r; Rel. 12: Allium sphaerocephalon L. +, Cichorium intybus L. +, Elymus pungens (Pers.) Melderis 1, Reichardia picroides (L.) Roth +; Rel. 13: Asparagus acutifolius L. r, Eryngium campestre L. +; Rel. 14: Eryngium campestre L. +, Dactylis glomerata L. ssp. hispanica (Roth) Nyman 1; Rel. 15: Limonium narbonense Mill. 2, Halimione portulacoides (L.) Aellen +, Suaeda maritima (L.) Dumort. +. Tab. 13 – Rel. 1: Agrimonia eupatoria L. +, Carex hallerana Asso +, Epipactis microphylla (Ehrh.) Sw. +, Inula conyza DC. +, Paliurus spina-christi Mill. +, Prunus spinosa L. +; Rel. 2: Crataegus monogyna Jacq. +; Rel. 4: Carex hallerana Asso +, Prunus cerasifera Ehrh. +; Rel. 5: Dactylis glomerata L. ssp. glomerata +, Lotus corniculatus L. ssp. hirsutus Rothm. +, Medicago arabica (L.) Huds. +, Reichardia picroides (L.) Roth +; Rel. 8: Agrimonia eupatoria L. +, Asphodelus aestivus Brot. +, Carlina corymbosa L. +, Dorycnium herbaceum Vill. +, Hieracium piloselloides Vill. +, Prunella laciniata (L.) L. +, Trifolium campestre Schreber +; Rel. 9: Lotus corniculatus L. ssp. hirsutus Rothm. +, Calamintha nepetoides Jord. +, Carex distachya Desf. +, Carex divulsa Stokes +, Melica ciliata L. +; Rel. 10: Hypericum perforatum L. +; Rel. 11: Carex distachya Desf. +; Rel. 12: Teucrium chamaedrys L. +; Rel. 13: Carex distachya Desf. +, Carlina corymbosa L. +, Reichardia picroides (L.) Roth +, Campanula rapunculus L. +, Carduus micropterus (Borbás) Teyber ssp. micropterus +, Euphorbia characias L. ssp. wulfenii (Hoppe ex Koch) A. M. Sm. +, Scorpiurus muricatus L. +, Securigera securidaca (L.) Degen et Dörfl. +, Vicia parviflora Cav. +; Rel. 14: Chrysopogon gryllus (L.) Trin. +, Dittrichia viscosa (L.) Greuter +, Eryngium campestre L. +; Rel. 15: Eryngium campestre L. r, Carlina corymbosa L. +, Dactylis glomerata L. ssp. glomerata +, Teucrium polium L. ssp. capitatum (L.) Arcang. +, Prunus spinosa L. ; Rel. 17: Dittrichia viscosa (L.) Greuter +, Carex hallerana Asso +; Rel. 20: Paliurus spina-christi Mill. +, Ulmus minor Miller +; Rel. 21: Euphorbia characias L. ssp. wulfenii (Hoppe ex Koch) A. M. Sm. +, Melica ciliata L. +, Cynosurus echinatus L. +, Dichanthium ischaemum (L.) Roberty +, Parietaria judaica L. +. Tab. 16 – Rel.

3: Cynosurus echinatus L. +, Lathyrus aphaca L. +, Phillyrea latifolia L. +, Trifolium campestre Schreber +; Rel. 4: Eryngium amethystinum L. +, Verbascum sinuatum L. +, Blackstonia perfoliata (L.) Huds. +; Rel. 5: Fraxinus ornus L. +, Bromus erectus Huds. +, Carex divulsa Stokes +, Asplenium trichomanes L. +; Rel. 6: Eryngium campestre L. +, Lolium perenne L. +, Calamintha nepetoides Jord. +, Euphorbia characias L. ssp. wulfenii (Hoppe ex Koch) A. M. Sm. +, Urospermum dalechampii (L.) Scop. ex F.W.Schmidt +, Plantago lanceolata L. +, Potentilla recta L. +; Rel. 7: Prunella laciniata (L.) L. +, Juncus gerardi Loisel. +, Rubia peregrina L. +, Paliurus spina-christi Mill. +, Prunus spinosa L. +, Trifolium fragiferum L. +, Trifolium angustifolium L. +, Rubus ulmifolius Schott +, Dittrichia viscosa (L.) Greuter r, Scolymus hispanicus L. r, Medicago sp. r; Rel. 8: Bryophyta coll. 1, Valantia muralis L. +; Rel. 9: Elymus repens (L.) Gould +, Cynodon dactylon (L.) Pers. +.

Appendix II: Coordinates and date of vegetation relevés for monospecific associations or associations sampled with one relevé

[*Charetum vulagris* Corillion 1957: Gauss-Krüger coordinates X=5483461 Y=4931095, locality of Kalac; date 29-5-2015; plot size 20 m^2; altitude 70 m a.s.l.; vegetation cover 100%: *Chara vulgaris* L. (5)]. [*Zannichellietum pedicellatae* Nordhagen 1954 em. Pott 1992: X=5482587 Y=4918854, the Draga Bay; date 28-5-2015; plot size 20 m^2; altitude 1 m a.s.l.; vascular plant cover 100%: *Zannichellia peduncula*ta Rchb. (5)]. [*Cymodoceetum nodosae* Feldman 1937: X=5482612 Y=4915137; date 29-05-2015, the Olib Bay, plot size 20 m^2; vascular plant cover 40%: *Cymodocea nodosa* (Ucria) Asch. (2)]. [*Posidonietum oceanicae* (Funk 1927) Molinier 1958: X=5483940 Y=4915764; date 25-05-2015]. [*Salicornietum emerici* O. Bolós ex Brullo & Furnari 1976: X=5482091 Y=4914718; date 17-8-2015; plot size 36 m^2; altitude -0.5 m a.s.l.; vascular plant cover 90%]. [*Arundinetum micranthae* Jasprica, Bogdanović & Dolina 2014: X=5483040 Y=4914721; date 21-8-2015; plot size 16 m^2; altitude 18 m a.s.l.; vascular plant cover 90%]. [*Tribulo terrestri-Amaranthetum graecizans* Hodak 1962 ex Pandža, Franjić & Škvorc 2005: X=5482820 Y=4914741; date 22-8-2015; plot size 25 m^2; altitude 12 m a.s.l.; vascular plant cover 60%]. [*Portulacetum oleraceae* Felföldy 1942: X=5482980 Y=4914690; date 17-8-2015; plot size 6 m^2; altitude 17 m a.s.l.; vascular plant cover 60%]. [*Hordeetum leporini* Braun-Blanquet 1936: X=5482591 Y=4915027; date 26-5-2015; plot size 12 m^2; altitude 1 m a.s.l.; vascular plant cover 85%]. [*Arundini donacis-Convolvuletum sepium* Tüxen & Oberdorfer ex O. Bolòs 1962: X=5482556 Y=4914864; date 17-8-2015; plot size 40 m^2; altitude 2 m a.s.l.; vascular plant cover 100%]. [*Piptatheretum miliaceae* Horvatić (1956) 1958: X=5482564 Y=4914851; date 17-8-2015; plot size 20 m^2; altitude 4 m a.s.l.; vascular plant cover 90%]. [*Rubus ulmifolius* and *Prunus spinosa* community: X=5483172 Y=4914187; date 20-8-2015; plot size 50 m^2; altitude 35 m a.s.l.; vascular plant cover 100%]

Appendix III: Coordinates and date of vegetation relevés within tables.

Tab. 1. *Scirpetum compacti* Van Langendonck 1931 corr. Bueno & F. Prieto in Bueno 1997 - Rel. 01: X=5483940 Y=4915764, 25/05/2015; Rel. 02: X=5483917 Y=4915760, 25/05/2015. Tab. 2. *Euphorbio pineae-Glaucietum flavi* Horvatić 1934 - Rel. 01: X=5483925 Y=4915747, 25/05/2015; Rel. 02: X=5484602 Y=4911066, 20/08/2015; Rel. 03: X=5484522 Y=4911125, 28/08/2015; Rel. 04: X=5484460 Y=4911125, 20/08/2015; Rel. 5: X=5483921 Y=4915730, 25/05/2015; Rel. 06: X=5482528 Y=4918866, 28/05/2015; Rel. 07: X=5484902 Y=4916940, 29/05/2015; Rel. 08: X=5484475 Y=4916919, 29/05/2015; Rel. 09: X=5484448 Y=4916857, 29/05/2015. Tab. 3. *Salsola soda-Cakile maritima* community - Rel. 01: X=5482564 Y=4914919, 17/08/2015; Rel. 02: X=5482498 Y=4914884, 16/08/2015; Rel. 03: X=5482531 Y=4915616, 18/08/2015; Rel. 4: X=5484329 Y=4915128, 21/08/2015. Tab. 4. *Plantagini holostei-Limonietum cancellati* Horvatić (1934) 1939 - Rel. 01: X=5483925 Y=4915742, 25/05/2015; Rel. 02: X=5483971 Y=4915760, 25/05/2015; Rel. 03: X=5484021 Y=4915732, 25/05/2015; Rel. 04: X=5484063 Y=4915720, 25/05/2015; Rel. 05: X=5482322 Y=4912390, 26/05/2015; Rel. 06: X=5482296 Y=4912387, 26/05/2015; Rel. 07: X =5482505 Y=4912256, 26/05/2015; Rel. 08: X=5484189 Y=4915220, 27/05/2015; Rel. 09: X=5482498 Y=4918894, 28/05/2015; Rel. 010: X=5482384 Y=4918920, 28/05/2015; Rel. 011: X=5484490 Y=4915819, 29/05/2015; Rel. 012: X=5484831 Y=4916214, 29/05/2015; Rel. 013: X=5481512 Y=4914338, 18/08/2015; Rel. 014: X=5480826 Y=4914261, 18/08/2015; Rel. 015: X=5484294 Y=4915097, 21/08/2015. Tab. 5. *Juncetum maritimo-acuti* Horvatić 1934 - Rel. 1: X=5482245 Y=4914814, 17/05/2015; Rel. 2: X=5484542 Y=4911140, 20/08/2015; Rel. 3: X=5484529 Y=4911151, 20/08/2015. Tab. 6. *Spergularia salina* community - Rel. 1: X=5482583 Y=4915016, 26/05/2015; Rel. 2: X=5482580 Y=4915001, 26/05/2015. Tab. 7. *Puccinellio festuciformis-Sarcocornietum fruticosae* (Braun-Blanquet 1928) Géhu 1976 - Rel. 1: X=5484212 Y=4915112, 27/05/2015; Rel. 2: X=5484215 Y=4915144,

27/05/2015; Rel. 3: X=5484190 Y=4915171, 27/05/2015. Tab. 8. *Parietarion judaicae* Segal 1969 - *Oxalido-Parietarietum judaicae* (Braun-Blanquet 1952) Segal 1969, Rel. 1: X=5482736 Y=4914808, 26/05/2015; *Resedo albae-Antirrhinetum majoris* Trinajstić 2008, Rel. 2: X=5482883 Y=4914645, 28/05/2015.Tab. 9. *Urtico dioicae-Sambucetum ebuli* Braun-Blanquet in Braun Blanquet, Roussine & Nègre - Rel. 1: X=5482980 Y=4914690, 17/08/2015; Rel. 2: X=5482219 Y=4914797, 20/08/2015. Tab. 10. *Inulion viscosae* Trinajstić (1965) 1978 - *Dauco majori-Foeniculetum vulgaris* Trinajstić 2008, Rel. 1: X=5483074 Y=4914911, 30/05/2015; Rel. 2: X=5482561 Y=491492, 16/08/2015; *Helichryso italici-Inuletum viscosae* Trinajstić 1965, Rel. 3: X=5482219 Y=4914797, 17/08/2015. Tab. 11. *Narcisso tazettae-Asphodeletum microcarpi* Šegulja 1969 - Rel. 1: X=5483095 Y=4918232, 28/05/2015; Rel. 2: X=5483468 Y=4912993, 29/05/2015; Rel. 3: X=5482395 Y=4912621, 26/05/2015. Tab. 12. *Lolio perennis-Plantaginetum majoris* Beger 1930 - Rel. 1: X=5483167 Y=4915007, 30/05/2015; Rel. 2: X=5482633 Y=4914827, 29/05/2015; Rel. 3: X=5482564 Y=4914851, 26/05/2015. Tab. 13. *Myrto communis-Quercetum ilicis* (Horvatić 1963) Trinajstić (1976) 1985 - Rel. 1: X=5482423 Y=4912513, 26/05/2015; Rel. 2: X=5482448 Y=4912563, 26/05/2015; Rel. 3: X=5482479 Y=4912627, 26/05/2015; Rel. 4: X=5482484 Y=4912675, 26/05/2015; Rel. 5: X=5482506 Y=4912253, 26/05/2015; Rel. 6: X=5483658 Y=4914764, 27/05/2015; Rel. 7: X=5484238 Y=4915052, 27/05/2015; Rel. 8: X=5484122 Y=4915205, 27/05/2015; Rel. 9: X=5483108 Y=4918226, 28/05/2015; Rel. 10: X=5482616 Y=4918933, 28/05/2015; Rel. 11: X=5482572 Y=4918933, 28/05/2015; Rel. 12: X=5482318 Y=4918885, 28/05/2015; Rel. 13: X=5483495 Y=4913145, 29/05/2015; Rel. 14: X=5484793 Y=4916283, 29/09/2015; Rel. 15: X=5481997 Y=4914647, 17/08/2015; Rel. 16: X=5480753 Y =4914233, 18/08/2015; Rel. 17: X=5484374 Y=4911074, 20/08/2015; Rel. 18: X=5484397 Y=4912905, 20/08/2015; Rel. 19: X=5484148 Y=4912288, 20/08/2015; Rel. 20: X=5483668 Y=4912784, 20/08/2015; Rel. 21: X=5483659 Y=4914510, 21/08/2015. Tab. 14. *Pistacio lentisci-Rhamnetalia alaterni* Rivas-Martínez 1975 - *Myrto communis-Pistacietum lentisci* (Molinier 1954) Rivas-Martínez 1975, Rel. 1: X=5482504 Y=4912316, 26/05/2015; Rel. 2: X=5484580 Y=4911098, 20/08/2015; *Pistacio lentisci-Juniperetum turbinatae* Trinajstić 1987 ex Asensi, Díez-Garretas & Quézel 2007, Rel. 3: X=5482269 Y=4912394, 26/05/2015; Rel. 4: X=5484302 Y=4915069, 21/08/2015; *Pistacio lentisci-Pinetum halepensis* De Marco, Veri & Caneva 1984, Rel. 5: X=5482544 Y=4914705, 18/08/2015. Tab. 15. *Rubo ulmifolii-Nerion oleandri* O.Bolòs 1985 - Rels. 1-2: *Rubo ulmifolii-Viticetum agni-casti* Paradis 2006, Rel. 1: X=5483461 Y=4931095, 29/05/2015; Rel. 2: X=5484534 Y=4911246, 20/08/2015; Rel. 3: *Paliuro australis-Viticetum agni-casti* Jasprica, Ruščić & Kovačić 2011, Rel. 3: X=5483461 Y=4931095, 25/05/2015. Tab. 16. *Erico manipuliflorae-Cistetum cretici* Horvatić 1958 - Rel. 1: X=5482423 Y=4912647, 26/05/2015; Rel. 2: X=5482409 Y=4912644, 26/05/2015; Rel. 3: X=5482395 Y=4912621, 26/05/2015; Rel. 4: X=5483653 Y=4914788, 27/05/2015; Rel. 5: X=5483095 Y=4918232, 28/05/2015; Rel. 6: X=5483468 Y=4912993, 29/05/2015; Rel. 7: X=5482106 Y=4914688, 17/08/2015; Rel. 8: X=5483396 Y=4913177, 20/08/2015; Rel. 9: X=5484029 Y=4912440, 20/08/2015.