NAT. CROAT. | VOL. 25 | No 1 | 1–24 | ZAGREB | June 30, 2016

original scientific paper / izvorni znanstveni rad
DOI: 10.20302/NC.2016.25.1

THE VEGETATION OF THE ISLET OF BADIJA (SOUTH CROATIA), WITH SOME NOTES ON ITS FLORA

Nenad Jasprica[1] & Milenko Milović[2]

[1]Institute for Marine and Coastal Research, University of Dubrovnik, P.O. Box 83, HR-20000 Dubrovnik, Croatia (e-mail: nenad.jasprica@unidu.hr)

[2]Antun Vrančić Grammar School, Put Gimnazije 64, HR-22000 Šibenik, Croatia

Jasprica, N. & Milović, M., The vegetation of the islet of Badija (south Croatia), with some notes on its flora. Nat. Croat., Vol. 25, No. 1, 1–24, 2016, Zagreb.

The vegetation and flora of the south Croatian islet of Badija (0.97 km^2), located in the Korčula archipelago, were studied in 2014 and 2015. From a total of 52 phytosociological relevés, 12 floristically and ecologically distinctive vegetation communities were identified and described (eight associations, one subassociation and three stands) within nine vegetation classes. Among them, *Teucrio capitati-Marrubietum incani* Jasprica et Milović 2016 is described and proposed as a new association, belonging to the *Stellarietea mediae* class. Altogether, nine NATURA 2000 habitat types were recognized. Regarding the flora, 27 new vascular plant taxa (26 species and one subspecies) were recorded for the islet. Therefore the entire recorded flora of the islet of Badija now consists of 409 vascular plant taxa. Of the newly recorded taxa, four are considered to be invasive. One taxon is strictly protected by law. The Red List categories Least Concern (LC) and Data Deficient (DD) are assigned to one species in each.

Key words*:* phytosociology, new syntaxon, vascular plants, new records, Directive 92/43/EEC, eastern Adriatic, Mediterranean

Jasprica, N. & Milović, M., Vegetacija na otočiću Badiji (južna Hrvatska) s floističkim bilješkama. Nat.Croat., Vol. 25, No. 1, 1–24, 2016, Zagreb.

Vegetacija i flora južnojadranskog otočića Badije (0,97 km^2), smještenog u korčulanskom arhipelagu, istraživani su 2014. i 2015. Na temelju 52 fitocenološke snimke određeno je i opisano 12 floristički i ekološki različitih vegetacijskih zajednica (osam asocijacija, jedna subasocijacija i tri sastojine) u okviru devet vegetacijskih razreda. Među njima, asocijacija *Teucrio capitati-Marrubietum incani* Jasprica et Milović 2016 opisana je i predložena kao nova za znanost, a pripada vegetacijskom razredu *Stellarietea mediae.* Uvrđeno je devet NATURA 2000 stanišnih tipova. Determinirano je 27 novih svojti (26 vrste i jedna podvrsta) vaskularnih biljaka za otočić, pa je ukupan broj svojti sada 409. Među novim svojtama, četiri su invazivne, jedna je zakonski strogo zaštićena. Po jedna svojta pripada kategorijama najmanje zabrinjavajućih (LC) i nedovoljno poznatim biljkama (DD).

Ključne riječi*:* fitocenologija, novi sintakson, vaskularne biljke, novi nalazi, Direktiva 92/43/EEZ, istočni Jadran, Sredozemlje

INTRODUCTION

Floristic investigations on the island of Korčula have a 160 year tradition (de Visiani, 1842, 1847, 1852, 1872–1881), while a detailed historical overview of research into the flora of the island has been presented by Trinajstić (1995, 2000). According to Jeričević *et al.* (2014), the total recorded number of plant taxa (species and infraspecific taxa) on the island of Korčula, including neighbouring islets, is 1063. Regarding the vegetation,

some studies within the phytosociological scope recognised several plant associations of the three main groups of communities on the island: forest, halophytic and ruderal vegetation (cf. Trinajstić, 1973, 1979, 1985, 1986). However, the level of knowledge on the vegetation of the island of Korčula is minimal, and the current state of the diversity in plant communities in practice remains to be determined.

Similarly, the vegetation of all islets in the Korčula archipelago, including the islet of Badija, is mostly unknown (cf. Trinajstić 1985, and references therein; Jasprica *et al*., 2014a; Dolina *et al*., 2015). Barčić (1942), within his BSc thesis, collected 11 phytosociological relevés on the islet. Among them, one relevé was made in the Aleppo pine wood and 10 relevés in the "*Quercetum ilicis galloprovincialis*" association. However, among the islets, only the flora of the islet of Badija has been investigated in any detail (Barčić, 1974a,b, 1978–1979). In these papers (*op. cit*.), the floristic data were mostly derived from herbarium material which had been collected before the Franciscans left the islet, as far back as 1949. According to these data, 382 taxa (species and infraspecific taxa) of vascular plants, including cultivated plants, have been recorded on the islet.

The aims of the present study were: i) to investigate the vegetation of the islet for the first time, ii) to present new records of vascular plant taxa for the islet. Additionally, the present study will provide a contribution towards a better understanding of the phytocoenoses that have colonised the islet, and to evaluate their levels of biodiversity in relation to the phytogeographical position and geomorphological characteristics.

Study area

The karstic islet of Badija (coordinates 42°57′20′′ N 17°09′40′′ E) is the largest (surface area of 0.97 km^2) in the Korčula archipelago, making it also the largest in Croatia. According to Duplančić *et al*. (2004) islets by definition have a surface area of less than 1 km^2. It is located near the town of Korčula in south Croatia. The coast is low and rocky and has a total length of 4.158 km. Sea depths around the islet are between 1.5 and 15 m. The maximum height is 75 m a.s.l.

The first recorded mention of the islet was in 1368; it was inhabited by Franciscans from Bosnia from 1392 until after World War II when in 1949 the Franciscans were expelled, the monastery being converted into a sports centre and resort in 1950. The monastery and church on Badija, after more than 60 years of neglect and destruction of religious and cultural heritage, are now being gradually restored. Today the islet is not inhabited, although the monastery garden is regularly maintained and planted with a variety of cultivated species. In the summer months the islet is an attraction for tourists on daily trips.

It should be noted that fallow deer [*Dama dama* (Linnaeus, 1758)] were introduced to the islet in the late 1950s (Vojinović & Miočić, 1994). The fallow deer is a ruminant and requires large amounts of plant food. It has been estimated that fallow deer prefer to peel the bark off *Viburnum tinus* (*op. cit*.). In addition, the richness and diversity of herbaceous and shrub layers that are rich in protein and carbohydrates, provide favourable conditions for the fallow deer population. In the early 80s, a large herd of 50–60 fallow deer was recorded but had been reduced by about a fifth by 1994 (Vojinović & Miočić, 1994). The deer population density on the islet today is not known.

The study area belongs to the Mediterranean Region, Eastern Mediterranean Subregion, Adriatic Province, and Epiro-Dalmatian Sector (Rivas-Martínez *et al*., 2004). Geologically, the ground consists of Senonian limestones (Korolija *et al*., 1997). The predo-

minant soil type is calcocambisol (Martinović, 1986). *Terra Rossa* has been developed on the interior level areas.

According to the Köppen classification, the climate of the island of Korčula is of type Csa (Šegota & Filipčić, 2003). Average annual air temperature is 16.8 °C and precipitation ranges from 1000–1250 mm yr^{-1} (data from the nearby town of Korčula station for 1981–2007, Krklec *et al*., 2011). The highest daily average temperature is 25.9 °C in July, and the lowest is below 9.1 °C in February. On average, the relative air humidity is 71.6 %. The greatest rainfall is in the period from October to March with the average monthly rainfall from 80 to 150 mm. In the period from June to August the total rainfall varies between 90 and 135.0 mm. Southern winds prevail throughout the year. The entire area is characterized by frequent sunny weather, with the most westerly parts having in excess of 2700 hours of sunshine a year, while the east has about 300 hours less (Jasprica, 2010). The area has a Mediterranean pluviseasonal-oceanic bioclimate, and it is situated within the lower meso-Mediterranean belt (Jeričević *et al*., 2014; *sensu* Rivas-Martínez *et al*., 2004).

The greater part of the islet's surface area is covered by macchia. Phytogeographically, the islets belong to the Euri-Mediterranean vegetation zone of the alliance *Fraxino orni-Quercion ilicis* (*sensu* Biondi *et al*., 2013).

The islet has been protected as being of natural value in the category of Significant Landscape from 1969. It belongs, as a part of the island of Korčula, to the Important Plant Areas (IPAs) in Croatia (Jasprica, 2010). In addition, the islet is part of the NATURA 2000 European Ecological Network (Anonymous, 2013a, 2015) of sites important for birds (site code HR1000036: Middle Dalmatian islands and the Pelješac peninsula).

MATERIAL AND METHODS

Flora

The study was carried out in the period between October 2014 and July 2015 in all seasons. Floristic surveys were conducted using the standard method described by Nikolić *et al.* (1998) and Nikolić (2006). The research includes indigenous taxa, but also included in the list are cultivated taxa where encountered out of a cultivated environment. The taxa that are now grown in culture (in the monastery garden) are not inventoried.

Taxa were determined using the standard determination keys, books and guides: Bonnier (1911–1935), Fiori (1923–1929), Hayek (1924–1933), Hegi (1936–1987), Tutin *et al.* (1968–1980, 1993), Horvatić & Trinajstić (1967–1981), Trinajstić (1975–1986), Javorka & Csapody (1975), Pignatti (1982), Domac (1994), Delforge (1995, 2006), etc.

Plant nomenclature follows Nikolić (2015), except for *Juniperus phoenicea* L. ssp. *turbinata* (Guss.) Nyman and *Teucrium capitatum* L., where the Euro+Med Plantbase were applied (Euro+Med, 2006–2016). Only those taxa that have not previously been reported in the literature (Barčić, 1974, Trinajstić, 1985) are reported in this study. Taxa listed in the Red Book of Vascular Flora of Croatia (Nikolić & Topić, 2005, Nikolić, 2015) are marked with their corresponding IUCN status (IUCN, 2014). In addition, strictly protected taxa (SP) as defined by Croatian Law are also denoted (Anonymous, 2013b,c). Any invasive alien taxa (IAS) have been defined according to Nikolić *et al.* (2014).

Vegetation

Phytosociological analysis allowed the detection of some associations, understanding of their ecological characteristics and definiitin of their syntaxonomic position. Vegetation was studied in accordance with the principles of the Braun-Blanquet approach (Braun-Blanquet, 1964). Only stands with at least the minimum area recommended for particular types of vegetation were investigated (cf. Chytrý & Otýpková, 2003). Gauss-Krüger coordinates (5th zone), altitude, aspect and slope were determined for each relevé.

The system of characterizing species was derived from Ilijanić & Hećimović (1982), Hećimović (1984), Horvat *et al.* (1974), Jasprica *et al.* (2014b, 2015a, and references therein), and only partly from Brullo & Guarino (1998) and Brullo *et al.* (2007, 2008). For the arrangement of the plant associations in the upper hierarchic levels (see the syntaxonomic listing) the scheme proposed by Biondi *et al.* (2014) for Italy was mainly followed. The survey covers the entire surface of the islet and all habitat types. Altogether, 52 phytosociological relevés were collected. The resulting tables (Tabs. 1–6) were slightly rearranged manually. In the tables, for each taxon, frequencies are given as percentages (%). If only four or fewer relevés were available, only the presence of taxa in a given association is indicated. Place and date of relevés are listed in the Appendix 1. In addition, classification of the vegetation units distinguished 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. The matrix consists of 105 species × 52 samples (relevés). Braun-

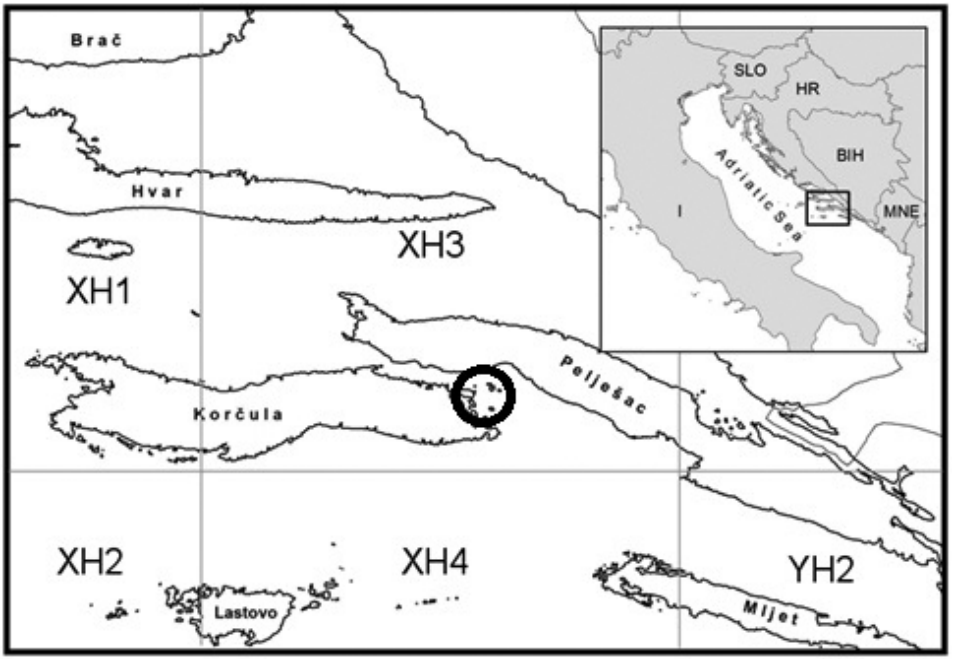

Fig. 1. Geographical position of the islet (circle) (Abbreviations: SLO: Slovenia; HR: Croatia; BIH: Bosnia and Herzegovina; MNE: Montenegro; I: Italy).

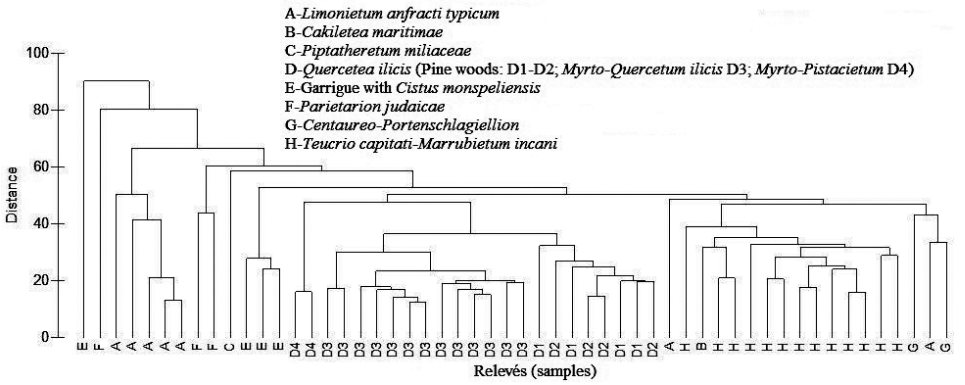

Fig. 2. Dendrogram of the relevés.

Blanquet (1964) values were transformed according to van der Maarel (1979). An agglomerative, hierarchical clustering algorithm based on Euclidean distances and Ward's method for determination of group linkages was used (McCune & Mefford, 2006). Differences between groups obtained in the classification were tested by analysis of similarities (ANOSIM). For these purposes the PC-ORD ver. 5 and PRIMERv6 software packages (McCune & Mefford, 2006, Clarke & Gorley, 2006) were used.

RESULTS AND DISCUSSION

Vegetation

Altogether, eight associations, one subassociation and three stands (communities) were determined within nine vegetation classes (Tabs. 1–6, Fig. 2).

Their syntaxomic survey is as follows:

POSIDONIETEA OCEANICAE Hartog 1976 ex Géhu in Bardat, Bioret, Botineau, Boullet, Delpech, Géhu, Haury, Lacoste, Rameau, Royer, Roux et Touffet 2004
+*Posidonietalia oceanicae* Hartog 1976
**Posidonion oceanicae* Braun-Blanquet, Roussine et Nègre 1952
***Posidonietum oceanicae* (Funk 1927) Molinier 1958**

CAKILETEA MARITIMAE Tüxen et Preising ex Braun-Blanquet et Tüxen 1952
+*Euphorbietalia peplis* Tüxen 1950
**Euphorbion peplis* Tüxen 1950
***Euphorbio pineae-Glaucietum flavi* Horvatić 1934**

CRITHMO MARITIMI-STATICETEA Braun-Blanquet in Braun-Blanquet, Roussine et Nègre 1952 em. Biondi 2007
+*Crithmo maritimi-Staticetalia* Molinier 1934
**Crithmo maritimi-Staticion* Molinier 1934
***Limonietum anfracti* subass. *typicum* Ilijanić et S. Hećimović 1982**

QUERCETEA ILICIS Braun-Blanquet in Braun-Blanquet, Roussine et Nègre 1952
+*Quercetalia ilicis* Braun-Blanquet ex Molinier 1934

**Fraxino orni-Quercion ilicis* Biondi, Casavecchia et Gigante ex Biondi, Casavecchia et Gigante in Biondi, Allegrezza, Casavecchia, Galdenzi, Gigante et 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 et Drouineau 1944

***Myrto communis-Pistacietum lentisci* (Molinier 1954) Rivas-Martínez 1975**

+Pinetalia halepensis Biondi, Blasi, Galdenzi, Pesaresi et Vagge in Biondi, Allegrezza, Casavecchia, Galdenzi, Gasparri, Pesaresi, Vagge et Blasi 2014

*******Pistacio lentisci-Pinion halepensis* Biondi, Blasi, Galdenzi, Pesaresi et Vagge in Biondi, Allegrezza, Casavecchia, Galdenzi, Gasparri, Pesaresi, Vagge et Blasi 2014

***Querco ilicis-Pinetum halepensis* Loisel 1971**

***Pistacio lentisci-Pinetum halepensis* De Marco, Veri et Caneva 1984**

CISTO CRETICI-MICROMERIETEA JULIANAE Oberdorfer ex Horvatić 1958 (=*ERICO-CISTETEA* Trinajstić 1985)

+Cisto cretici-Ericetalia manipuliflorae Horvatić 1958

*******Cisto cretici-Ericion manipuliflorae* Horvatić 1958

Garrigue with *Cistus monspeliensis*

PARIETARIETEA JUDAICAE Oberdorfer 1977

+Tortulo-Cymbalarietalia Segal 1969

**Parietarion judaicae* Segal 1969

ASPLENIETEA TRICHOMANIS (Braun-Blanquet in Meier et Braun-Blanquet 1934) Oberdorfer 1977

+ Centaureo dalmaticae-Campanuletalia pyramidalis Trinajstić 1980

**Centaureo cuspidatae-Portenschlagiellion ramosissimae* Trinajstić 1980

THERO-BRACHYPODIETEA RAMOSI Braun-Blanquet in Braun-Blanquet 1947)

+Cymbopogono hirti-Brachypodietalia ramosi Horvatić 1963

**Cymbopogono hirti-Brachypodion ramosi* Horvatić 1963

***Piptatheretum miliaceae* Horvatić (1956) 1958 (=*Oryzopsetum miliaceae*)**

STELLARIETEA MEDIAE Tüxen, Lohmeyer et Preising in Tüxen ex von Rochow 1951

CHENOPODIO-STELLARIENEA Rivas Goday 1956

+Chenopodietalia muralis Braun-Blanquet in Braun-Blanquet, Gajewski, Wraber et Walas 1936

**Chenopodion muralis* Braun-Blanquet in Braun-Blanquet, Gajewski, Wraber et Walas 1936

***Teucrio capitati-Marrubietum incani* Jasprica et Milović 2016**, *ass. nova* hoc loco (holotypus rel. 4 in Tab. 6)

DESCRIPTION OF THE ASSOCIATIONS

The submerged beach

Posidonietum oceanicae [NATURA 2000 habitat code 1120 – *Posidonia* beds (*Posidonion oceanicae*)]

This is the site of the phanerogamic seagrass *Posidonia oceanica* (endemic to the Mediterranean), which has developed on the moving seabed between 2 m and 15 in depth.

This seagrass constitutes an effective barrier to wave motion, and thus effectively protects the shoreline from erosion and stabilises the sea bottom; moreover, it is a breeding site for many species ant is one of the main sources of oxygenation of the environment.

The shingle beach

Euphorbio pineae-Glaucietum flavi [NATURA 2000 habitat code 121 – Annual vegetation of drift lines (*Euphorbion peplis*)]

This therophytic halo-nitrophilous pioneer vegetation from the Shingle beach is only fragmentarily developed. It occupies a very small surface area near the port. The *Glaucium flavum* is missing in the relevé. The floristic composition of the association was as follows [Gauss-Krüger coordinates X=5677025 Y=4758542; date 21.3.2015; plot size 20 m^2; altitude 0–1 m a.s.l.; vascular plant cover 40 %; geological type: limestone; soil: brown littoral]: *Euphorbia pinea* (3), *Datura inoxia* (1), *Inula verbascifolia* (+), *Vitex agnus-castus* (+), *Senecio bicolor* ssp. *cineraria* (+), *Arum italicum* (+), *Marrubium incanum* (+), *Diplotaxis muralis* (+), *Teucrium capitatum* (+), *Ferula communis* (+), *Taraxacum officinale* (r), *Cistus monspeliensis* (r), *Oxalis corniculata* (r).

The low rocky coast

Limonietum anfracti typicum [NATURA 2000 habitat code 124 – Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp. (*Crithmo maritimi-Staticion*)]

The low rocky coast is subjected to the actions of the marine aerosol and is colonised by halo-chasmophytic vegetation of the *Limonietum anfracti typicum* subassociation (Tab. 1). The subassociation is characterised by *Limonium dictyophorum* (=*L. anfractum*), a species endemic to the southern coast of the eastern Adriatic that forms dense low-spreading formations that colonise the cracks in the rocks. The rocky coasts are largely exploited as holiday beaches.

More recently, *Limonium leprosorum* Bogdanović et Brullo, a species belonging to *L. cancellatum* group, was described and found on the Pelješac peninsula and the island of Korčula including some nearby islets (Bogdanović & Brullo, 2015). However, further research is required to demonstrate the presence of this taxon on the islet.

The Holm Oak forest

Myrto communis-Quercetum ilicis [NATURA 2000 habitat code 934 – *Quercus ilex* and *Quercus rotundifolia* forests]

This association covers more than 70 % of the islet's surface area. It is characterised by the absence of any deciduous species and represents the driest forest or macchia with *Quercus ilex* on the eastern Adriatic coast (Tab. 2, rels. 9–21). In our case, a hornbeam (*Ostrya carpinifolia*) was recorded in the association (Tab, 2, rel. 15). In the study area, the association is developed as macchia of 3 to 5 m height. The ground layer has extremely low vegetation cover (up to 10 %) and consists of a low number of species, of which the most common was *Cyclamen repandum*. In addition, some climbing species are completely missing (e.g. *Lonicera implexa*, etc.). In our case, the extremely low herb layer coverage cannot be attributed to potentially low light intensity as a limiting factor (e.g. Vukelić, 2012), but rather the presence of the large population of fallow deer (cf. Barčić, 1942). Deer exhibit direct and indirect effects on forest communities by reducing host plant densities or altering forest structure (Vojinović & Miočić, 1994; Shipley, 1999; Rooney, 2001; etc.).

Low macchia

Myrto communis-Pistacietum lentisci

The association forms small patches between halophytic vegetation (*Limonietum anfracti typicum*) and the *Pistacio lentisci-Pinetum halepensis* association (Tab. 2, rels. 22–23). This association has developed as low (mostly between 1 and 1.5 m) and dense shrub formations on the south-eastern part of the islet. It covers larger surface areas on some islets along the northern coast of the Pelješac peninsula (Jasprica *et al*., 2014a, 2015b). Due to the influences of the strong southern winds, it is mostly composed of only a small number of plant species.

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

The Aleppo pine forests refer to the associations *Querco ilicis-Pinetum halepensis* and *Pistacio lentisci-Pinetum halepensis*. These associations cover more than 20 % of the islet's surface area.

Querco ilicis-Pinetum halepensis

The association occupies a very limited surface area on the northern side of the monastery (Tab. 2, rels. 1–4). *Quercus ilex* is developed in the brush layer and *Pinus halepensis* is the dominant taxon. Despite the strong anthropogenic influence (clearing, grazing) (cf. Barčić, 1942), it has value from the aesthetic and ecological point of view.

Pistacio lentisci-Pinetum halepensis

This association is developed over the area north of the monastery and partly on the eastern part of the islet (Tab. 2, rels. 5–8). The number of plant taxa in the association is about five times smaller than in those reported from the Mid-Adriatic (Trinajstić & Kamenjarin, 1998, 2001). On the islet, some common taxa from this association (e.g. *Lonicera implexa*, *Juniperus oxycedrus* ssp. *macrocarpa*, *Viburnum tinus*, *Rubia peregrina*, etc.) are missing. Furthermore, among companions, *Brachypodium retusum* is a quite sporadic taxon. It can be assumed that the association has developed here on the remains of long-abandoned olive groves. The negative impact of deer on the structure and floral composition of the wood cannot be ignored.

Garrigue with *Cistus monspeliensis*

Garrigue covers a very small surface area on the islet. It is developed in the north-western part of the islet on the area formerly under crops (at the locality of Lokva) and near the monastery garden. This association does not have a floral composition typical of garrigue, and, alongside *Cistus monspeliensis*, *Pistacia lentiscus* and *Teucrium capitatum* were the most abundant (Tab. 3). The presence of some characteristic species of ruderal and weed vegetation (*Stellarietea media*, *Artemisietea vulgaris*) suggests that the environment is still highly affected by man. The highly anthropogenic composition of *Cistus monspeliensis* garrigue within the study area does not permit the provision of a precise syntaxonomical reference in terms of association.

Within garrigue of the *Cisto cretici-Micromerietea julianae* (=*Erico-Cistetea*) class, the *Cisto-Ericetum arboreae* Horvatić 1958 (=*Erico arboreae-Arbutetum unedonis* Allier & Lacoste 1980, p.p.) association previously reported by Barčić (1978–1979), though without phytosociological relevés, was not found on the islet during this study.

Wall vegetation

Parietarion judaicae [NATURA 2000 habitat code 8210 – Calcareous rocky slopes with chasmophyic vegetation (*Tortulo-Cymbalarietalia*)]

Wall vegetation is included in chasmophytic synanthropic vegetation of the *Parietarietea judaicae* class. On the islet, this vegetation was only found at three sites near the monastery garden (Tab. 4). In general, some of the characteristic taxa of thermophilous vegetation (*Umbilicus horizontalis*, *Cymbalaria muralis*, *Asplenium ruta-muraria*, etc.) mainly linked to *Parietarion judaicae* or upper syntaxa are not found on the islet (*sensu* Brullo & Guarino, 1998).

Although *Corydalis acaulis* has its primary habitats in rocky sites within the order *Centaureo dalmaticae-Campanuletalia pyramidalis* (Trinajstić, 2008; Milović, 2015), here it occurs exclusively on the islet's walls. Further, the population of this species is estimated to consist of fewer than 30 individuals.

Thermophilous chasmophytic vegetation

Centaureo cuspidatae-Portenschlagiellion ramosissimae [NATURA 2000 habitat code 8210 – Calcareous rocky slopes with chasmophyic vegetation (*Centaureo-Campanuletalia*)]

The rocky vegetation is characterized by a high abundance of *Inula verbascifolia* and *Campanula pyramidalis* on small rocky surfaces at higher altitudes on the islet (Tab. 5). Some species from *Quercetea ilicis* (*Ephedra fragilis* ssp. *campylopoda*) and *Thero-Brachypodietea ramosi* (*Allium subhirsutum*) have a relatively significant degree of coverage. Species of wall vegetation are completely missing.

Piptatheretum miliaceae (=*Oryzopsetum miliaceae*) [NATURA 2000 habitat code 6220* – Pseudosteppe with grasses and annuals *Thero-Brachypodietea*]

This association occurs within the monastery garden. The floristic composition of the association was as follows [Gauss-Krüger coordinates X=5676843 Y=4758731; date 4.7.2015; plot size 15 m^2; altitude 1 m a.s.l.; vascular plant cover 100 %; geological type: limestone; soil: brown littoral soil]: *Piptatherum miliaceum* (4), *Rubus ulmifolius* (1), *Conyza canadensis* (1), *Lactuca serriola* (1), *Delphinium staphisagria* (1), *Medicago sativa* (+).

Within the *Thero-Brachypodietea ramosi* class, the *Brachypodio ramosi-Trifolietum stellati* Horvatić in Horvat *et al*. 1974 association previously reported by Barčić (1978–1979), but not documented by phytosociological relevés, was not found on the islet. Currently these open rocky habitats, previously observed in the form of a narrow strip between macchia and halophytic vegetation, do not exist on the islet.

Teucrio capitati-Marrubietum incani, *ass. nova* hoc loco (Tab. 6, holotypus rel. 4, Fig. 3)

This newly proposed association is mostly developed on the sites of previous cereal crops (wheat, barley, oat, rye) on the nitrophilous soils. This vegetation was also found near the coast in untilled habitats. The characteristic taxa *Marrubium incanum* and *Delphinium staphisagria* (the latter an endangered and strictly protected taxon in Croatia), are in relations of co-dominance with *Teucrium capitatum*. The vegetation is connected with the dynamic series of *Fraxino orni-Quercion ilicis* and *Oleo sylvestris-Ceratonion siliquae* (Fig. 2; and Brullo *et al*., 2007), and has been observed on the edges of this patch partially overgrown by garrigue with *Cistus monspeliensis* or macchia. This association differed from the *Scolymo-Marrubietum incani* Horvatić et Hodak 1965, distributed in the Illyrian-Adriatic Karst area, and mostly linked with the dynamic series of the *Thero-Brachypodietea ramosi* (Jasprica & Carić, 2002). The association is subordinated to the

Fig. 3. The *Teucrio capitati-Marrubietum incani* Jasprica et Milović 2016 association, *ass. nova* hoc loco, on the islet of Badija.

Chenopodietalia muralis order, which represents highly nitrophilous pioneer ruderal vegetation on habitats that are well exposed and sunny, and is found in Mediterranean regions (cf. Pandža *et al*., 2005; Biondi *et al*., 2014).

Floristic notes

In 2014 and 2015, 27 new vascular plant taxa (26 species and one subspecies) were recorded on the islet. They are [abbreviations: IAS – invasive alien species, LC – Least Concern taxon, SP – strictly protected taxon]: *Ailanthus altissima* (Mill.) Swingle (IAS), *Aphanes arvensis* L., *Aster squamatus* (Spreng.) Hieron (IAS), *Atriplex prostrata* Boucher ex DC. in Lam. et DC., *Bromus rigidus* Roth, *Carpobrotus acinaciformis* (L.) L. Bolus (IAS), *Chenopodium album* L., *Chenopodium murale* L. (DD), *Coronilla varia* L., *Diplotaxis muralis* (L.) DC., *Filago vulgaris* Lam., *Galium murale* (L.) All., *Hedera helix* L., *Inula conyza* DC., *Lactuca serriola* L., *Lactuca viminea* (L.) J. et C.Presl, *Lolium multiflorum* Lam., *Medicago sativa* L., *Opuntia ficus-indica* (L.) Miller (IAS), *Ostrya carpinifolia* Scop., *Plantago coronopus* L., *Plantago holosteum* Scop. (LC), *Posidonia oceanica* (L.) Delile (SP), *Teucrium capitatum* L., *Trifolium arvense* L., *Verbascum blattaria* L. and *Vicia angustifolia* L. ssp. *angustifolia*.

Thus the entire flora of the islet of Badija now consists of 409 vascular plant taxa. Of the newly recorded taxa, four are considered to be invasive. One taxon is strictly protected by statute. The Red List categories Least Concern (LC) and Data Deficient (DD) are assigned to one species in each.

In this study, some taxa previously recorded on the islet have not been confirmed. These taxa can be categorized into three groups: i) taxa of the coastal halophytic communities (*Salicornia perennans* ssp. *perennans*, *Salsola soda*, *S. kali*, *Glaucium flavum*, *Cakile maritima*, etc.), ii) taxa of the dry grasslands including olive groves (mainly *Orchidaceae*, *Hermodactylus tuberosus*, etc.), iii) nitrophilous and ruderal taxa (*Agrostemma githago*, etc.).

CONCLUSIONS

The sea bed is colonized by a dense population of submerged *Posidonia oceanica*. In the part of the islet near the sea, the coast is colonized by halophytes. There is a vegetation belt with locally large stands of *Limonium dictyophorum*. Inward from this belt vegetation with *Euphorbia pinea* can be found preceding the low macchia dominated by *Pistacia lentiscus*. In the intermediate part, between the *Quercus ilex* forest and low macchia, on the southern slopes and at lowest altitudes, there is a belt of pine woods. The garrigue and nitrophilous vegetation are the result of a long history of disturbance. The latter is connected with the dynamic series of *Fraxino orni-Quercion ilicis* vegetation. Near the top of the islet, the slope is not steep and small vertical rocky cliffs are present with only a few chasmophytic species, while wall vegetation is found only in the area of high visitor attendance.

The vegetation on the islet is under significant anthropogenic influence, primarily due to the presence of fallow deer. Furthermore, part of the open rocky habitat has become overgrown during the last several decades. On the other hand, previously well developed nitrophilous and ruderal habitats (crops, stables for livestock, etc.) are now scarce.

Classification of the distinguished vegetation units into habitat types according to Habitats Directive 92/43/EEC revealed nine habitat types. These communities are an important part of the Croatian natural heritage and they must in fact be protected according to international obligations. However, management plans must ensure that the land of these types of habitat is used in a sustainable way. The islet still meets the criteria for Significant Landscape level of protection, but the authorities should take measures regarding the regulation of the size of the population of deer on the islet. Further infringement of the islets with respect to activities carried out during the summer (daily trips for recreation) is not to be expected.

ACKNOWLEDGEMENTS

Research funding came from the Public Institution for Management of Protected Natural Values in the Dubrovnik-Neretva County, Dubrovnik. We thank Dr Marija Crnčević for her very useful contributions and help. Special thanks go to Friar Dr Stipe Nosić, Guardian of the Friars Minor Franciscan Monastery in Dubrovnik, who has kindly sent us the articles of Friar Berard Barčić. The authors thank Mirjana Jeričević and Nebojša Jeričević for their support during the field research. Thanks also are extended to Steve Latham (UK) for improving the English. We would like to thank the two anonymous reviewers and the editors for their constructive comments on an earlier version of this manuscript.

Received July 28, 2015

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APPENDIX 1

Locality and date of relevés

Table 1. *Limonietum anfracti typicum*: Rel. 1. X=5677164 Y=4758503, 17.5.2015; Rel. 2. X=5677297 Y=4758584, 17.5.2015, Rel. 3. X=5677348 Y=4758702, 17.5.2015, Rel. 4. X=5677025 Y=4759295, 17.5.2015, Rel. 5. X=5676243 Y=4759348, 17.5.2015, Rel. 6. X=5676106 Y=4758865, 17.5.2015, Rel. 7. X=5677248 Y=4758534, 4.7.2015. **Table 2.** *Querco ilicis-Pinetum halepensis*: Rel. 1. X=5677062 Y=4758577, 21.3.2015; Rel. 2. X=5676981 Y=4758710, 21.3.2015; Rel. 3. =5676706 Y=4758825, 21.3.2015; Rel. 4. X=5677408 Y=4758946, 17.5.2015; *Pistacio lentisci-Pinetum halepensis*: Rel. 5. X=5676722 Y=4758865, 21.3.2015; Rel. 6. X=5676762 Y=4758876, 21.3.2015; Rel. 7. X=5677226 Y=4758577, 20.12.2014; Rel. 8. X=5677232 Y=4758718, 17.5.2015; *Myrto communis-Quercetum ilicis*: Rel. 9. X=5676608 Y=4759022, 21.3.2015; Rel. 10. X=5676338 Y=4758762, 21.3.2015; Rel. 11. X=5676260 Y=4759127, 21.3.2015; Rel. 12. X=5676300 Y=4758673, 21.3.2015; Rel. 13. X=5677111 Y=4758701, 21.3.2015; Rel. 14. X=5677118 Y=4759219, 17.5.2015; Rel. 15. X=5676593 Y=4759293, 17.5.2015; Rel. 16. X=5677106 Y=4758812, 4.7.2015; Rel. 17. X=5677035 Y=4758858, 4.7.2015; Rel. 18. X=5677042 Y=4758907, 4.7.2015; Rel. 19. X=5677097 Y=4758745, 4.7.2015; Rel. 20. X=5676248 Y=4758870, 4.7.2015; Rel. 21. X=5677059 Y=4758862, 4.7.2015; *Myrto communis-Pistacietum lentisci*: Rel. 22. X=5677340 Y=4758714, 17.5.2015; Rel. 23. X=5677240 Y=4758552, 4.7.2015. **Table 3.** Garrigue with *Cistus monspeliensis*: Rel. 1. X=5676204 Y=4759033, 4.7.2015; Rel. 2. X=5676214 Y=4759068, 4.7.2015; Rel. 3. X=5676230 Y=4759060, 4.7.2015; Rel. 4. X=5676868 Y=4758741; 4.7.2015. **Table 4.** *Parietarion judaicae:* Rel. 1. X=5676914 Y=4758709, 21.3.2015; Rel. 2. X=5676660 Y=4759048, 21.3.2015; Rel. 3. X=5676764 Y=4758634, 17.5.2015. **Table 5.** *Centaureo cuspidatae-Portenschlagiellion ramosissimae*: Rel. 1. X=5676671 Y=4759043, 21.3.2015; Rel. 2. X=5677059 Y=4758862, 4.7.2015. **Table 6**. *Teucrio capitati-Marrubietum incani*: Rel. 1. X=5676200 Y=4759016; 21.3.2015; Rel. 2. X=5676200 Y=4759016; 21.3.2015; Rel. 3. X=5676968 Y=4758607; 21.3.2015; *Rel. 4. X=5676209 Y=4759004; 17.5.2015 (**holotypus*); Rel. 5. X=5676229 Y=4759004; 17.5.2015; Rel. 6. X=5676217 Y=4759045; 17.5.2015; Rel. 7. X=5676245 Y=4759007; 17.5.2015; Rel. 8. X=5676207 Y=4759087; 17.5.2015; Rels. 9-13. X=5676764 Y=4758634, 17.5.2015.

Tab. 1. *Limonietum anfracti typicum* Ilijanić et S. Hećimović 1982.

No. of relevés	1	2	3	4	5	6	7	
No. of taxa	8	4	4	5	11	3	4	P
Altitude (m a.s.l.)	0	0	0	1	1	0	0	r
Slope (°)	.	.	.	10	10	2	2	e
Aspect	.	.	.	N	N	S	SE	s.
Vascular plant cover (%)	40	10	20	30	5	5	10	
Plot size (m²)	20	20	20	20	20	20	25	%
Char. Ass.								
Limonium dictyophorum	+	3	4	4	1	1	1	100
Crithmo maritimi-Staticetea								
Euphorbia pinea	+	+	+	+	+	+	.	86
Crithmum maritimum	.	.	+	.	+	.	+	43
Senecio bicolor ssp. *cineraria*	3	.	.	.	.	.	.	14
Vincetoxicum hirundinaria ssp. *adriaticum*	.	.	.	+	.	.	.	14
Silene vulgaris ssp. *angustifolia*	.	.	.	.	+	.	.	14
Inula crithmoides	.	.	.	.	.	+	.	14
Companions								
Asplenietea trichomanis								
Inula verbascifolia	+	1	1	1	+	.	.	71
Capparis orientalis	.	.	.	.	+	.	+	29
Nerio oleandri-Tamaricetea africanae								
Vitex agnus-castus	1	.	.	.	.	.	+	29
Artemisietea vulgaris								
Dittricia viscosa	.	+	.	+	.	.	.	29
Stellarietea mediae								
Delphinium staphisagria	3	.	.	.	.	.	.	14
Chenopodium album	+	.	.	.	.	.	.	14
Quercetea ilicis								
Arum italicum	+	.	.	.	.	.	.	14
Thero-Brachypodietea ramosi								
Brachypodium retusum	.	.	.	.	+	.	.	14
Reichardia picroides	.	.	.	.	+	.	.	14
Valantia muralis	.	.	.	.	+	.	.	14
Allium subhirsutum	.	.	.	.	1	.	.	14
Ammophiletea								
Elymus pycnanthus	.	.	.	.	+	.	.	14

Tab. 2. Forest vegetation: *Querco ilicis-Pinetum halepensis* Loisel 1971 (rels. 1–4);

Pistacio lentisci-Pinetum halepensis De Marco, Veri et Caneva 1984 (rels. 5–8),
Myrto communis-Quercetum ilicis (Horvatić 1963) Trinajstić (1976) 1985 (rels. 9–21),
Myrto communis-Pistacietum lentisci (Molinier 1954) Rivas-Martínez 1975 (rels. 22–23).

No. of relevés	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
No. of taxa	9	13	9	10	13	11	9	8	10	12	12	13	8	12	12	10	9	9	8	12	14	5	6
Altitude (m a.s.l.)	3	5	30	5	30	30	4	8	70	35	25	3	30	20	3	42	56	66	33	28	60	1	1
Slope (°)	5	10	5	.	5	5	.	10	20	20	.	5	20	20	10	.	40	5	5	5	40	5	5
Aspect	S	S	S	N	S	S	E	S	S	S	.	S	S	N	W	.	S	N	S	S	S	E	SE
Vascular plant cover (%)	90	90	80	100	90	90	95	90	90	100	100	100	100	90	90	95	100	100	90	90	80	100	90
Underbrush layer cover (%)	60	30	20	.	40	40	30	10	20	20	20	20	20	30	5	20	20	5	5	20	50	.	.
Herbaceous layer cover (%)	2	5	2	5	5	5	10	5	5	2	2	2	2	10	5	5	5	5	5	10	10	5	5
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	25	25
Vegetation height (m)	12	10	15–20	4	15	15	15	12	5	4	4	4	4	3	5	4	5	5	5	5	5	1	1
Quercetea ilicis, Pistacio-Pinion & Oleo sylvestris-Ceratonion siliquae																							
Pistacia lentiscus	+	2	3	r	3	3	2	1	1	2	2	3	3	2	2	1	1	1	1	1	1	3	4
Myrtus communis	+	2	+	1	.	.	+	2	+	3	2	1	2	1	+	1	+	+	1	1	1	2	2
Olea europaea var. *sylvestris*	.	1	+	.	.	.	.	.	+	2	.	3	1	2	+	.	3	.	+	1	4	.	.

Pinus halepensis	4	3	4	3	4	3	4	4	.	.	.	.	.	.	.	r	.	.	.	.	.	+	+
Ceratonia siliqua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	1	.	.
Juniperus phoenicaea ssp. *turbinata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Ephedra fragilis ssp. *campylopoda*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Fraxino orni-Quercion ilicis																							
Quercus ilex	3	2	3	2	1	+	1	+	4	4	3	2	4	4	4	4	1	4	4	4	1	.	.
Juniperus oxycedrus ssp. *oxycedrus*	.	+	+	.	+	+	.	+	+	+	+	+	+	3	2	1	+	+	+	+	+	.	.
Erica arborea	+	1	+	2	+	1	1	+	1	1	1	1	1	3	1	1	.	1	+	1	.	.	r
Phillyrea latifolia (incl. *Ph. media*)	.	1	.	.	.	+	+	+	2	1	+	2	3	1	+	2	4	3	2	+	3	.	.
Smilax aspera	.	1	.	+	.	.	+	.	.	1	+	1	.	.	.	+	+	+	+	+	+	.	.
Arbutus unedo	.	.	.	3	.	.	.	.	.	1	+	+	1	1	2	+	.	.	.	1	+	.	.
Arisarum vulgare	2	+	+	.	+	+	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Viburnum tinus	.	+	.	.	.	.	.	.	.	+	+	+	.	.	1	.	.	.	.	1	.	.	.
Laurus nobilis	.	.	.	+	.	.	.	.	.	+	+	+	.	.	2	r	.	.	.	.	1	.	.
Cyclamen repandum	+	.	.	r	+	+	.	.	+	.	+	+	.	+	+	.	.	.	.	.	.	.	.
Arum italicum	1	+	+	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ruscus aculeatus	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.
Asparagus acutifolius	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pistacia terebinthus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	+	.	.
Cupressus sempervirens	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Companions																							
Thero-Brachypodietea ramosi																							
Brachypodium retusum	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Blackstonia perfoliata	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Ferula communis	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuco valesiacae-Brometea erecti																							
Salvia officinalis	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Gladiolus illyricus	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Crithmo maritimi-Staticetea																							
Euphorbia pinea	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Asplenietea trichomanis																							
Inula verbascifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Nerio oleandri-Tamaricetea africanae																							
Vitex agnus-castus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Querco-Fagetea sylvaticae																							
Ostrya carpinifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Other companions																							
Bryophyta coll.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Cladonia spp.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ailanthus altissima	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Tab. 3. Garrigue with *Cistus monspeliensis*.

No. of relevés	1	2	3	4	
No. of taxa	6	6	2	10	
Altitude (m a.s.l.)	30	30	30	2	P
Slope (°)	.	.	.	5	r
Aspect	.	.	.	S	e
Vascular plant cover (%)	40	80	90	80	s.
Plot size (m²)	25	25	25	25	
Cisto-Micromerietea					
Cistus monspeliensis	3	4	5	4	4
Companions					
Thero-Brachypodietea ramosi					
Teucrium capitatum	1	1	+	+	4
Artemisietea vulgaris					
Dittrichia viscosa	+	+	.	+	3
Quercetea ilicis					
Pistacia lentiscus	.	1	.	2	2
Juniperus oxycedrus ssp. *oxycedrus*	+	.	.	.	1
Myrtus communis	.	.	.	+	1
Stellarietea mediae					
Delphinium staphisagria	1	+	.	1	3
Marrubium incanum	.	.	.	+	1
Ruta graveolens	.	.	.	+	1
Crithmo maritimi-Staticetea					
Euphorbia pinea	+	.	.	1	2
Other companions					
Ailanthus altissima	.	+	.	.	1
Melia azedarach	.	.	.	1	1

Tab. 4. *Parietarion judaicae* Segal 1969.

No. of relevés	1	2	3	
No. of taxa	6	4	2	P
Altitude (m a.s.l.)	3	70	1	r
Slope (°)	90	90	90	e
Aspect	N	E	E	s.
Vascular plant cover (%)	20	20	10	
Plot size (m²)	10	2	4	
Parietarietea judaicae and lower syntaxa				
Asplenium ceterach	2	1	.	2
Parietaria judaica	1	.	.	1
Veronica cymbalaria	.	+	.	1
Theligonum cynocrambe	+	.	.	1
Companions				
Artemisietea vulgaris				
Conyza canadensis	+	.	.	1
Asplenietea trichomanis				
Capparis orientalis	+	.	.	1
Tuberarietea guttatae				
Geranium rontudifolium	.	+	.	1
Crithmo maritimi-Staticetea				
Euphorbia pinea	.	.	+	1
Asplenietea trichomanis				
Corydalis acaulis	.	.	1	1
Other companion				
Bryophyta coll.	+	+	.	2

Tab. 5. *Centaureo cuspidatae-Portenschlagiellion ramosissimae* Trinajstić 1980.

No. of relevés	1	2	
No. of taxa	7	17	P
Altitude (m a.s.l.)	70	65	r
Slope (°)	90	90	e
Aspect	S	S	s.
Vascular plant cover (%)	10	30	
Plot size (m²)	6	20	
Asplenietea trichomanis			
Campanula pyramidalis	1	1	2
Inula verbascifolia	+	1	2
Companions			
Quercetea ilicis			
Cyclamen repandum	+	.	1
Prasium majus	+	.	1
Ephedra fragilis ssp. *campylopoda*	.	1	1
Asparagus acutifolius	.	+	1
Colutea arborescens	+	.	1
Thero-Brachypodietea ramosi			
Teucrium capitatum	.	+	1
Brachypodium retusum	.	+	1
Sideritis romana	.	+	1
Convolvulus althaeoides ssp. *tenuissimus*	.	+	1
Allium subhirsutum	.	1	1
Stellarietea mediae			
Mercurialis annua	+	.	1
Fumaria capreolata	+	.	1
Festuco valesiacae-Brometea erecti			
Salvia officinalis	.	+	1
Muscari comosum	.	+	1
Teucrium chamaedrys	.	+	1
Bituminaria bituminosa	.	+	1
Aethionema saxatile	.	+	1
Querco-Fagetea sylvaticae			
Coronilla emerus ssp. *emeroides*	.	+	1
Other companions			
Galium sp.	.	+	1
Orobanche sp.	.	+	1

Tab 6. *Teucrio capitati-Marrubietum incani* Jasprica et Milović 2016, *ass. nova* hoc loco

No. of relevés	1	2	3	4*	5	6	7	8	9	10	11	12	13	
No. of taxa	12	20	19	10	5	10	11	11	10	8	8	8	12	P
Altitude (m a.s.l.)	20	20	2	20	20	20	20	20	1	1	1	2	2	r
Slope (°)	.	.	5	.	.	.	.	.	1–2	1–2	1–2	1–2	1–2	e
Aspect	.	.	S	.	.	.	.	.	S	S	S	S	S	s.
Vascular plant cover (%)	70	90	20	60	40	30	30	30	70	70	70	40	80	
Plot size (m^2)	50	50	50	25	25	25	25	25	25	20	20	20	20	%
Char. Ass.														
Marrubium incanum	2	1	1	4	3	4	4	2	4	2	2	1	+	100
Delphinium staphisagria	+	1	+	+	.	+	.	+	+	2	+	+	+	87
Stellarietea mediae and lower syntaxa														
Ruta graveolens	.	+	.	.	+	1	+	.	.	+	.	+	.	46
Euphorbia peplus	1	+	+	+	.	.	.	.	.	+	.	.	.	38
Aphanes arvensis	+	r	.	+	.	.	.	.	.	.	.	.	.	23
Heliotropium europaeum	.	.	.	.	.	.	.	.	2	.	+	+	.	23
Euphorbia helioscopia	+	.	.	.	.	.	.	.	.	+	.	.	.	15
Cynodon dactylon	.	.	.	.	.	.	.	.	.	+	+	.	.	15
Fumaria capreolata	.	.	.	.	.	.	.	.	.	.	.	+	+	15
Silene vulgaris	.	.	.	.	.	.	.	.	.	.	.	+	+	15
Scrophularia peregrina	.	.	.	+	.	.	.	.	.	.	.	.	+	15
Convolvulus arvensis	.	+	.	.	.	.	.	.	.	.	.	.	.	8
Chenopodium murale	.	.	.	+	.	.	.	.	.	.	.	.	.	8
Papaver rhoeas	.	.	.	.	.	.	.	+	.	.	.	.	.	8
Malva sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	+	8
Thero-Brachypodietea ramosi														
Teucrium capitatum	2	1	1	2	1	1	+	3	2	2	2	1	3	100
Ferula communis	+	5	2	.	+	1	+	+	.	.	.	.	+	62
Centaurium erythraea ssp. erythraea	.	+	.	.	.	.	.	.	.	.	.	.	.	8
Sideritis romana	.	+	.	.	.	.	.	.	.	.	.	.	.	8
Crithmo maritimi-Staticetea														
Euphorbia pinea	+	+	1	+	+	.	+	+	1	.	+	+	+	85
Senecio bicolor ssp. *cineraria*	.	.	.	.	.	.	.	.	+	.	+	.	+	23
Quercetea ilicis														

Pistacia lentiscus	+	+	+	.	.	+	+	+	+	.	.	.	+	62
Arum italicum	+	3	1	.	.	+	+	+	.	.	.	.	.	46
Myrtus communis	.	+	+	.	.	.	.	.	.	.	.	.	.	15
Juniperus oxycedrus ssp. *oxycedrus*	.	+	.	.	.	.	.	.	.	.	.	.	.	8
Olea europaea var. *sylvestris*	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Arisarum vulgare	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Artemisietea vulgaris														
Dittrichia viscosa	+	.	.	1	.	+	+	+	.	.	.	.	.	38
Ailanthus altissima	.	.	.	.	.	+	.	+	+	.	.	.	+	31
Sonchus oleraceus	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Conyza canadensis	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Rosmarinetea officinalis														
Cistus monspeliensis	+	1	.	.	.	+	+	1	.	.	.	.	.	38
Nerio oleandri-Tamaricetea africanae														
Vitex agnus-castus	.	.	.	+	.	.	+	.	+	.	.	.	.	23
Festuco valesiacae–Brometea erecti														
Hypericum perforatum	.	.	.	.	.	.	+	.	+	.	.	.	.	15
Colchicum hungaricum	.	+	.	.	.	.	.	.	.	.	.	.	.	8
Muscari comosum	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Petrorhagia saxifraga	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Asplenietea trichomanis														
Ficus carica	.	+	.	.	.	.	.	.	.	.	.	.	.	8
Misopates orontium	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Capparis orientalis	.	.	.	.	.	.	.	.	.	+	.	.	.	8
Querco-Fagetea sylvaticae														
Tamus communis	.	+	.	.	.	.	.	.	.	.	.	.	.	8
Morus alba	.	+	.	.	.	.	.	.		.	.	.	.	8
Tuberarietea guttatae														
Galium murale	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Geranium rotundifolium	.	.	+	.	.	.	.	.	.	.	.	.	.	8
Other companions														
Bryophyta coll.	.	.	r	.	.	.	.	.	.	.	.	.	.	8
Melia azedarach	.	.	.	.	.	.	.	.	.	.	+	.	.	8
*Holotypus														