Flora and vegetation of the islet of Mlin (Pakleni Archipelago, Eastern Adriatic)

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Abstract

A floristic and vegetation study of the islet Mlin (Pakleni Archipelago near island of Hvar, Central Dalmatia, surface area of 1.1 ha) resulted in the finding of 39 taxa and three plant associations belonging to halophytic vegetation, macchia and garigues. The islet is not a subject to any human interference, so the floristic diversity and vegetation structure are the result of the geographical position, exposure to the influences of the open sea (wind, waves) and non-anthropogenic stochastic events.

Keywords: flora, Mlin, Pakleni Archipelago, vegetation

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Sažetak

Floističkim i vegetacijskim istraživanjem otočića Mlin (Pakleni otoci blizu otoka Hvara, srednja Dalmacija, 1,1 ha) zabilježeno je 39 svojti te tri biljne zajednice koje pripadaju halofitskoj vegetaciji, makiji i garizima. Otočić je bez ikakvog ljudskog utjecaja, pa su biljna raznolikost i struktura vegetacije rezultat zemljopisnog položaja, izloženosti utjecajima otvorenog mora (vjetar, valovi) te neantropogenih stohastičkih događaja.

Ključne riječi: flora, Mlin, Pakleni otoci, vegetacija

Introduction

The Pakleni Archipelago (Pakleni or Paklinski otoci) is a group of 21 islands forming an approximately 10 km long archipelago. It is situated North-West of the island of Hvar and belongs to the group of Central Dalmatian Islands. According to current classification of islands (Duplančić Leder et al. 2004) the archipelago consists of only one island (Sv. Klement), but as many as 15 islets (in alphabetical order: Borovac, Borovac, Dobri otok, Gališnik, Gojca, Jerolim, Marinkovac, Mlin, Paržanj, Planikovac, Pokonji dol, Stambedar, Travna, Vlaka and Vodnjak Veli) and five reefs (Baba, Karbun, Lengva, Pločice and Vodnjak Mali). The whole archipelago is protected as a significant landscape (Anonymous 1968).

With an area of 1.1591 ha, the islet of Mlin is the smallest islet of the Pakleni Archipelago. It has an oval shape, with 150 m maximal length and 90 m maximal width, while the length of the coastline is 424 m. It is situated on the southeastern part of the archipelago, between the islets of Marinkovac and Bobovac (Fig. 1). On the 1:5000 topographic map the islet is named Prisega. Similarly, local people use the longer name Prisega od juga ("protection from the South") since it constitutes a natural protection for the adjacent Mlini Bay from the southern winds and waves coming from the open sea. There is only a 40 m long and not more than 1 m deep channel between Mlin and Marinkovac, so it is not navigable for boats but easily accessible by swimming or even walking. Therefore, on low resolution maps the islet is sometimes shown as a promontory of the islet of Marinkovac.

The flora of the Pakleni Archipelago has been poorly investigated to date. Only the largest island (Sv. Klement) has been systematically studied (Magajne 2010); however even these data have not been published and are hardly accessible. As for other islets and reefs, only few records from Pločice, Stambedar, Dobri otok, Marinkovac and Jerolim exist (Nikolić 2018).

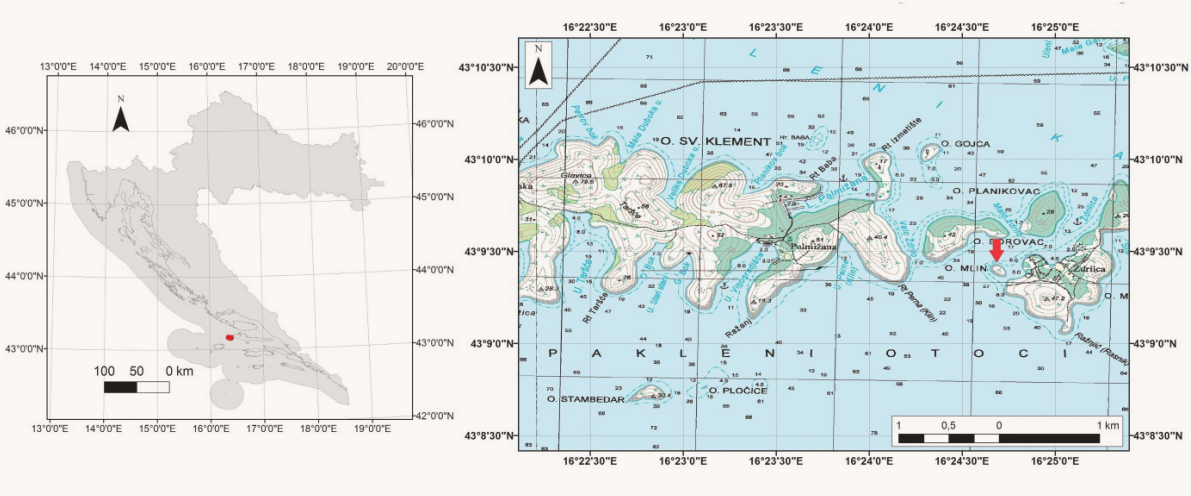

Figure 1. Geographical position of the islet of Mlin.

Material and methods

The field study of the islet of Mlin was carried out on two occasions, in August 2017 and in June 2018. Taxa were identified using Tutin et al. (1968-1980, 1993), Pignatti (1982) and Domac (1994). Although the study was performed during summer months when therophytes are usually already dry, identification was still possible in 2018, since the summer had many periods of rain and the vegetation was still vigorous. Collected specimens were stored in the ZA herbarium collection (Thiers 2018), digitized according to Šegota et al. (2017) and made publicly available via the Flora Croatica database (Nikolić 2018) and ZA & ZAHO Virtual Herbarium (Rešetnik & Šegota 2018). Nomenclature follows Nikolić (2018).

The vegetation study included an assessment of plant coverage and abundance according to the expanded Braun-Blanquet scale (Barkman et al. 1964, Braun-Blanquet 1964, Dierschke 1994) on the 9 plots with an area of 25 square meters. The coordinates of the vegetation relevés are listed here for each association: *Plantagino holostei-Limonietum cancellati* Horvatić (1934) 1939 – rel. 01: X=5615133 Y=4780091; rel. 02: X=5615211 Y=4780131; rel. 03: X=5615127 Y=4780144; *Myrto communis-Pistacietum lentisci* (Molinier 1954) Rivas-Mart. 1975 – rel. 01: X=5615216 Y=4780111; rel. 02: X=5615197 Y=4780134; rel. 03: X=5615178 Y=4780152; *Erico manipuliflorae-Cistetum cretici* Horvatić 1958 – rel. 01: X=5615189 Y=4780094; rel. 02: X=5615188 Y=4780115; rel. 03: X=5615159 Y=4780134. The syntaxonomical system proposed by Mucina et al. (2016) and Škvorc et al. (2017) was applied. The life forms (therophytes - T, geophytes - G, hemicryptophytes - H, chamaephytes - Ch and phanerophytes - P) follows the Raunkiaer's system (Raunkiaer 1934) as proposed by Horvat (1949). Floristic elements were designated according to Horvatić (1963a, b) and Horvatić et al. (1967-1968), including Eurasian (EUAS), circum-Mediterranean (CME), East Mediterranean (EME), Illyrian-Adriatic endemic (IADE), Illyrian-Apennine (IAP), Mediterranean-Atlantic (MEAT), South European-Mediterranean (SEUME) and widespread plants taxa (WSP). Taxa listed in the Red Book of Vascular flora of Croatia (Nikolić & Topić 2005), are marked with their corresponding IUCN status (IUCN 2016). The abbreviation SPT indicates strictly protected taxa according to Anonymous (2013).

Results and discussion

Floristic study of the islet of Mlin resulted in the finding of 39 taxa (33 species and 6 subspecies), belonging to 25 families, given alphabetically as follows:

Amaryllidaceae
Allium sphaerocephalon L. – G; WSP
Allium flavum L. – G; SEUME

Anacardiaceae
Pistacia lentiscus L. – P; CME

Apiaceae
Crithmum maritimum L. – Ch; MEAT

Asclepiadaceae
Vincetoxicum hirundinaria Medik. ssp. *adriaticum* (Beck) Markgr. – G; IADE; SPT

Asparagaceae
Asparagus acutifolius L. – G; CME

Asteraceae
Dittrichia viscosa (L.) Greuter – H; CME
Filago vulgaris Lam. – T; WSP
Inula crithmoides L. – Ch; MEAT
Inula verbascifolia (Willd.) Hausskn. – Ch; IADE

Caryophyllaceae
Silene vulgaris (Moench) Garcke ssp. *angustifolia* Hayek – H; IADE
Silene sedoides Poir. – T; CME

Chenopodiaceae
Arthrocnemum fruticosum (L.) Moq. – Ch; SEUME

Cichoriaceae
Reichardia picroides (L.) Roth – H; CME

Cistaceae
Cistus monspeliensis L. – P; CME
Cistus incanus L. ssp. *creticus* (L.) Heywood – P; EME
Fumana thymifolia (L.) Spach ex Webb – Ch; CME

Cupressaceae
Juniperus phoenicea L. – P; CME

Cyperaceae
Carex flacca Schreb. ssp. *serrulata* (Biv.) Greuter – G; CME
Schoenus nigricans L. – H; WME

Ericaceae
Erica multiflora L. – P; EME

Euphorbiaceae
Euphorbia spinosa L. – Ch; CME

Fabaceae
Coronilla emerus L. ssp. *emeroides* Boiss. et Spruner – P; EME
Dorycnium hirsutum (L.) Ser. – Ch; CME
Lotus cytisoides L. – Ch; CME

Gentianaceae
Blackstonia perfoliata (L.) Huds. – T; MEAT
Centaurium pulchellum (Sw.) Druce – T; EUAS

Lamiaceae
Rosmarinus officinalis L. – P; CME

Linaceae
Linum strictum L. ssp. *strictum* – T; CME

Myrtaceae
Myrtus communis L. – P; CME

Pinaceae
Pinus halepensis Mill. – P; CME

Plumbaginaceae
Limonium cancellatum (Bernh. ex Bertol.) Kuntze – H; IAP; SPT

Poaceae
Brachypodium retusum (Pers.) P. Beauv. – H; CME
Desmazeria rigida (L.) Tutin – T; MEAT
Elymus pycnanthus (Godr.) Melderis – G; CME; NT
Koeleria splendens C. Presl – H; SEUME

Primulaceae
Anagallis arvensis L. – T; WSP

Smilacaceae
Smilax aspera L. – P; CME

Verbenaceae
Vitex agnus-castus L. – P; CME

The floristic diversity of small islands is influenced more strongly by their habitat diversity than by their size (Pandža & Milović 2015) meaning that islets of the same size will differ in the number of species if they differ in habitat diversity. Even a small proportion of anthropogenic habitats can significantly enrich the flora of such an islet (Limić et al. 2018). The rather small number of taxa on the islet of Mlin is a consequence of the complete absence of human influence, since the islet has never been used for activities such as agriculture, tourism, recreation etc. Moreover, the lack of soil over the dominant limestone bedrock and the exposure to the open sea (winds and waves) also contributes to small number of taxa. Phanerophytes account for 28.2%, chamaephytes 20.5%, hemicryptophytes and geophytes 18.0% each, and therophytes 15.4% of the flora (Fig. 2). The low number of therophytes, which are usually predominant on Dalmatian islands (e.g. Jasprica et al. 2006, Jasprica & Ruščić 2013, Skelin et al. 2014), also clearly indicates the absence of any human impact on the islet.

The families with the highest number of taxa recorded on the islet of Mlin are *Asteraceae* (10.3%), *Poaceae* (10.3%) and *Fabaceae* (7.7%). In the chorological spectrum, Mediterranean plants dominate with 79.5%, including Circum-Mediterranean (51.3%), Mediterranean-Atlantic (10.3%), South European-Mediterranean (7.7%) and other Mediterranean floral elements (Fig. 2). The dominant families and chorological groups clearly demonstrate the Mediterranean phytogeographical position of the islet. Only one red-listed, near threatened (NT) species (*Elymus pycnanthus*) and two strictly protected taxa (*Vincetoxicum hirundinaria* ssp. *adriaticum* and *Limonium cancellatum*) were recorded on the islet. The flora completely lacks adventive and invasive species, which can also be explained by the complete absence of any anthropogenic influence.

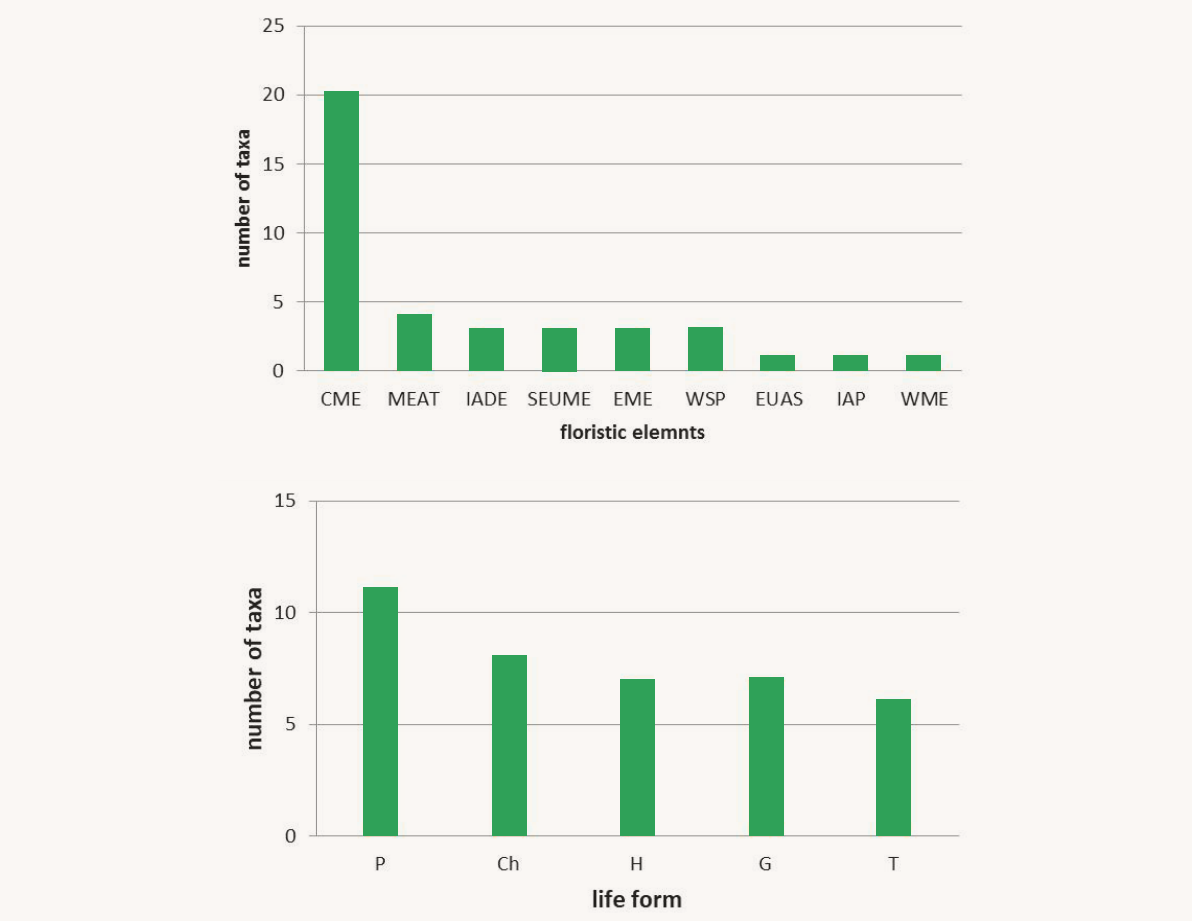

Figure 2. Floristic elements and life forms of the flora of the islet of Mlin. For abbreviations see Material and Methods.

As for vegetation, three types have been recognized, as follows:

Halophytic vegetation

Halophytic vegetation is developed in a coastal zone that is approximately 10 m wide on the eastern and 25 m wide on the western part of the islet. It belongs to the association *Plantagino holostei-Limonietum cancellati* Horvatić (1934) 1939, with low vascular plant cover (Table 1). Three taxa (*Crithmum maritimum, Limonium cancellatum* and *Elymus pycnanthus*) were found in all relevés. Facies with *Schoenus nigricans* (subass. *schoenetosum* Horvatić 1963) can be found on the northern coast of the islet, while on the southern coast with higher positions *Inula verbascifolia* becomes abundant.

Table 1. *Plantagino holostei-Limonietum cancellati* Horvatić (1934) 1939

CRITHMO-STATICETEA Br.-Bl. in Br.-Bl. et al. 1952 *CRITHMO-STATICETALIA* Molinier 1934 **Limonion anfracti-cancellati** (Horvatić 1934) Mucina in Mucina et al. 2016 *Plantagino holostei-Limonietum cancellati* Horvatić (1934) 1939				
Relevé No.	1	2	3	Presences
No. of taxa	8	6	8	
Plot size (m2)	25	25	25	
Altitude (m a.s.l.)	1	1	1	
Aspect	W	E	NW	
Slope (°)	2	0	1	
Vascular plant cover	5	10	5	
Charact. and diff. taxa of the ass.				
Limonium cancellatum	1	+	2m	3
Charact. and diff. taxa of the upper units				
Crithmum maritimum	2m	2a	2m	3
Silene vulgaris ssp. *angustifolia*	1		+	2
Lotus cytisoides	1	+		2
Silene sedoides	+		+	2
Other species				
Elymus pycnanthus	1	1	+	3
Dittrichia viscosa		+		1
Reichardia picroides	+	+		2
Inula crithmoides			+	1
Schoenus nigricans			1	1
Inula verbascifolia	1			1

Macchia vegetation

Vegetation of macchia is developed mostly on the eastern part of the islet, forming a discontinuous belt of low, up to 1 m high shrubs. It belongs to the association *Myrto communis-Pistacietum lentisci* (Molinier 1954) Rivas-Mart. 1975. and is dominated by *Pistacia lentiscus* and *Myrtus communis*, with a rather short growth due to exposure to the winds and waves from the open sea. Rather dense formation does not allow the penetration of any heliophilous species; however the presence of typically garigue genera *Cistus* and *Erica* indicates its transitional character.

Table 2. *Myrto communis-Pistacietum lentisci* (Molinier 1954) Rivas-Mart. 1975

QUERCETEA ILICIS Br.-Bl. ex A. Bolòs et O. de Bolòs in A. Bolòs y Vayreda 1950 *PISTACIO LENTISCI-RHAMNETALIA ALATERNI* Rivas-Mart. 1975 **Oleo-Ceratonion siliquae** Br.-Bl. ex Guinochet et Drouineau 1944 *Myrto communis-Pistacietum lentisci* (Molinier 1954) Rivas-Mart. 1975				
Relevé No.	1	2	3	Presences
No. of taxa	8	6	7	
Plot size (m2)	25	25	25	
Altitude (m a.s.l.)	2	2	2	
Aspect	E	E	E	
Slope (°)	1	1	0	
Vascular plant cover	70	70	90	
Charact. and diff. taxa of the ass.				
Pistacia lentiscus	3	3	2b	3
Myrtus communis	2a	2a	3	
Charact. and diff. taxa of the upper units				
Smilax aspera	+		+	2
Asparagus acutifolius	+			1
Charact. and diff. taxa of *Cisto-Micromerietalia julianae*				
Erica multiflora	+	1	2a	3
Cistus incanus ssp. *creticus*	+	+	+	3
Cistus monspeliensis	1		+	2
Other species				
Coronilla emerus ssp. *emeroides*		r		1

Garrigue vegetation

Garrigue vegetation is developed in the central and western part of the islet and belongs to the association *Erico manipuliflorae-Cistetum cretici* Horvatić 1958. This nanophanerophytic formation dominated by *Erica multiflora*, *Cistus monspeliensis* and *Rosmarinus officinalis* is directly exposed to western winds and waves, and therefore the plants are dwarf and mostly prostrate on the rocky surface, especially *Rosmarinus officinalis*. Several heliophilous, mostly therophytic species (*Anagallis arvensis*, *Blackstonia perfoliata*, *Desmazeria rigida*, *Filago vulgaris*, *Linum strictum* ssp. *strictum*) were recorded among the shrubs.

Table 3. *Erico manipuliflorae-Cistetum cretici* Horvatić 1958

ONONIDO-ROSMARINETEA Br.-Bl. in A. Bolòs y Vayreda 1950 *CISTO-MICROMERIETALIA JULIANAE* Oberd. 1954 **Cisto cretici-Ericion manipuliflorae Horvatić 1958** *Erico manipuliflorae-Cistetum cretici* Horvatić 1958				
Relevé No.	1	2	3	Presences
No. of taxa	13	14	12	
Plot size (m2)	25	25	25	
Altitude (m a.s.l.)	2	2	2	
Aspect	W	W	W	
Slope (°)	0	0	0	
Vascular plant cover	60	70	60	
Charact. and diff. taxa of the ass.				
Cistus incanus ssp. *creticus*	+		+	2
Charact. and diff. taxa of the upper units				
Cistus monspeliensis	2b	2b	2b	3
Erica multiflora	2b	2a	2b	3
Rosmarinus officinalis	2b	3	2b	3
Fumana thymifolia	+			1
Charact. and diff. taxa of *Pistacio lentisci-Rhamnetalia* alaterni				
Pistacia lentiscus	1		+	2
Myrtus communis	+	+		2
Juniperus phoenicea		r		1
Other species				
Brachypodium retusum	2m	1	2m	3
Cladonia sp.			+	1
Linum strictum ssp. strictum		+	+	2
Blackstonia perfoliata	+	+		2
Allium flavum	+	+		2
Filago vulgaris	+		+	2
Carex flacca ssp. serrulata	+	+		2
Centaurium pulchellum		+	+	2
Koeleria splendens	1		+	2
Anagallis arvensis		+	+	2
Allium sphaerocephalon		+		1
Desmazeria rigida		+		1

To conclude, the islet of Mlin is a perfect example of a small island without any human interference, where floristic and vegetation diversity is a result solely of its geographical position, exposure to the influences of the open sea (winds and waves) and non-anthropogenic stochastic events. This paper represents a small, but nevertheless valuable contribution to the knowledge of the flora and vegetation of the Pakleni Archipelago and Middle Dalmatian islets and reefs, which are, in comparison to other island groups on Eastern Adriatic, still to a large extent understudied.

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