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VASCULAR AND BRYOPHYTE FLORA OF THE ISLET OF MRDUJA (EASTERN ADRIATIC, CROATIA)

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The flora of the minute islet of Mrduja (1.3 ha), located between the Middle Adriatic islands of Brač and Šolta, was studied in 2017, resulting in the recording of 63 taxa of vascular plants and six bryophytes. The predominance of the *Poaceae* (13%) and *Fabaceae* (8%), terophytes (30%) and Mediterranean floral elements (73%) clearly demonstrates the Mediterranean phyto-geographical position of the islet. Nearly one third of taxa were found on anthropogenic habitats, even though they are exceptionally rare on the islet, proving that even a slight human presence can have a profound influence on the flora of an island.

Key words: islet, Brač, bryophytes, Šolta, vascular flora, anthropogenic influence

Limić, I., Šegota, V. & Alegro, A.: Vaskularna i mahovinska flora otočića Mrduja (Istočni Jadran, Hrvatska). Nat. Croat. Vol. 27, No. 1, 27-39, 2018, Zagreb.

Tijekom 2017. provedena su istraživanja vaskularne flore i flore mahovina otočića Mrduje (1.3 ha), smještenog između srednjodalmatinskih otoka Brača i Šolte. Utvrđene su 63 svojte vaskularne flore, te šest svojti mahovina. Dominacija porodica *Poaceae* (13%) i *Fabaceae* (8%), terofitskog životnog oblika (30%) i mediteranskih flornih elemenata (73%) jasno ukazuje na mediteranski fitogoegrafski položaj otočića. Gotovo trećina svojti zabilježena je na antropogenim staništima koja su vrlo rijetka na otočiću, što dokazuje da čak i slaba prisutnost ljudi može značajno utjecati na floru otoka.

Ključne riječi: otočić, Brač, mahovine, Šolta, vaskularna flora, antropogeni utjecaj

INTRODUCTION

In the Mediterranean Basin the flora of islands and islets has long been a subject of interest with respect to both basic floristic knowledge and an attempt to assess the impact of land use on the land cover (Jasprica *et al.*, 2015). The Dalmatian coast has been recognized as a botanical hotspot; however, data on its flora are still largely incomplete (Médail & Quézel, 1997). In the Croatian part of the Adriatic Sea there are 1246 islands, islets, rocks and ridges, of which 79 are islands (>1 km²), 525 are islets (0.01-1 km²) and 642 are reefs (<0.01 km²) (Duplančić Leder *et al.*, 2004). While larger and inhabited islands are botanically sufficiently explored (Nikolić *et al.*, 2008, 2014), a significant number of smaller, mostly uninhabited islets and reefs, are still understudied. During the last 25 years, however, significant efforts have been made to improve this situation, and small

islands are increasingly being explored e.g. Northern Dalmatian islands (Pandža & Stančić, 1995; Pandža, 1998a, 1998b, 1998c; Pandža, 2002; Pandža *et al.*, 2002; Pandža, 2003; Milović, 2004; Pandža & Stančić 2004; Milović, 2005; Piljac-Kosović & Pandža, 2009; Milović & Pandža, 2010; Pandža *et al.*, 2011; Milović *et al.*, 2013; Pandža *et al.*, 2015; Pandža & Milović, 2015; Milović *et al.*, 2016), Central Dalmatian islands (Skelin *et al*, 2014) and Southern Dalmatian islands (Jasprica *et* al, 2006; Jasprica & Ruščić, 2013; Jasprica *et al.*, 2015; 2018).

Mrduja is a small, circular islet, situated within the Split straits (Splitska vrata), a narrow passage between the islands of Šolta and Brač. It is located about 19 km from the City of Split, 0.48 km from Brač and 1 km from Šolta (Fig. 1). It has an area of 1.3 ha, a 417 m long coastline (Duplančić Leder *et al.*, 2004) and the highest point at only 11.4 m a. s. l. The sea around the islet is 18 to 26 m deep. Due to its low altitude, major parts of the islet are affected by sea spray.

Fig. 1. Geographical position of the islet Mrduja.

According to a map from 1806, Mrduja was historically labelled as *Smerduglia* (Marasović-Alujević, 2002). As reported by local fishermen, the islet was used in the past as a place where old and diseased animals were brought and left to die, causing a bad smell (in Croatian *smrdjeti*) (Marasović-Alujević, 2010). However, it is more likely that the name derives from *smrduja, smrdej, smrča*, the local names for *Pistacia lentiscus*, a foetid shrub common on the islet, used traditionally for dyeing fishing nets. Similar toponyms are not rare on the neighbouring island of Brač either.

Although the flora of the adjacent islands of Brač (Štamol & Marković, 1985; Vladović *et al.*, 2016) and Šolta (Bedalov, 1989) has already been studied, to our knowledge there are no published data on the flora of Mrduja. The islands of Brač and Šolta belong to the Central Dalmatian island group (Crkvenčić *et al.*, 1974) and, from the phytogeographical point of view, are part of the Adriatic province of the Mediterranean vegetation region (Horvatić, 1963).

According to the nearest meteorological station in Sutivan village (Brač) the average annual air temperature in the period 1981-2016 was 16 ºC, while average relative air

humidity was 65%. Average annual precipitation was 768 mm in Milna (Brač, 1950-2016) and 817 mm in Gornje selo (Šolta, 1952-2016).

Mrduja is an uninhabited islet, but during the summer it becomes a popular swimming and sunbathing spot for one day trips, mostly used by locals. There are no large anthropogenic habitats on the islet, except a small area around the ruined medieval fortification (a church) and a modern lighthouse on the west side of the islet.

The aim of this study was to investigate the vascular and bryophyte flora of the islet of Mrduja. Our hypothesis was that flora of islet shows a Mediterranean character and that even weak human impact has a strong influence on the floristic structure.

MATERIAL AND METHODS

Field research was carried out twice, during the spring and autumn 2017. Taxa were identified using the standard floristic literature for vascular plants (Tutin *et al.*, 1968-1935, 1993; Javorka & Csapody, 1975; Pignatti, 1982; Domac, 1994) and bryophytes (Smith, 2004; Frey *et al*., 2006). The nomenclature follows Nikolić (2018) for vascular plants and Ros *et al.* (2013) for bryophytes. The largest part of the plant material was collected in the field, pressed and subsequently identified. Afterwards, the material was stored at the ZA collection (Thiers, 2017) where it was digitized according to Šegota *et al.* (2017) and is publicly available (Rešetnik & Šegota, 2018). Syntaxonomic nomenclature follows Škvorc *et al.* (2017).

Based on the life form classification of Raunkiaer (1934), life forms were designated according to categories reported in Horvat (1949) and Pignatti (1982): therophytes, geophytes, hemicryptophytes, chamaephytes and phanerophytes. The chorological analysis was made according to Horvatić (1963a, 1963b) and Horvatić *et al.* (1967-1968) and each taxa in the list is followed by the floral element marked as follows: Circum-Mediterranean plants (**C-med**), Illyrian-Adriatic plants (**ilir-jadr**), Mediterranean Atlantic plants (**med-atl**), European Mediterranean plants (**eu-med**), Mediterranean Pontic plants (**med-pon**), South European Mediterranean plants (**S-eu-med**), South-European-Pontic plants (**S-eu-pon**), plants of the Eurasian floral element (**eu-az**), widespread plants (**kozm**) and cultivated and adventive plants (**kult**). Abbreviation *end* indicates endemic taxa, VU and NT indicate conservation status according to Nikolić & Topić (2005), SZ indicates strictly protected taxa according to the Nature Protection Act (Anonymous, 2013a) and listed in the Ordinance on Designating Wild Taxa Protected (Anonymous, 2013b) while AL and IAS indicate alien and invasive species, respectively (Boršić *et al.*, 2008, Nikolić, 2017). Obligatory and facultative ornitho-coprophytes were analysed according to Lovrić (1970). The species list was compared to those from adjacent islands of Brač and Šolta. Islets (as defined by Duplančić Leder *et al.*, 2004) usually hold a small number of species, so each species makes a difference. Thus, we have additionally included two minute unidentified leguminous species, found in the form of seedlings, to the plant families' spectrum. A vegetation study was not undertaken, but the main habitat types were marked and a vegetation profile of the islet was created. The habitats are marked by letters: maquis/garrigue (**a**), coastal rocks (**b**), fragmented rocky grasslands (**c**) and anthropogenic habitats e.g. walls, paths) (**d**). Taxa found on two or more habitat types were assigned to each of them. The bryophytes were not included in flora analyses.

RESULTS

The list of vascular flora of Mrduja islet contains a total of 63 taxa within 56 genera and 38 families, as follows:

Agavaceae
Agave americana L.; P; **kult**; d; AL

Amaryllidaceae
Allium ampeloprasum L.; G; **C-med**; b

Anacardiaceae
Pistacia lentiscus L.; P; **C-med**; a

Apiaceae
Crithmum maritimum L.; Ch; **med-atl**; b
Peucedanum cervaria (L.) Lapeyr.; h; **S-eu-med**; c

Araceae
Arum italicum Mill.; G; **med-atl**; a
Arisarum vulgare O.Targ.Tozz.; G; **C-med**; a

Asparagaceae
Asparagus acutifolius L.; G; **C-med**; a, c

Aspleniaceae
Asplenium ceterach L.; H; **S-eu-med**; d

Asteraceae
Dittrichia viscosa (L.) Greuter; H; **C-med**; b
Inula crithmoides L.; Ch; **med-atl**, b

Brassicaceae
Aethionema saxatile (L.) R. Br.; Ch; **S-eu-med**; c

Cactaceae
Opuntia ficus-indica (L.) Miller; P; **kult**; d; IAS; AL

Capparaceae
Capparis orientalis Veill.; P; **C-med**; b

Caprifoliaceae
Lonicera etrusca Santi; P; **C-med**; a

Caryophyllaceae
Silene vulgaris (Moench) Garcke ssp. *angustifolia* Hayek; H; **ilir-jadr**; b, c
Stellaria media (L.) Vill.; T; **kozm**; d

Chenopodiaceae
Arthrocnemum fruticosum (L.) Moq.; Ch; **S-eu-med**; b
Atriplex tatarica L.; T; **kozm**; b
Salsola soda L.; T; **S-eu-pon**; b; VU; SZ

Cichoriaceae
Reichardia picroides (L.) Roth; H; **C-med**; b
Sonchus asper (L.) Hill ssp. *glaucescens* (Jord.) Ball; T; **C-med**; d

Clusiaceae
Hypericum perforatum L. ssp. *veronense* (Schrank) H. Lindb.; H; **S-eu-med**; c, d

Crassulaceae
Sedum acre L.; CH; **eu-az**; c, d
Sedum rubens L.; T; **S-eu-med**; c, d

Cupressaceae
Cupressus sempervirens L.; P; **kult**; d; AL

Dioscoreaceae
Tamus communis L.; G; **S-eu-med**; a

Ephedraceae
Ephedra fragilis Desf. ssp. *campylopoda* (C. A. Mayer) Asch. et Graeb.; P; **ea-med**; b; NT

Euphorbiaceae
Euphorbia pinea L.; Ch; **kult**; b
Euphorbia spinosa L.; Ch; **C-med**; c
Mercurialis annua L.; T; **kozm**; d

Fabaceae
Lotus cytisoides L.; Ch; **C-med**; b
Melilotus indica (L.) All.; T; **C-med**; d
Vicia cracca L.; H; **eu-az**; d

Fumariaceae
Fumaria capreolata L.; T; **med-atl**; b

Gentianaceae
Blackstonia perfoliata (L.) Huds.; T; **med-atl**; c
Centaurium erythraea Rafn; T; **kozm**; c, d

Geraniaceae
Geranium columbinum L.; T; **eu-az**; b
Geranium rotundifolium L.; T; **eu-az**; b

Lamiaceae
Prasium majus L.; Ch; **C-med**; c
Teucrium polium L. ssp. *capitatum* (L.) Arcang.; Ch; **med-pon**; c

Linaceae
Linum strictum L.; T; **C-med**; c, d

Malvaceae
Malva neglecta Wallr.; T; **kozm**; d

Myrtaceae
Myrtus communis L.; P; **C-med**; a

Oleaceae
Olea europaea L.; Ch; **kult**; a
Olea europaea L. var. *sylvestris* Brot.; P; **C-med**; a
Phillyrea media L.; P; **C-med**; a

Pinaceae
Pinus halepensis Mill.; P; **C-med**; a

Plumbaginaceae
Limonium cancellatum (Bernh. ex Bertol.) Kuntze; H; **ilir-jadr**; b; SZ; *end*
Limonium narbonense Mill.; H; **C-med**; b

Poaceae
Brachypodium distachyon (L.) P.Beauv.; T; **C-med**; d
Brachypodium retusum (Pers.) P.Beauv.; H; **C-med**; c
Briza maxima L.; T**; C-med**; c, d
Dactylis glomerata L. ssp. *hispanica* (Roth) Nyman; H; **C-med**; d
Desmazeria rigida (L.) Tutin; T; **med-atl**; b, d
Elymus pycnanthus (Godr.) Melderis; G; **C-med**; b; NT
Lagurus ovatus L.; T; **C-med**, c, d
Piptatherum miliaceum (L.) Coss.; P; **C-med**; c, d

Rubiaceae
Valantia muralis L.; T; **C-med**; d

Smilacaceae
Smilax aspera L.; P; **C-med**; a

Tamaricaceae
Tamarix africana Poir.; P; **kult**; d

Urticaceae
Parietaria judaica L.; H; **S-eu-med**; b, d

Xanthorrhoeaceae
Asphodelus aestivus Brot.; G; **C-med**; c

The list of bryophytes of Mrduja islet contains a total of six taxa within six genera and four families, as follows:

Brachytheciaceae
Rhynchostegium megapolitanum (Blandow ex F. Weber & D. Mohr) Schimp.

Bryaceae
Ptychostomum capillare (Hedw.) Holyoak & N. Pedersen (syn. *Bryum capillare* L.)

Fissidentaceae
Fissidens viridulus (Sw. ex anon.) Wahlenb. var. *incurvus* (Starke ex Röhl.) Waldh.

Pottiaceae
Tortella squarrosa (Brid.) Limpr. (syn. *Pleurochaete squarrosa* (Brid.) Lindb.)
Tortula muralis Hedw.
Weissia sp.

Families with the highest number of taxa were *Poaceae* (12%) and *Fabaceae* (8%), followed by *Chenopodiaceae*, *Euphoribiaceae* and *Oleaceae* (5% each), etc. (Fig. 2).

Therophytes (T) prevailed among life forms, with a contribution of 30%, followed by phanerophytes (P) (22%), hemicryptophytes (H) (19%), chamaeophytes (Ch) (18%) and geophytes (G) (11%) (Fig. 3).

Chorological analysis shows the dominance of Circum-Mediterranean plants (48%), followed by South European Mediterranean plants (13%), Mediterranean Atlantic (9%), widespread plants (8%), cultivated and adventive plants (8%), and others (Fig. 4).

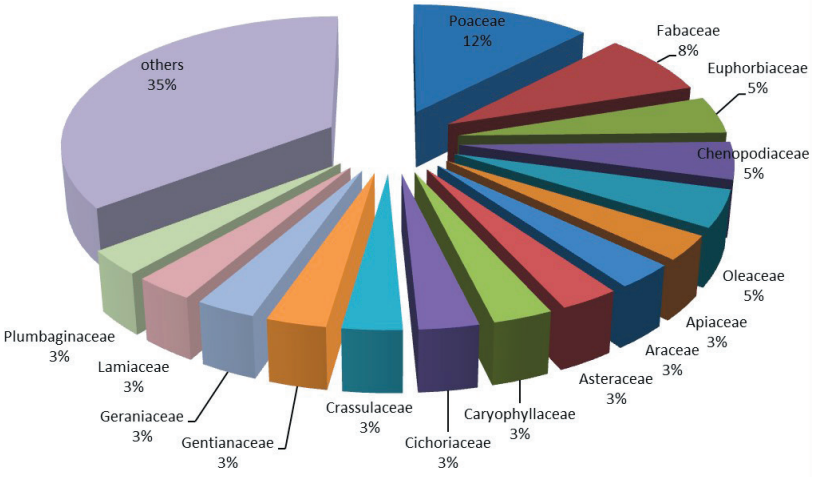

Fig. 2. Spectrum of plant families of the flora of Mrduja.

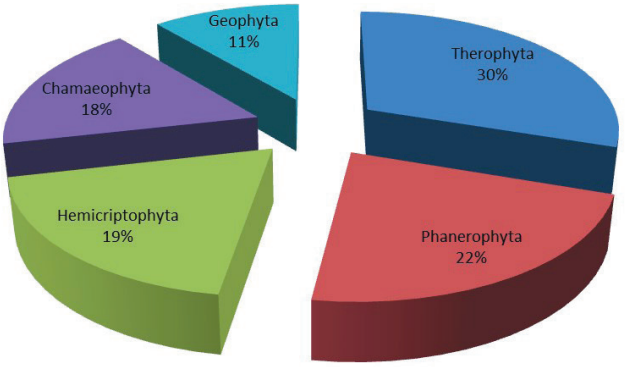

Fig. 3. Life form spectrum of the flora of Mrduja.

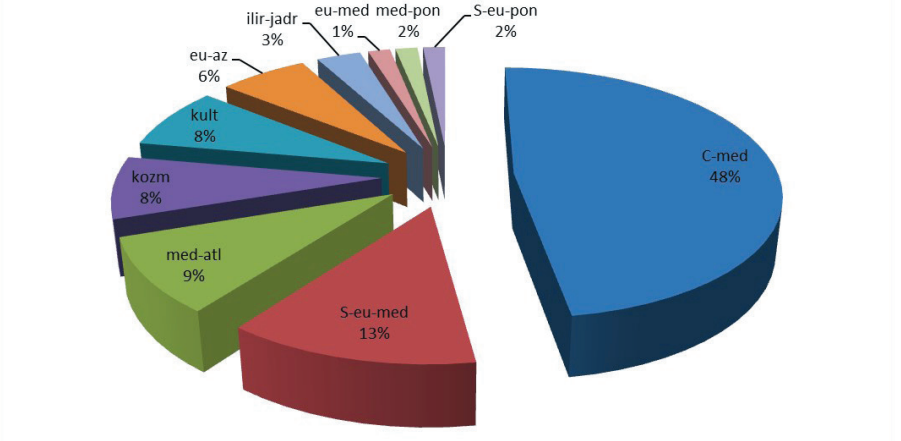

Fig. 4. Chorological spectrum of the flora of Mrduja.

Only one endemic species (*Limonium cancellatum*) was found growing abundantly on coastal rocky habitats belonging to the *Crithmo-Staticetalia* Molinier 1934 order. One VU (*Salsola soda*) and two NT taxa (*Ephedra fragilis* ssp. *campylopoda* and *Elymus pycnanthus*) were recorded, the first two taxa being strictly protected as well. In total, three alien species were found (*Agave americana*, *Cupressus sempervirens* and *Opuntia ficus-indica*), the latter considered invasive in Croatia. As for *Tamarix africana*, it is considered a native species according to Nikolić (2018), but here on the islet it has been planted.

On Mrduja, three obligatory (*Atriplex tatarica*, *Silene vulgaris* ssp. *angustifolia*, *Limonium cancellatum*) and two facultative (*Allium ampeloprasum* and *Parietaria judaica*) ornitho-coprophytes were recorded.

Approximately 80% of taxa were found exclusively on one habitat type. One third of the taxa (32%) were recorded on anthropogenic habitats, followed by salt-sprayed coastal rocks (28%), fragmented rocky grasslands (24%) and maquis/garrigue (16%) (Fig. 5). The main vegetation units of the islet are illustrated in Fig. 6.

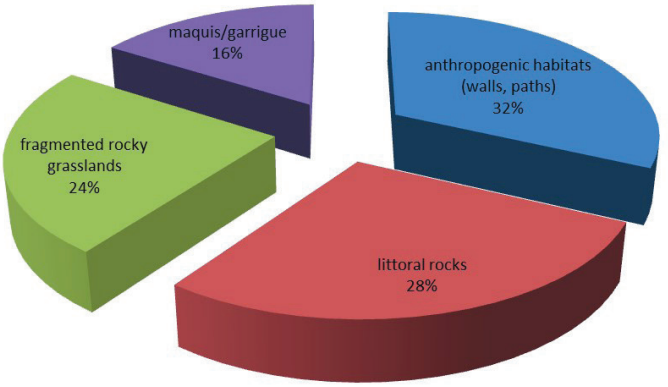

Fig. 5. Contribution of taxa per each habitat type on the islet of Mrduja.

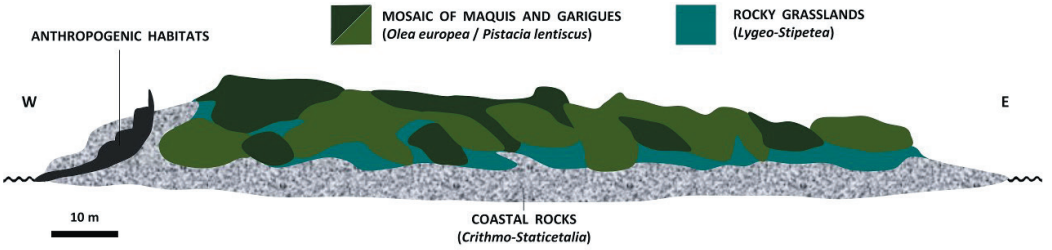

Fig. 6. Vegetation profile of the islet Mrduja.

DISCUSSION

The flora of the Mrduja islet, recorded here for the first time, includes 63 taxa of vascular plants and six bryophytes. Islets (as defined by Duplančić Leder *et al.*, 2004) usually hold a small number of species, so each species makes a difference in the analyses (Šegota & Alegro, 2007). The richness of the vascular flora of small islands is often more influenced by the diversity of habitats and anthropogenic pressure than by the area of islet (Pandža

& Milović, 2015). When islets with the same surface area are compared, it is usually shown that those with anthropogenic pressure have significantly more taxa than those without such an impact (Pandža *et al*., 2011). It may be expected that with a more detailed floristic research into Mrduja, especially into the hibernal aspect of the flora in winter season, the number of taxa will be somewhat increased, but not significantly, because the islet is uninhabited and has no cultivated land with ruderal and segetal species. The most numerous families are *Poaceae* (13%) and *Fabaceae* (8%), like the majority of Adriatic islands (e.g. Pandža, 2003; Jasprica *et al*., 2006, 2015; Jasprica & Ruščić, 2013; Milović *et al*., 2013; Pandža & Milović, 2015). Therophytes are, expectedly, the most numerous life form on the islet (30%), since they are the best adapted to the summer droughts and high temperatures that normally occur in the Mediterranean basin. The same has been recorded on the majority of Dalmatian islets (conf. Jasprica & Ruščić, 2013; Skelin *et al*., 2014). However, the slightly less pronounced representation of therophytes on Mrduja has also been noticed in the flora of several uninhabited islands of the Šibenik archipelago too (Pandža, 2002; Milović *et al*., 2013). The predominance of Mediterranean floral elements (in total 73%) among which Circum-Mediterranean plants (48%) prevail, clearly demonstrates the Mediterranean character of the area's climate. Almost all endangered, protected and endemic taxa recorded on the islet are related to salt-sprayed rocky cliffs. Their rocky habitats are similar to those of obligate or facultative ornitho-coprophytes, which reflect the specific influence of nesting birds. This is most pronounced on the west side of the islet, where rocky cliffs are being used as nesting sites of seagulls who fertilize the habitat, enabling the development of more nitrophilous species. Similarly, Pandža *et al.* (2011) noticed a significant number of ruderal species brought to the islets around the island of Vrgada, by the nesting seagulls. Alien plants were found only in the vicinity of the ruins of the medieval church and the lighthouse, and have been, without any doubt, planted there by people.

Nearly one third of the taxa were found on anthropogenic habitats on the islet. Surprisingly, those habitats are exceptionally rare on the islet, restricted solely to the ruined fortification/church, the modern lighthouse, and several short paths on the western part. This discrepancy might seem strange; however, it proves that even a weak human presence can have a strong influence on an island's flora, especially in the case of small islets. Natural environmental fluctuations as well as human interference, even of a low intensity, can considerably affect the flora of islets (Vidal *et al*., 1998; Panitsa & Tzanoudakis, 2010). There is no cultivated land on the islet and the only cultivated plant recorded was *Olea europea.* However, we found no clear evidence of real olive cultivation, so its presence might have been the remnant of some former land use, or, more likely, the plant arrived by bird dispersion. Notably, a large proportion of olive shrubs and trees on the islet belong to the wild variety *O. europea* var. *sylvestris*. Although Mrduja is uninhabited, occasional animal husbandry in the past and moderate tourist impact nowadays seemingly had and still has a certain influence on its flora. Milović & Pandža (2010) concluded that small-sized inhabited islands are distinguished by their abundance of plant taxa, due to the great diversity of the habitats and the strong and permanent human impact on the island landscape. Another third of the Mrduja species is related to costal sea-influenced rocks, a habitat usually poor in species, but in this case enriched by ornitho-coprophytes. The major part of the islet is covered by maquis, dominated by *Pistacia lentiscus*, forming dense, sometimes impassable stands. As expected, the lowest plant diversity is found here. However, in some parts, maquis forms a mosaic landscape with rocky grasslands belonging

to the class *Lygeo sparti-Stipetea tenacissimae* Rivas-Mart. 1978 *nom. conserv. propos.* (=*Thero-Brachipodietea* Br.-Bl. in Br.-Bl. et al. 1947) dominated by *Brachypodium retusum*.

As for bryophytes, the majority of species belong to a group of calciphilous taxa of open base rich soils in unshaded habitats. *Tortula muralis* was found on man-made structures e.g. mortared stone walls. By contrast, *Fissidens viridulus* var. *incurvus* is a species of more shaded habitats, thus it was found beneath maquis canopies. A few more species could be expected for the islet, namely winter ephemerophytes that periodically emerge during the wet season.

The flora of Mrduja, when compared to adjacent Brač and Šolta, shows a high similarity (95 % and 81 %, respectively). This is not unexpected, since their vicinity enabled easy dispersion of diaspores by wind, animals (mostly birds), humans, etc. The slightly lower similarity with the flora of Šolta is undoubtedly the consequence of the insufficient floristic research of Šolta.

Our study presents a small but important contibution to knowledge of the flora of Eastern Adriatic islets. Moreover, it contributes to floristic research of uninhabited islets, generally less studied in the Adriatic Sea. Additionally, this is the first contemporary study of the bryophytes in Croatian islands, since most of the data date back to begining of last century. It has been proven that even a weak human impact will strongly influence floristic structure. Finally, our study emphasizes the importance of floristic surveys of Adriatic islands and islets, the majority of which are still completely unstudied.

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REFERENCES

Anonymous, 2013a: Zakon o zaštiti prirode. NN 80/2013

Anonymous, 2013b: Pravilnik o strogo zaštićenim vrstama. NN 144/2013, Prilog I

Bedalov, M., 1989: Prilog flori otoka Šolte. Acta Botanica Croatica **48**(1), 121-127.

Boršić, I., Milović, M., Dujmović, I., Bogdanović, S., Cigić, P., Rešetnik, I., Nikolić, T. & Mitić, B., 2008: Preliminary check-list of invasive alien plant species (IAS) in Croatia. Natura Croatica **17**(2), 55-71.

Crkvenčić, I., Friganović, M., Sić, M., Pavić, R. & Rogić, V., 1974: Geografija SR Hrvatske, knjiga 6 – južno hrvatsko primorje. Školska knjiga, Zagreb.

Domac, R., 1994: Flora Hrvatske. Priručnik za određivanje bilja. Zagreb.

Duplančić Leder, T., Ujević, T. & Čala, M., 2004: Coastline lengths and areas of islands in the Croatian part of the Adriatic Sea determined from the topographic maps at the scale of 1: 25 000. Geoadria **9**(1), 5–32.

Frey W., Frahm J.-P., Fische, E. & Lobin W., 2006: The liverworts, mosses and ferns of Europe. Harley Books, Colchester.

Horvat, I., 1949: Nauka o biljnim zajednicama. Nakladni zavod Hrvatske, Zagreb.

Horvatić, S., 1963a: Biljnogeografski položaj i raščlanjenje našeg primorja u svjetlu suvremenih fitocenoloških istraživanja. Acta Botanica Croatica **22**, 27–81.

Horvatić, S., 1963b: Vegetacijska karta otoka Paga s općim pregledom vegetacijskih jedinica Hrvatskog primorja. Zagreb. Prir. Istraž. Jugosl. Akad. 33. Acta biologica 4. Zagreb,

Horvatić, S., Ilijanić, Lj. & Marković-Gospodarić, LJ., 1967–1968: Biljni pokrov okolice Senja. Senjski zbornik **3**, 298–322.

Jasprica, N. & Ruščić, M., 2013: Flora i vegetacija otočića Supetra (Cavtat, južna Hrvatska). Hrvatska misao (Sarajevo), **46**, 111–134.

Jasprica, N., Dolina, K. & Milović, M., 2015: Plant taxa and communities on three islets in south Croatia, NE Mediterranean. Natura Croatica **24**(2), 191–213.

Jasprica, N., Kovačić, S. & Ruščić, M., 2006: Flora and Vegetation of Sveti Andrija Island, Southern Croatia. Natura Croatica **15** (1-2), 27–42.

Jasprica, N., Dolina, K. & Milović, M., 2018: The flora and vegetation of the NE Mediterranean islet with centuries-long human influences. Acta Botanica Croatica. DOI: https://doi.org/10.2478/botcro-2018-0007

Javorka, S. & Csápody, V., 1975: Iconographia florae partis Austro-orientalis Europae centralis. Akadémiai Kiadó, Budapest.

Lovrić, A., 1970: Ornitogena vegetacija Prvića i susjednih otoka. Magistarski rad. Prirodoslovno-matematički fakultet, Sveučilište u Zagrebu. 1-128.

Marasović-Alujević, M., 2002: Un antico portolano dell'acquatorio della Dalmazia centrale. Atti del XIV Congresso dell'A. I. P. I. Firenze, 153–161.

Marasović-Alujević, M., 2010: Tragovima Skokijevih istraživanja – prilog etimologiji nesonima šireg splitskog akvatorija: Folia onomastica Croatica, **19**¸163–173.

Médail, F. & Quézel, P., 1997: Hot-spots analysis for conservation of plant biodiversity in the Mediterranean basin. Annals of Missouri Botanical Garden **84**, 112–127.

Milović, M., 2004: Flora of the Island of Obonjan (Šibenik archipelago, Croatia). Natura Croatica **13**(3), 213-230.

Milović, M., 2005: Addition to the vascular flora of the island of Krapanj (Šibenik archipelago, Croatia). Natura Croatica **14**(4), 289-300.

Milović, M., Kovačić, S., Jasprica, N. & Stamenković, V., 2016: Contribution to the study of Adriatic island flora: Vascular plant species diversity in the Croatian Island of Olib. Natura Croatica **25**(9), 25-54.

Milović, M. & Pandža M., 2010: A contribution to the vascular flora of the Šibenik archipelago islands (Dalmatia, Croatia). Natura Croatica **19**(1), 179-203.

Milović, M., Vukelja, N., Pandža, M. & Mitić, B., 2013: The vascular flora of Tribunj and nearby islets of Logorun and Lukovnik (Dalmatia, Croatia). Natura Croatica **22**(1), 45-71.

Nikolić, T. & Topić, J. (eds.), 2005: Crvena knjiga vaskularne flore Hrvatske. Ministarstvo kulture. Državni zavod za zaštitu prirode, Zagreb.

Nikolić, T. (ed.), 2018: Flora Croatica baza podataka / Flora Croatica Database. http:// hirc.botanic.hr/fcd. Botanički zavod, Prirodoslovno-matematički fakultet, Sveučilište u Zagrebu [Last access: January 2018].

Nikolić, T., Antonić, O., Alegro, A. L., Dobrović, I., Bogdanović, S., Liber, Z. & Rešetnik, I., 2008: Plant species diversity of Adriatic islands: An introductory survey. Plant Biosystems **142**(3), 435–445.

Nikolić, T., Mitić, B., Ruščić, M. & Milašinović, B., 2014: Diversity, knowledge and spatial distribution of the vascular flora of Croatia. Plant Biosystems. **148**(4), 591–601.

Pandža, M. & Stančić, Z., 2004: Second contribution to the flora of the Kornati islands (Croatia). Natura Croatica **13**(1), 47-61.

Pandža, M. & Stančić, Z., 1995: Contribution to the flora of Kornati islands (Croatia). Natura Croatica **4**(3), 133-142.

Pandža, M., 1998: Flora of the island of Murter (Central Adriatic). Acta Botanica Croatica **57**, 99-122.

Pandža, M., 1998: Flora of the island of Zlarin. Natura Croatica **7**(1), 59-78.

Pandža, M., 1998: Flora of the islands of Krapanj and Prvić. Natura Croatica **7**(4), 321-339.

Pandža, M., 2002: Flora of the small islands of Murter. Natura Croatica **11**(1), 77–101.

Pandža, M., 2003: Flora of the island of Žirje and the small islands around it (Eastern Adriatic coast, Croatia). Acta Botanica Croatica **62**(2), 115-139.

Pandža, M., Franjić, J. & Škvorc, Ž., 2002: The flora of some uninhabited Šibenik archipelago islands (Dalmatia, Croatia). Natura Croatica **11**(4), 367-385.

Pandža, M. & Milović, M., 2015: Flora of the islets near Pakoštane (Dalmatia, Croatia). Natura Croatica **24**(1), 19-35.

Pandža, M. & Milović, M., 2015: Flora of the Veliki Lagan and Mali Lagan islets (Dugi otok island, Croatia). Natura Croatica **24**(2), 215-222.

Pandža, M., Milović, M., Krpina & M., Tafra, D., 2011: Vascular flora of the Vrgada islets (Zadar archipelago, eastern Adriatic). Natura Croatica **20**(1), 97-116.

Panitsa, M. & Tzanoudakis, D., 2010: Floristic diversity on small islands and islets: Leros islets' group (East Aegean area, Greece). Phytologia Balcanica **16**, 271-284.

Pignatti, S., 1982: Flora d'Italia. I–III. Edagricole. Bologna.

Piljac-Kosović, L. & Pandža, M., 2009: Flora of the island of Vrgada and the surrounding islets. Natura Croatica **18**(2), 309-333.

Raunkiaer, C., 1934: The life forms of plants and statistical plant geography. The Clarendon Press, Oxford, pp. 632.

Rešetnik, I. & Šegota, V. (eds.), 2018: Virtual herbarium ZA i ZAHO. University of Zagreb, Faculty of Science. http://herbariumcroaticum.biol.pmf.hr [Last access: January 2018].

Ros, R. M., Mazimpaka, V., Abou-Salama, U., Aleffi, M., Blockeel, T. L., Brugués, M., Cros, R. M., Dia, M., G., Dirkse, G. M., Draper, I., El-Saadawi, W., Erdağ, A., Ganeva, A., Gabriel, R., González-Mancebo, J. M., Granger, C., Herrnstadt, I., Hugonot, V., Khalili, K., Kürschner, H., Losada-Lima, A., Luis, L., Mifsud, S., Privitera, M., Puglisi, M., Sabovljević, M., Sérgio, C., Shabbara, H., Sim-Sim, M., Sotiaux, A., Tacchi, R., Vanderpoorten & A., Werner, O., 2013: Mosses of the Mediterranean, an annotated checklist. Cryptogamie Bryologie **34**, 99-283.

Šegota, V., Buzjak, S., Vilović, T., Sedlar, Z., Rešetnik, I. & Bogdanović, S., 2017: Curators in action: intricate genus *Fritillaria* L. (Liliaceae) from ZA, ZAHO, CNHM and ZAGR revised and digitized. Glasnik Hrvatskog botaničkog društva **5** (2), 4-14.

Šegota, V. & Alegro, A., 2007: Flora of islets in Kvarner Bay. In: Britvec, M. & Škvorc, Ž. (eds.): Book of Abstract of the 2nd Croatian Botanical Congress, Zagreb.

Škvorc, Ž., Jasprica, N., Alegro, A., Kovačić, S., Franjić, J., Krstonošić, D., Vraneša, A. & Čarni, A., 2017: Vegetation of Croatia: Phytosociological classification of the high-rank syntaxa. Acta Botanica Croatica **76** (2), 200–224

Skelin, M., Ljubičić, I., Skelin, I., Vitasović Kosić, I. & Bogdanović, S., 2014: The Flora of Zečevo (Hvar Archipelago, Croatia). Agriculturae Conspectus Scientificus **79** (2), 85–91.

Smith, A. J. E., 2004: The Moss Flora of Britain and Ireland. Cambridge University Press.

Štamol, V. & Marković, Lj., 1985: Prilog flori otoka Brača. Acta Botanica Croatica **44**, 99-106.

Thiers, B., 2018: Index Herbariorum. A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. http://sweetgum.nybg.org/ih/. Accessed January, 2018.

Tutin, T. G., Burges, N. A., Chater, A. O., Edmondson, J. R. E., Heywood, V. H., Moore, D. M., Valentine, D. H., Walters, S. M. & Webb, D. A. (eds.), 1993: Flora Europaea 1 (2nd ed.), Cambridge University press. Cambridge.

Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine, D. H., Walters, S. M. & Webb, D. A. (Eds.), 1968–1980: Flora Europaea 2–5. Cambridge University press. Cambridge.

Vidal, E., Medail, F., Tatoni, T., Vidal, P. & Roche, P., 1998: Functional analysis of the newly established plants induced by nesting gulls on Riou Archipelago (Marseille, France). Acta Oecologica **19**, 241-250.

Vladović, D., Ževrnja, N., Mekinić, S. & Piasevoli, G., 2016: Prilog vegetaciji i flori otoka Brača (Dalmacija, Hrvatska). Glasnik Hrvatskog botaničkog društva, **4** (1), 32-35.

SAŽETAK

Vaskularna i mahovinska flora otočića Mrduja (Istočni Jadran, Hrvatska)

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Vaskularna flora i flora mahovina na nenaseljenim otocima, otočićima i hridima hrvatskog otočnog arhipelaga uglavnom su slabo istražene. Flora otočića Mrduja, koji se nalazi između otoka Brača i Šolte, istražena je tijekom 2017. godine. Zabilježene su 63 svojte unutar 56 rodova i 38 porodica vaskularne flore, te šest svojti unutar šest rodova i četiri porodice mahovina. Porodice s najvećim brojem svojti su *Poaceae* (13%) i *Fabaceae* (8%). Analiza životnih oblika ukazuje na najveći udio terofita (30%), dok su među flornim elementima najzastupljenije mediteranske biljke (73%). Zabilježene su sveukupno četiri gotovo ugrožene, osjetljive, endemične i zaštićene vrste te tri alohtone vrste, sađene oko ruševne crkve i svjetionika. Zbog utjecaja ptica gnjezdarica, u ovom slučaju galebova, zabilježeno je i pet ornitokoprofagnih nitrofilnih vrsta. Gotovo trećina svojti pronađena je na antropogenim staništima, što je iznenađujuće s obzirom na to da su takva staništa iznimno rijetka na otočiću. To ukazuje da i mala ljudska prisutnost može imati značajan utjecaj na sastav flore otoka. Većinu površine Mrduje prekriva mozaik makije i gariga kojeg karakterizira najniža floristička raznolikost te fragmentirani kamenjarski travnjaci s nešto više raznolikosti. Flora Mrduje pokazuje veliku sličnost u usporedbi sa susjednim otocima Bračom (95%) i Šoltom (81%), što je posljedica disperzije biljaka vjetrom, pticama i ljudima.