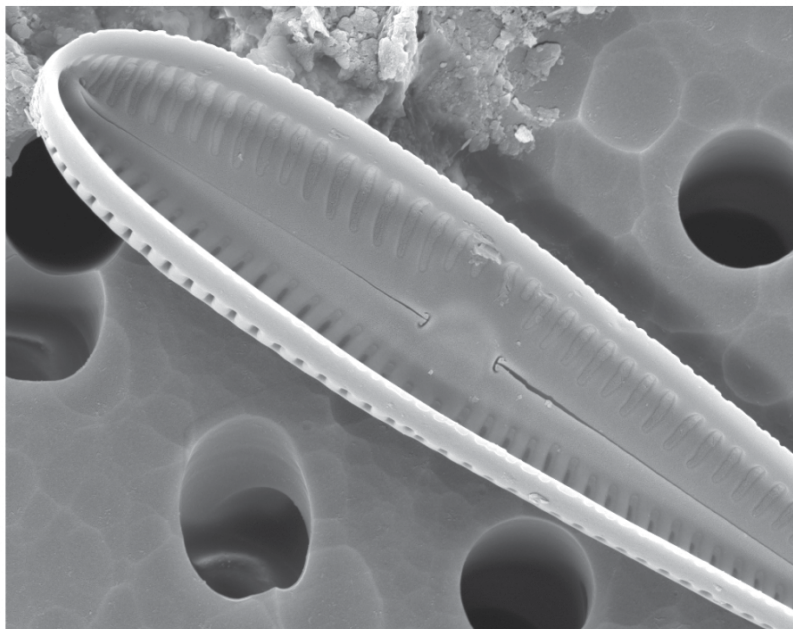
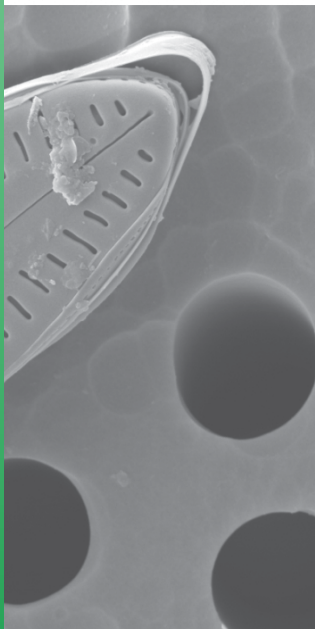
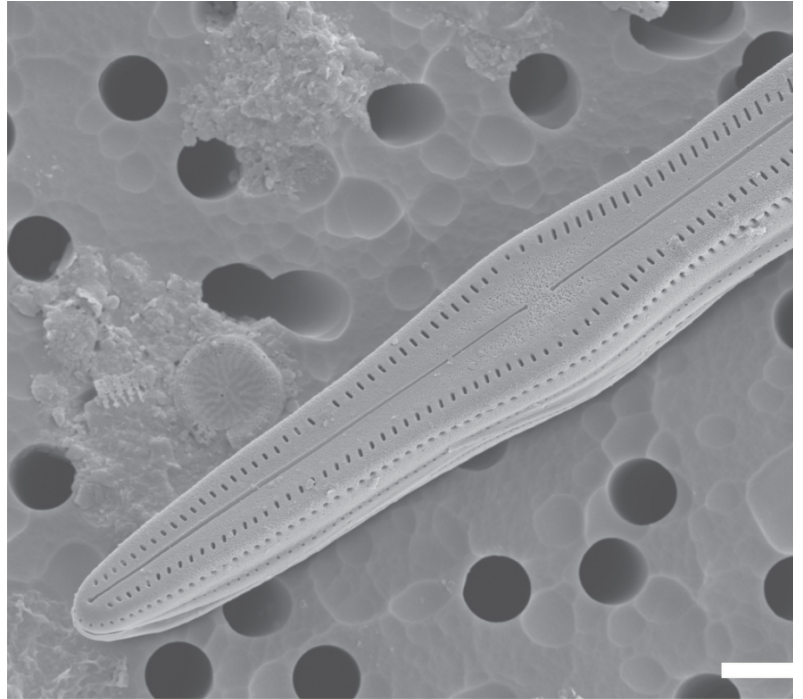
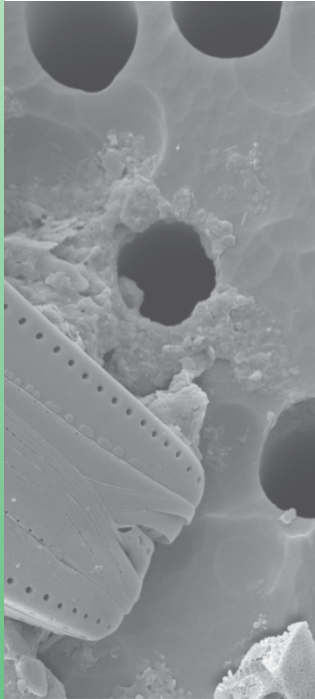




Glasnik

Hrvatskog botaničkog društva

Journal of the Croatian Botanical Society



Gomphosphenia plenkoviciae Gligora Udovič & Žutinić
(Foto: M. Gligora Udovič)

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Journal of the Croatian Botanical Society publishes

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1. Original scientific paper
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Other details on manuscript submission and other specificities could be found on web pages of the Journal (<http://hirc.botanic.hr/Glasnik-HBoD>).

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Prilozi poznavanju flore Hrvatske / Contributions to the knowledge of the Croatian flora

***Anemone sylvestris* L. (Ranunculaceae) in eastern Prigorje (Zagreb, Croatia)**

original scientific paper / izvorni znanstveni članak

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The article summarizes the current status and distribution of the vulnerable plant species *Anemone sylvestris* L. (Ranunculaceae) in the eastern part of the Prigorje region, NE from the Croatian capital, Zagreb. Data were collected during two inventory studies performed in 2015 and 2016 when over 12000 individuals were observed on 130 microlocations. Their distribution is discussed with respect to the borders of protected nature

areas within the region. Habitat characteristics are described in relation to plant abundance. The main results indicate that the species prefers open grassland-type habitats of different expositions, with low coverage of woody plants, with abundance increasing on moderately-sloped terrain. We recommend active habitat protection measures and further monitoring.

Keywords: Medvednica, Natura 2000 Ecological Network, Vejalnica and Krč**Zadravec, V., Zadravec, M., Jugovic, J., Zadravec, M. (2019): *Anemone sylvestris* (Ranunculaceae) u istočnom Prigorju (Zagreb, Hrvatska). Glas. Hrvat. bot. druš. 7(1): 1-14.****Sažetak**

Članak sažima trenutni status i rasprostranjenost osjetljive vrste *Anemone sylvestris* L. (Ranunculaceae) u istočnom dijelu regije Prigorje, smještene SI od hrvatskog glavnog grada Zagreba. Podaci su prikupljeni u dva terenska istraživanja tijekom 2015. i 2016. godine, kada je opaženo više od 12000 jedinki na 130 mikrolokacija. Diskutira se o njihovoj rasprostranjenosti u odnosu na granice zaštićenih

područja prirode u regiji. Opisane su značajke staništa u odnosu na brojnost jedinki. Glavni rezultati ukazuju da vrsta preferira otvorena livadna staništa osunčana iz više smjerova, s niskom pokrovnosću drvenaste vegetacije i većom brojnošću na blago nagnutim padinama. Preporučuju se aktivnosti zaštite staništa i daljnja promatranja.

Ključne riječi: Medvednica, Natura 2000 ekološka mreža, Vejalnica i Krč**Introduction**

Anemone sylvestris L. (Ranunculaceae) is a vulnerable (VU) vascular plant in Croatia due to its scarce habitat and reduced distribution (Nikolić & Topić 2005, Borovečki-Voska & Šincek 2014). In eastern Prigorje *A. sylvestris* grows on two habitat types: semi-natural dry grasslands and forest fringes. They are often adjacent, forming a mosaic on hill tops and slopes (Zadravec & Zadravec 2015, 2016, 2017; Zadravec et al. 2016).

The first habitat type is classified as a semi-natural dry grasslands and scrubland facies on calcareous substrates of the class *Festuco-Brometea* Br.-Bl. et R. Tx. 1943 (Natura 2000 habitat code: 6210). This type is also suitable for orchids and in general is among the richest habitats with flora and fauna species in the whole European environment (Anonymous 2015a). So, it is of special community importance and targeted for

protection by the Natura 2000 Ecological Network (Anonymous 2014a).

The second habitat is the fringes of thermophilous forests and patches of *Quercus pubescens* Willd. that contain the association of *Geranium sanguineum* L. and *A. sylvestris* (As. *Geranio-Anemonetum sylvestris* Th. Müller 1961). This habitat type is listed in the National Habitats Classification under C.5.1.1.2. (Anonymous 2014a) and is considered to be reduced only to the eastern Prigorje region of Croatia (Anonymous 2014b).

Eastern Prigorje is currently the only known Croatian region where *A. sylvestris* occurs over a larger area and is fairly abundant. There are only two known locations outside this region where *A. sylvestris* had been recently observed in small numbers – one confirmed finding on Ivanščica Mt, in north-western Croatia (Šincek 2013) and one unconfirmed finding on Pakleni otoci, near the island of Hvar in Dalmatia (Ruščić 2007). There are several century-old or older literature references in continental Croatia but none have been confirmed by field observations since.

In Eastern Europe there was some long-term monitoring of *A. sylvestris*. In a three-decade long research in NE Poland the disappearance of *A. sylvestris* was documented from strongly shaded areas (Kwiatkowska-Falinska & Falinski 2007). Another long-term research of dry grassland species distribution with respect to previous and current land usage was conducted in the Czech Republic. Their results show that *A. sylvestris* persists only on the continuously maintained grasslands (Chýlová & Münzbergová 2008). After a dozen years of observations of the grasslands and clearings inside the thermophilous deciduous forests of the “Mierzvice” nature reserve the observers noticed a decrease in the number of locations and in the abundance of several species, including *A. sylvestris* (Krechowski et al. 2015). The deterioration of the lighting conditions caused by natural succession is considered to be the main cause for that regression of species richness.

Due to the importance of *A. sylvestris*, as an umbrella species, the Public Institution “Maksimir”, responsible for nature protection in eastern Prigorje, supported an inventory and monitoring study. The region contains several nature protection areas: Natura 2000 site „Vejalnica & Krč“, „Goranec“ Significant Landscape, and „Medvednica“ Nature Park and Natura 2000 site (Fig. 1). Our survey was conducted both in and outside of the protected

areas in order to map the distribution of *A. sylvestris* in eastern Prigorje and to determine the proportion of the unprotected population. Besides only one vegetation screening project on a spatially limited area with *A. sylvestris* at the eastern border of Medvednica Nature Park (Alegro 2012), no wider and more detailed survey has ever been performed before for this plant species in Croatia.

Our goal was to determine the abundance, distribution and ecological preferences of *A. sylvestris* in eastern Prigorje that could serve as a baseline for conservation actions of the species and its habitat in the future. We specifically tried to identify key environmental factors that positively influence the species' abundance.

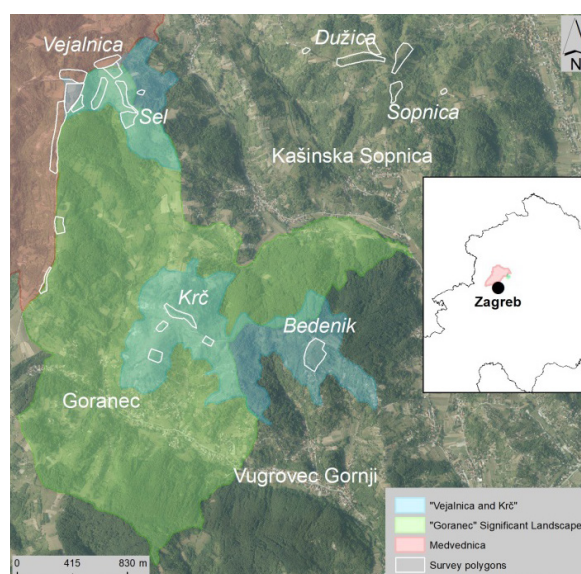


Figure 1. Nature protection sites in the eastern Prigorje region and contours of surveyed plots. Toponyms are written in white text – village names normal, hill names in italic.

Materials and methods

The study area was located between the villages Vugrovec, Goranec, Čučerje, Planina and Kašina. Here, the SE slopes of Medvednica Mt gradually transform into small hills: Vejalnica, Sel, Krč, Bedenik, Dužica, and Sopnica with the peak altitudes varying from 300 to 500 m a.s.l. (Fig. 1).

We divided the research area into five regional segments (D, G, K, M, V) with 23 plots of different sizes, covering a total surface area of almost 25 ha (Table 1).

Table 1. Regional segments and surveyed plots.

Segment Name	Significant toponym / oronym	Number of plots	Total plot area (ha)	Plot Names
D	Dužica-Sopnica	6	5.5	Da, Db, Dc, Dd, De, Df
G	Goranec	2	1.3	Ga, Gb
K	Krč-Bedenik	5	5.5	Ka, Kb, Kc, Kd, Ke
M	Medvednica	3	5.3	Ma, Mb, Mc
V	Vejalnica-Sel	7	7	Va, Vb, Vc, Vd, Ve, Vf, Vg
	Total	23	24.6	

Plot borders were determined mostly by landscape features, man-made features and borders of protected sites – easily recognisable in the field. Regional segments are marked with the first letter of the most significant toponym (e.g. K for Krč). Plot names are constructed from the capital letter representing the segment name with the addition of a single lowercase alphabet letter (e.g. Df, Ga, Mb). Each plot consists of several neighbouring microlocations.

In 2015 we have previously established the presence of *A. sylvestris* on all plots and in 2016 we performed a detailed inventory of microlocations, counting all individual plants during the peak of the flowering phase at the beginning of May. We recorded the exact GPS coordinates and elevation of our findings using a Garmin eTrex 30 device. The surface area containing all observed plants on a microlocation was recorded as the area of that microlocation. For smaller microlocations the surface area was regarded as a rectangle around all plants and its sides were measured. For larger areas we tracked the areas' borders using the GPS device and later their surface area was calculated using QGIS 2.14.0. Detailed maps of all plots and microlocations in each segment are presented in Appendix 1. The exact area and position of all large groups is known and can be traced for future changes with respect to the plants' propagation and emergence of surrounding woody vegetation.

Plant densities were calculated for each microlocation as the ratio of the plant abundance and microlocation surface area. Then we summarized the density for each regional segment and individual plots. For the segment density we calculated the average value since the related Kolmogorov-Smirnov normality test showed no significant deviation from the normal distribution. However, for plant density correlated to habitat type, the Kolmogorov-Smirnov test showed significant deviation from the normal distribution, so we gave the median value, instead of the average. Before median calculation we cut the lower and upper 1/8 of the data.

To determine the impact of environmental factors

upon species abundance and density we recorded basic information about topology (exposition to the sunlight), geography (slope gradient and slope direction) and the coverage of the surrounding vegetation. Concerning the surrounding vegetation, we recorded dominant woody plant taxa and estimated the percentage of their coverage of the microlocation surface, for woody plants below and above 2 m in height, respectively, using the expanded Braun-Blanquet scale (Barkman et al. 1964). However, for the statistical analysis, this had to be reduced to three categories: low, moderate and high.

For the purpose of the statistical analysis, we divided each of the recorded environmental factors in classes (see Table 2). Environmental factors were used as explanatory variables for the species' abundance and density. We also tested for correlation between the two dependent variables (Pearson correlation coefficient, statistical significance set at $p < 0.001$). To define the plant preferences the comparison of absolute frequencies among the predefined classes of each independent variable and abundance classes was performed using the Likelihood ratio statistic. Standardized residuals were used to define the significant contributors to the overall Chi square value. Cells with standard residuals with values $\geq |2.0|$ were considered as significantly important.

Regarding the *A. sylvestris* plants shading by surrounding vegetation we introduced three simple categories for habitat type on microlocations. Those microlocations that are shaded less than 20% we designate as "grassland". Microlocations whose surface area is more than 50% in the shade of nearby trees and shrubs we designate as "fringe". Microlocations where both characteristics are present, but neither is dominant, we designate as the "mixed" type. For distribution quantification we introduce three categories for absolute abundance on a microlocation: low abundance (less than 50 plants), moderate (50–200 plants) and high (more than 200 plants).

The following data tables and graphs were created by Microsoft Excel 2010. The statistical

χ^2 test was performed in “IBM SPSS Statistics” software package (version 24). We have tested the dependence of each of the two dependent variables (DV*), upon six independent variables (IV*). All variables and their categorization methods

are summarized in Table 2. Pearson’s correlation coefficient was used to test the correlation between both dependent variables, plant abundance and density.

Table 2. Variable categorization used for the χ^2 test. DV – dependent variable, IV – independent variable.

Variable	Data	No. of categories	Category Criteria Explanation
DV1	plant abundance	3	low: 0–49; moderate: 50–199; high: ≥ 200
DV2	plant density	3	low: 0–0.9; moderate: 1–9; high: ≥ 10
IV1	slope direction	9	N, S, W, E, NE, NW, SE, SW, flat
IV2	slope gradient	4	none (= flat), low, moderate, high
IV3	exposition	9	E, N, NE, NW, S, SE, SW, W, several (more than one direction)
IV4	habitat type	3	grassland (shade < 20%), fringe (shade > 50%), mixed
IV5	coverage of woody plants < 2 m	3	low: 0–29%; moderate: 30–59%; high: $\geq 60\%$
IV6	coverage of woody plants > 2 m	3	low: 0–29%; moderate: 30–59%; high: $\geq 60\%$

Results

The data collected in 2016 presents the most comprehensive and accurate status of the *A. sylvestris* population in eastern Prigorje region performed so far. We report a total of 130 distinct microlocations with 12511 plants counted on them. They are all shown on maps in Appendix 1 and their geographic locations have been precisely listed in the on-line accessible Flora Croatica Database (Nikolić 2018).

Since the Pearson’s correlation coefficient showed that plant abundance and plant density are

positively correlated ($r = 0.459, p < 0.001$; Appendix 2), the Likelihood ratio test results are shown only for plant abundance.

Overall Population Results

Observing the distribution of the *A. sylvestris* population across regional segments, there are two that dominate in total abundance: V and D. Segment D also has the greatest plant density by plot area (Fig. 2).

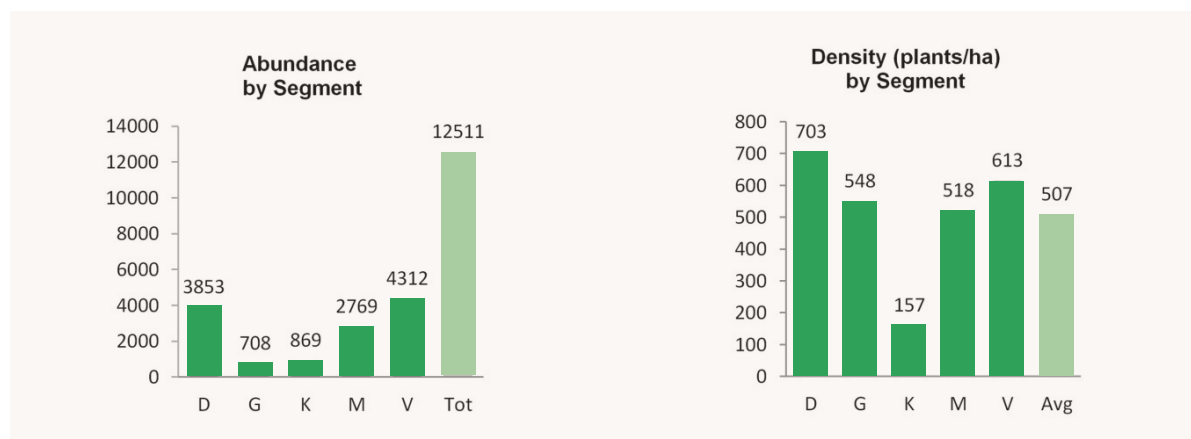


Figure 2. Abundance and density of *A. sylvestris* findings across regional segments. Tot – total number of counted plants. Avg – Average plant density. Segment names are explained in Table 1.

The result of Kolmogorov-Smirnov test for normal distribution for density per segment data set is $p = 0.105$, so the average value appropriately expresses the central tendency for density

(Appendix 2). Four plots substantially contribute to the total population size: Dc, Dd, Mb and Va. Among all plots, Dc stands out in regard to both plant count and density (Fig. 3).

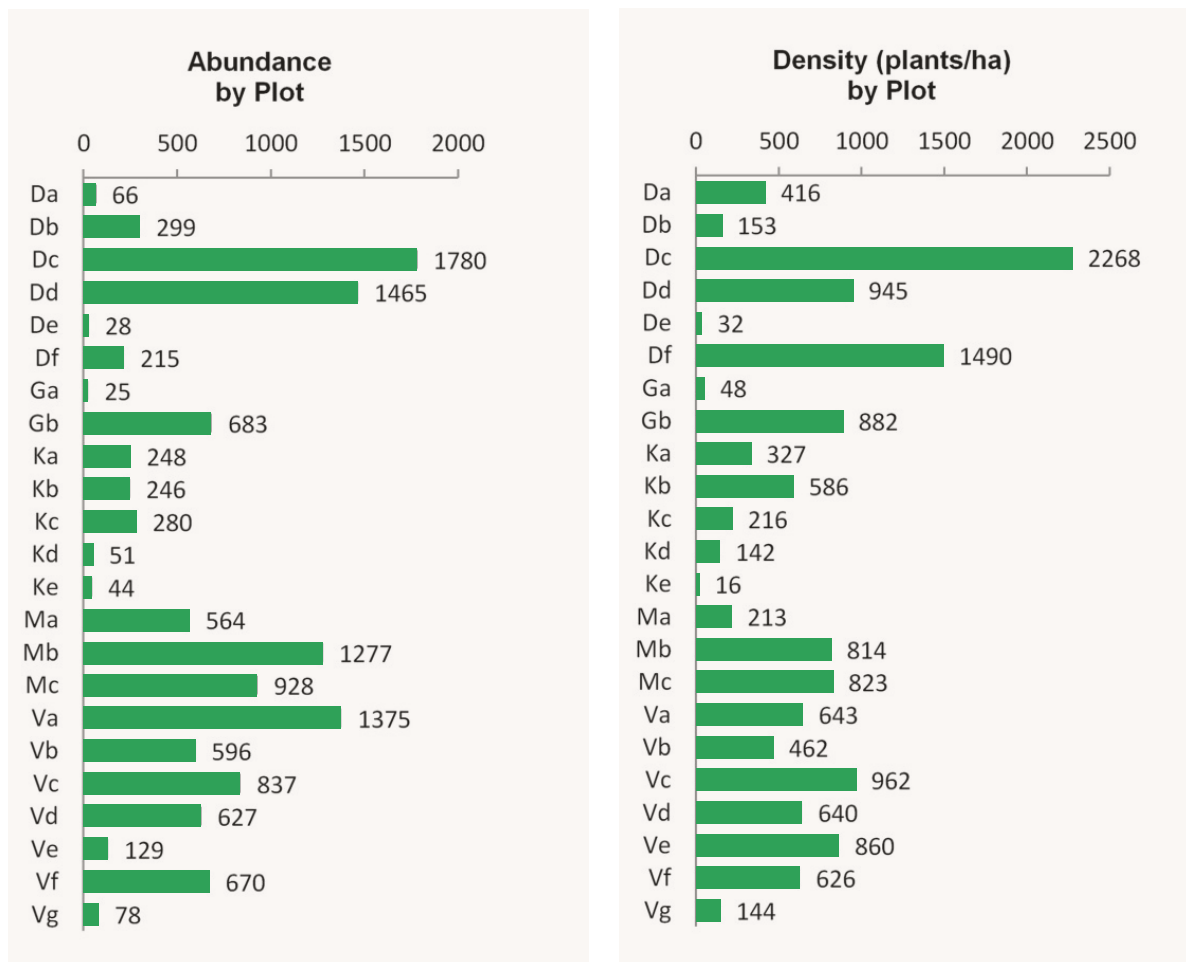


Figure 3. Abundance and density of *A. sylvestris* across plots.

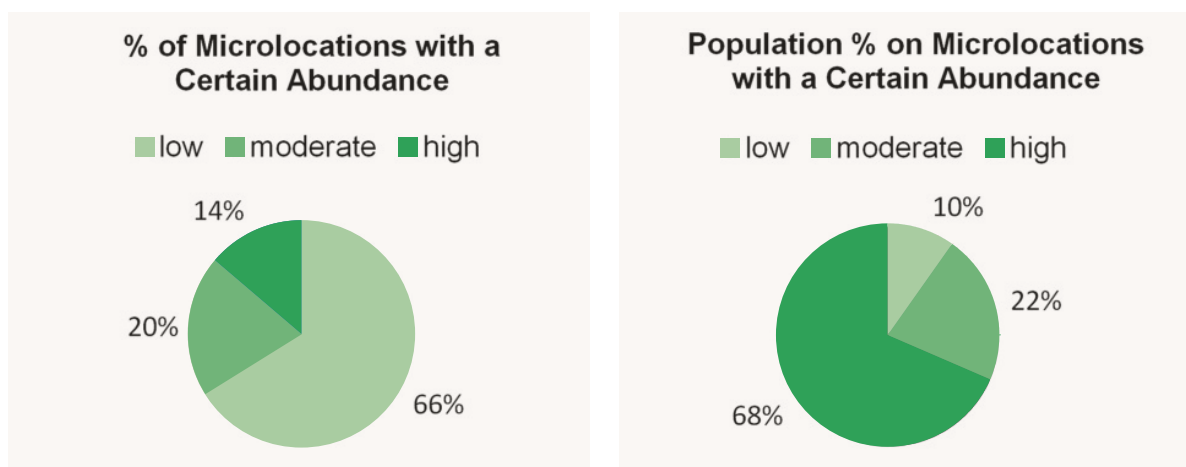


Figure 4. The percentage of microlocations with a certain abundance and the percentage of the population of *A. sylvestris* per abundance category.

Concerning the microlocation level it is obvious that the majority of microlocations have a low abundance, with very few microlocations standing out as very rich, containing several hundreds of plants. Just 14% of all microlocations with a high absolute abundance comprise 68% of the overall *A. sylvestris* population. The majority of microlocations are with low or moderate absolute abundance (86%) but they comprise only 32% of the total population (Fig. 4). These results show that future changes on a small number of microlocations with a high abundance would have a greater impact on the total *A. sylvestris* population.

Results Regarding Ecological Factors

The *A. sylvestris* habitat on each microlocation consists of a mix of grasslands with shrubs and trees, but in further analysis we relate to the predominant habitat type on each microlocation. Overall, there is an even distribution of “fringe” and “grassland” microlocations (Fig. 5).

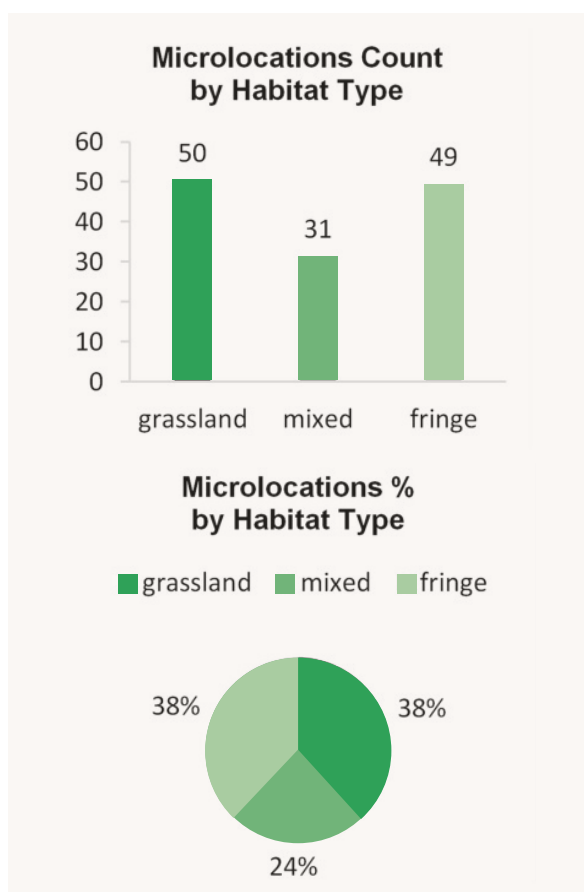


Figure 5. Microlocations related to dominant habitat type.

“Fringes” contribute far less to the whole *A. sylvestris* population (7%) because of the smaller abundance. The “grassland” microlocations have a much higher abundance and represent a substantial majority of the whole population (65%) (Fig. 6). The influence of habitat type on plant abundance is statistically significant ($p < 0.001$; Appendix 2). Fringe habitats often have low abundance. Grassland habitats often have high abundance and only rarely low density. These results suggest the future protection measures should prioritize the “grassland” habitat type.

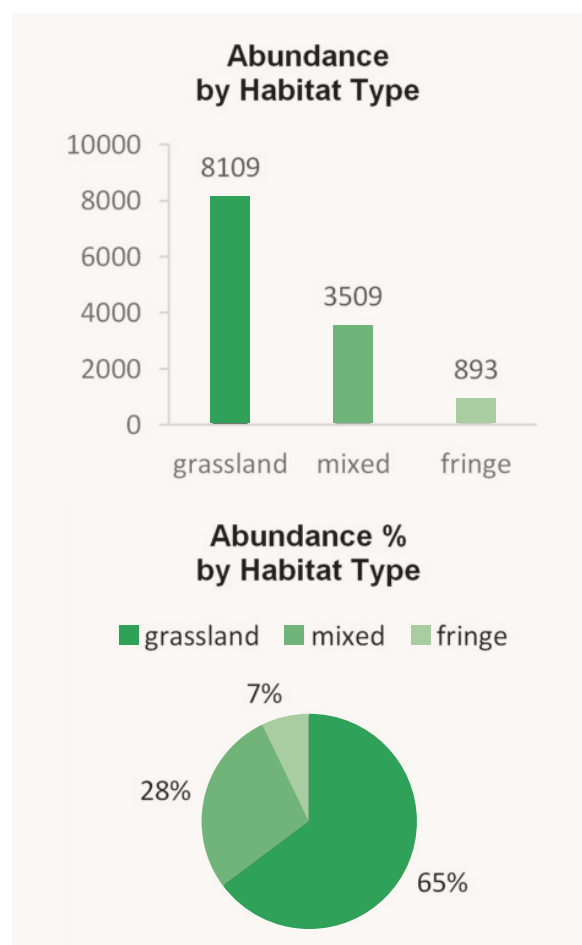


Figure 6. Abundance related to dominant habitat type.

On *A. sylvestris* microlocations we have observed the following terrain characteristics and calculated their influence on plant abundance: slope gradient, slope direction and exposition. There are more flat and weakly sloping microlocations than the others (Fig. 7).

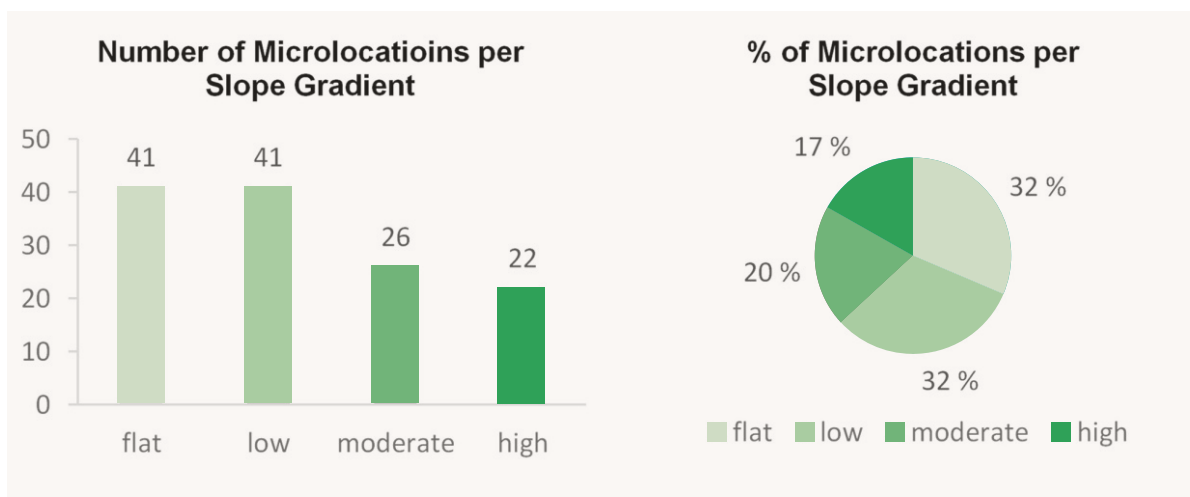


Figure 7. Microlocations related to slope gradient.

The plant abundance is similar on flat terrain and slightly inclined (low) slopes but much greater on moderate slopes and even more reduced on steep (high) slopes compared to flat and low

(Fig. 8). Statistical results show a noticeably significant influence of moderate-gradient slopes on plant abundance ($p < 0.001$; Appendix 2).

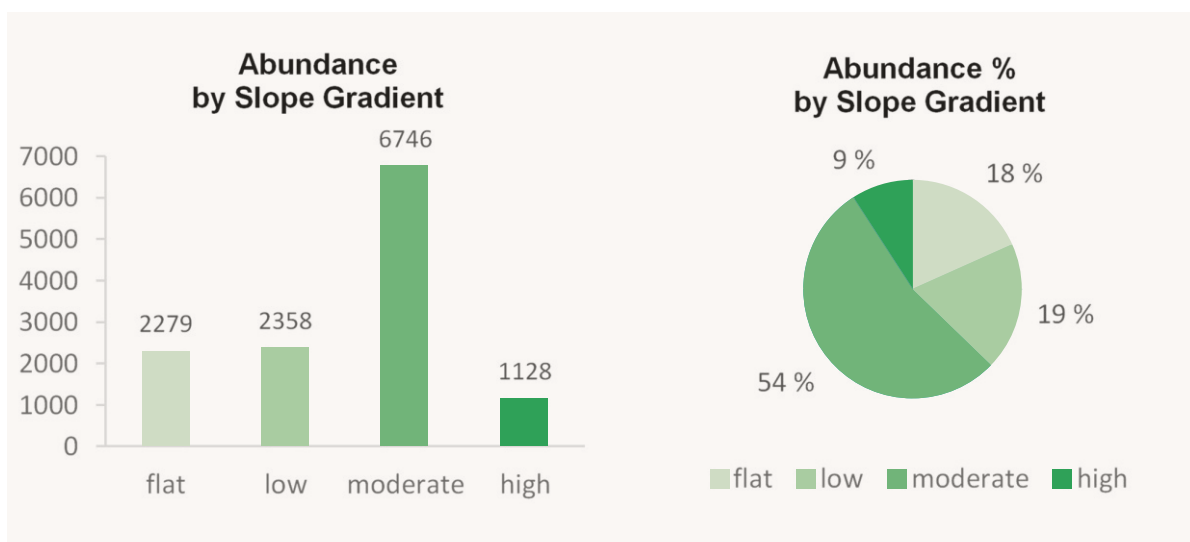


Figure 8. Abundance related to slope gradient.

Regarding slope directions there is no evidence that *A. sylvestris* prefers any of them. Microlocations on flat terrain slightly dominate by count over any other slope direction but such microlocations do

not contribute predominantly to the overall plant abundance (Fig. 9). Statistics shows no significant influence of slope direction to plant abundance (Appendix 2).

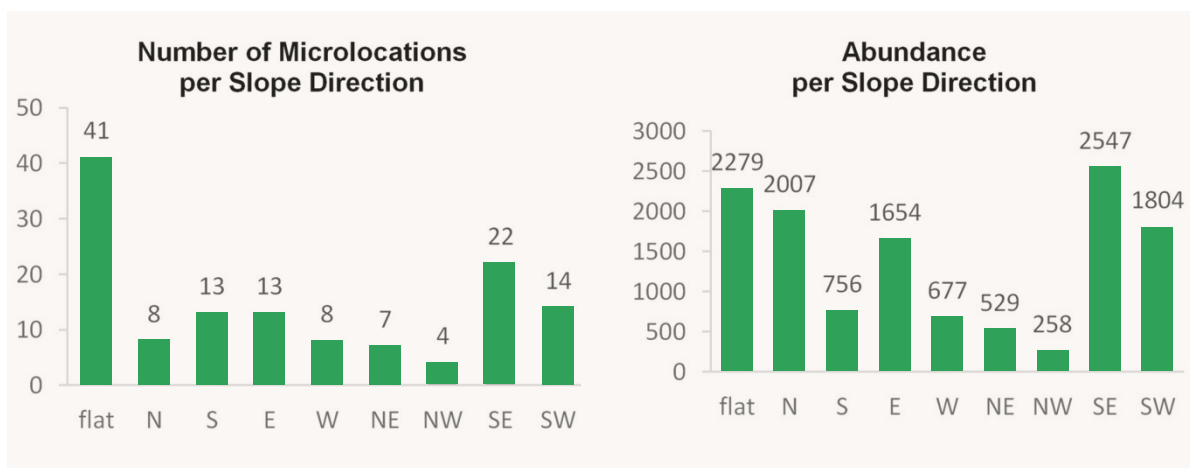


Figure 9. Microlocations and abundance related to slope direction.

Regarding exposition, the data shows that *A. sylvestris* prefers sunlight from several directions. The majority of microlocations are exposed to sunlight from several direction and they contribute dominantly to the overall plant abundance (Fig. 10).

Statistics shows that exposition from several directions strongly increases the chances for high and moderate plant abundance and reduces the chance for low abundance ($p < 0.001$; Appendix 2).

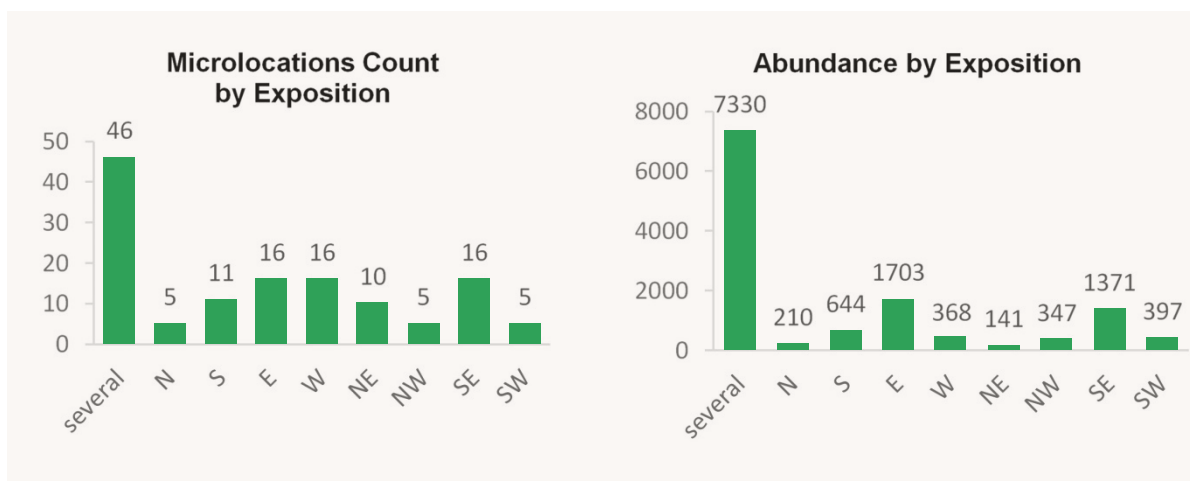


Figure 10. Microlocations and abundance related to exposition.

Our estimation results of the total woody plant coverage on all plots and each microlocation are shown in Fig. 11. There are plots of all coverage levels but those below 50% dominate. The majority

of microlocations with *A. sylvestris* findings are with a coverage below 25%. That is also in concordance with the established preference of *A. sylvestris* towards less shaded positions.

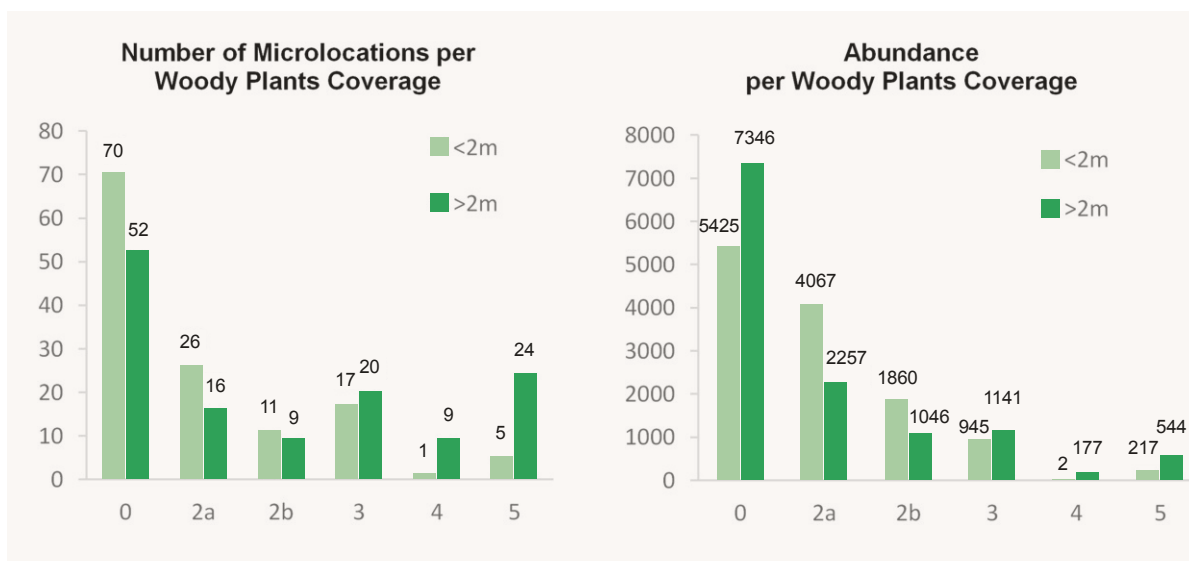


Figure 11. Microlocations count and abundance related to woody plants coverage levels according to the standard scale: 0 = no coverage; 2a = 5–15%; 2b = 16–25%; 3 = 26–50%; 4 = 51–75%; 5 = 76–100%.

The number of microlocations and abundance related to woody plants coverage expressed in the reduced scale is given in Fig. 12, emphasizing more the statistically significant influence of shading. The increase in the coverage of woody

plants above 2 m strongly reduces chances for high plant abundance ($p < 0.001$; Appendix 2) while the coverage of woody plants below 2 m has no statistically significant influence.

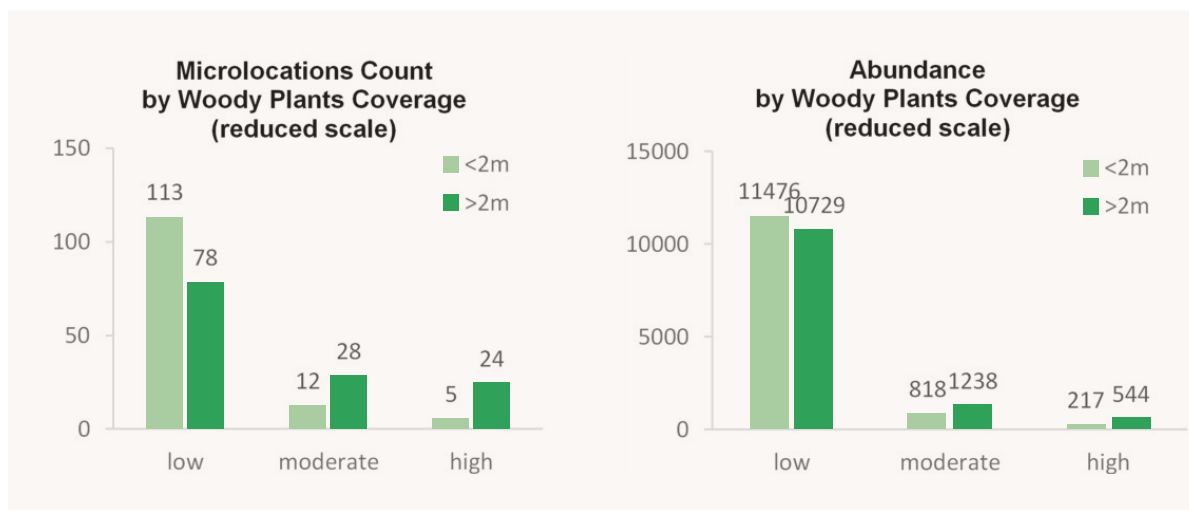


Figure 12. Number of microlocations and abundance related to woody plants coverage expressed in the reduced scale: low = 0–29%; moderate = 30–59%; high = 60–100%.

The most dominant woody plants on the majority of plots and microlocations are listed in particular order from the most to less frequent ones, based on personal observations in the field: *Quercus* sp., *Viburnum* sp., *Cornus* sp., *Fraxinus* sp., *Crataegus* sp. and *Juniperus communis* L., *Rosa* sp., *Pyrus* sp., *Berberis* sp., *Carpinus betulus* L. and *Prunus spinosa* L. are all frequent, while *Corylus avellana* L., *Ligustrum vulgare* L., *Pinus* sp., *Robinia pseudoacacia* L., *Ulmus* sp., *Betula pendula* Roth

and *Sorbus torminalis* (L.) Crantz. are present only occasionally.

A. sylvestris plants in eastern Prigorje usually grow in the form of small isolated groups with a density of 1–10 plants/m². There are some exceptions on unshaded grasslands when plants create densely covered islands with 10–20 plants/m². In the northernmost microlocation of plot Dc there were 1080 plants in an area of just 15 m² that gives an extreme density of 72 plants/m² (Fig. 13).



Figure 13. *Anemone sylvestris* dense “carpet” on the northernmost microlocation of plot Dc (Photo: V. Zadavec, 6 May 2016).

On some microlocations *A. sylvestris* plants grow individually but occur over a wider area, resulting in the median density below 2 plants/m² regardless of the habitat type (Table 3).

Table 3. Median plants density regarding habitat type.

Habitat type	Median density plants/m ²	Min (12 th percentile) (lowest 1/8)	(88 th percentile) Max (highest 1/8)
Grassland	1.9	0.1 (0.7)	(5.0) 72.0
Mixed	0.8	0.1 (0.16)	(8.2) 17.8
Fringe	1.6	0.2 (0.4)	(5.1) 13.6

The results of Kolmogorov-Smirnov test for normal distribution for each habitat type deviates significantly from the normal distribution: grassland test statistic = 0.36 (p<0.001), mixed test statistic = 0.335, (p<0.001), fringe test statistic = 0.230 (p<0.001). Detailed statistics regarding habitat type are in Appendix 2.

Nature Protection and Environmental Impact

The nature protection status of all regional segments and the population percentage of *A. sylvestris* found in them are given in Table 4.

Table 4. Nature protection status of all surveyed *A. sylvestris* segments.

Segment	Nature Protection Status	Protected since	% of total area	% of population	Responsible institution
D	none	–	21	31	–
G	Significant Landscape “Goranec”	1977	5	6	Public Institution “Maksimir”
K	Natura 2000 “Vejalnica & Krč”	2013	21	7	Public Institution “Maksimir”
M	Nature Park “Medvednica” & Natura 2000 “Medvednica”	1981 2013	24	22	Nature Park “Medvednica”
V	Natura 2000 “Vejalnica & Krč”	2013	29	34	Public Institution “Maksimir”

Thirty-one percent of the total *A. sylvestris* population and 21% of the total surface area is currently outside of any official nature protection. Public Institution “Maksimir” is currently responsible for segments: G, K, and V, containing 47% of population on 55% of the surface area. Nature Park “Medvednica” is responsible for the segment M, with 22% of population on 24% of the surface area.

With respect only to the Natura 2000 Ecological Network, the following charts illustrate that nearly half of the *A. sylvestris* plot surface area and nearly half of the population reside inside the “Vejalnica & Krč” site. About one third of both the surface area and the population is outside the Natura 2000 Ecological Network (Fig. 14).

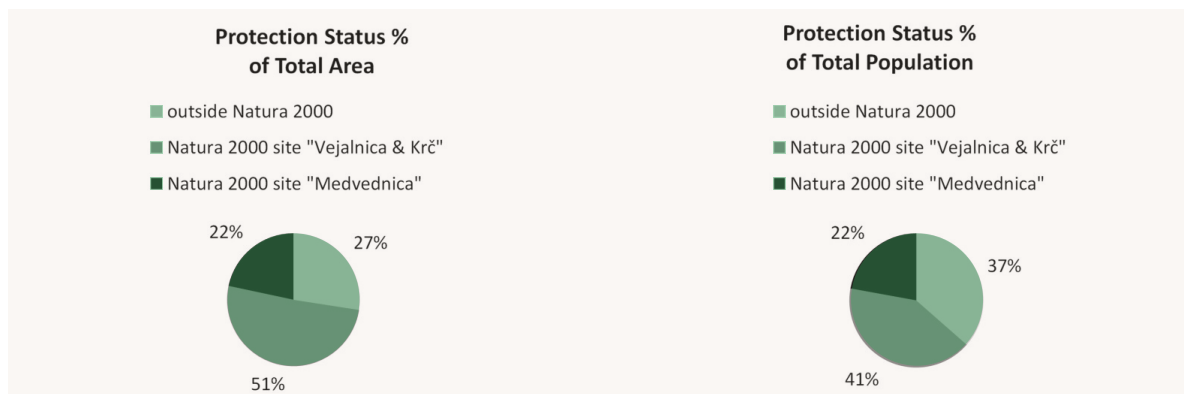


Figure 14. Natura 2000 protection status of all *A. sylvestris* findings.

The majority of grasslands in eastern Prigorje have not been maintained for several decades and they are exposed to the natural succession of woody species. We can confirm that only ten out of 130 *A. sylvestris* microlocations (8%) were recently mowed and they contain 11% of the total plant count. So 92% of all microlocations are abandoned and under some stage of succession.

The next important problem on the “grassland” microlocation type in eastern Prigorje is the occasional traffic of recreational vehicles. They damage the gentle plants and compact the soil, which prevents the emergence of plants the following seasons. This problem is noticed and documented on microlocations of plots Ke, Kc and Dd.

For “fringe” microlocations the greatest problem is soil erosion on fringes of roads, paths and trails. There are 20% of such microlocations where the soil is eroded by heavy rainfall or human disturbance during road maintenance. Those microlocations are also much more susceptible to flower picking damage than are other less noticeable ones.

There are traces of a wildfire that burned the herbaceous and short woody vegetation several years ago on most of the northern slopes of Dužica Hill. We noticed that after those burning events the grass coverage changes on those slopes in favour of the aggressive *Carex* sp. and the originally present *Bromus* sp. disappears. The most recent fire event was in mid-April 2016 on plot Df, after which the northernmost microlocation was devoid of *Anemone*.

Discussion

Anemone sylvestris plants tolerate some shade made by low and high woody plant coverage from any direction but their abundance tends to drop because of it. When high shade dominates from several directions, they tend to regress. The most intense regression is on the intensely overgrowing plot Ga which had only three microlocations in 2016 out of 12 previously documented four years ago (Alegro 2012). Our results about the *A. sylvestris* abundance drop due to increased shading are in concordance with other European research cases (Kwiatkowska-Falinska & Falinski 2007, Chýlová & Münzbergová 2008, Krechowski et al. 2015).

A. sylvestris grows together with orchids on the same plots. Since orchid habitats are already considered as a protection target within the Natura 2000 Ecological Network, *A. sylvestris* should benefit from the same protection measures used for orchids. But a significant area in eastern Prigorje rich in both *A. sylvestris* and orchids is not included

in any nature protection sites. As such, we suggest the borders of protected site “Vejalnica & Krč” to be enlarged to include also plots in the Goranec region. Dužica and Sopnica regions should be designated as a new subsite within the “Vejalnica & Krč” Natura 2000 site, or as a new Natura 2000 site. Although *A. sylvestris* itself is not listed on the Annexes of the Habitats Directive (Anonymous 1992), it is endangered in Croatia, holding the status of “vulnerable”, strictly protected by the law, listed under Section 3.2 Other important species of flora and fauna in the Standard Data Form for “Vejalnica & Krč” (Anonymous 2015b), and it occurs on a priority habitat type along with orchid species which are on the Annexes II and/or IV of the Habitats Directive (Anonymous 2015b). Therefore such an expansion in nature protected areas will be beneficial for all.

A. sylvestris disperses by wind-dispersible diaspores so all these separated segments should be regarded as an integral population and should be monitored and managed by joint efforts of all responsible nature protection institutions. We urge them to: restrict the passage of motor vehicles inside protected zones, especially off-road motorized “excursions”, and to encourage landowners to properly maintain their land in favour of the future existence of the vulnerable *A. sylvestris*.

A continuous periodical monitoring should be established in the whole eastern Prigorje Region in order to determine the population trend with respect to various human influences. Soil composition analysis and a phytocoenological assessment should be performed to better understand the characteristics of the habitat and its co-dependence on surrounding plants.

Conclusion

The *A. sylvestris* population in eastern Prigorje is fairly abundant but narrowly distributed only on a few neighbouring hills. Because of the plant's preference towards the less shaded dry grassland habitat we consider the observed advanced succession by woody plants the greatest risk for the *A. sylvestris* population. Appropriate habitat maintenance measures based on the species' preferences should be implemented and enforced as soon as possible.

Acknowledgments

This research was funded by the Public Institution “Maksimiri” in 2015 and 2016.

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Appendix 2. Statistical results for plant abundance (DV1) dependency of IV1-IV5:

IV*→DV1	Categories	Likelihood ratio value	df	Likelihood ratio	Dependency	Significant influences (std. res. > 2.0)
Slope direction (IV1)	9	23,2	16	0,108	no	no
Slope gradient (IV2)	4	13,8	6	0,033	noticable	moderate slopes increase the chance for high abundance (std. res. = 2.3)
Exposition (IV3)	9	156,9	16	< 0.001	strong	exposition from above increases the chances for high (std. res. = 4.3) and moderate (std. res. = 3.5) abundance and reduces chance for low abundance (std. res. = -2.6), the opposite stands for NE (std. res. are -2.8 and -3.2 for high and moderate abundances, respectively, and 2.0 for low abundance) and W (std. res. are -3.9 and -3.7 for high and moderate abundances, respectively, and 2.5 for low abundance) expositions
Habitat (IV4)	3	34,3	4	<0.001	strong	fringe habitat often increases the chance for low (std. res. = 2.2) and decreases the chance of moderate (std. res. = -2.0) and high (std. res. = -2.6) abundance; grassland habitat increases the chance for high abundance (std. res. = 2.3)
Woody plants < 2m (IV5)	3	2,1	4	0,724	no	no
Woody plants > 2m (IV6)	3	22,8	4	<0.001	strong	high coverage reduces chances for high abundance (std. res. = -1.8)

bold values – statistically significant results.

Statistical results for plant density regarding habitat type:

Habitat Type:	Grassland	Mixed	Fringe
N Valid	49	29	44
N Missing	0	0	0
Mean	4,1551	2,4517	2,3727
Std. Error of Mean	1,47222	0,75966	0,42343
Median	1,9	0,8	1,6
Std. Deviation	10,30554	4,0909	2,80874
Skewness	6,22	2,591	2,615
Std. Error of Skewness	0,34	0,434	0,357
Kurtosis	41,196	6,897	7,715
Std. Error of Kurtosis	0,668	0,845	0,702
Minimum	0,1	0,1	0,2
Maximum	72	17,8	13,6
12 Percentiles	0,7	0,16	0,4
25 Percentiles	1,1	0,35	0,625
50 Percentiles	1,9	0,8	1,6
75 Percentiles	3,4	2,25	3
88 Percentiles	5	8,2	5,1

bold values – statistically significant results.

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

short scientific communication / kratko znanstveno priopćenje

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Šegota, V. (2019): Flora and vegetation of the islet of Mlin (Pakleni Archipelago, Eastern Adriatic). Glas. Hrvat. bot. druš. 7(1): 15-23.

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

Šegota, V. (2019): Flora i vegetacija otočića Mlin (Pakleni otoci, istočni Jadran). Glas. Hrvat. bot. druš. 7(1): 15-23.

Sažetak

Florističkim i vegetacijskim istraživanjem otočića Mlin (Pakleni otoci blizu otoka Hvara, srednja Dalmacija, 1,1 ha) zabilježeno je 39 svojiti 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).

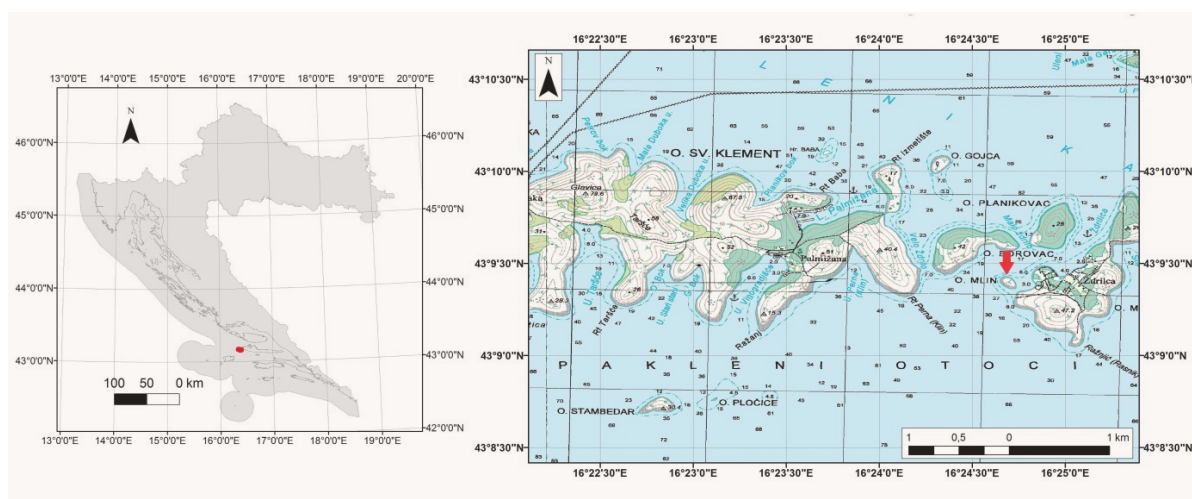


Figure 1. Geographical position of the islet of Mlin.

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 hircundinaria 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
Centaureum 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.

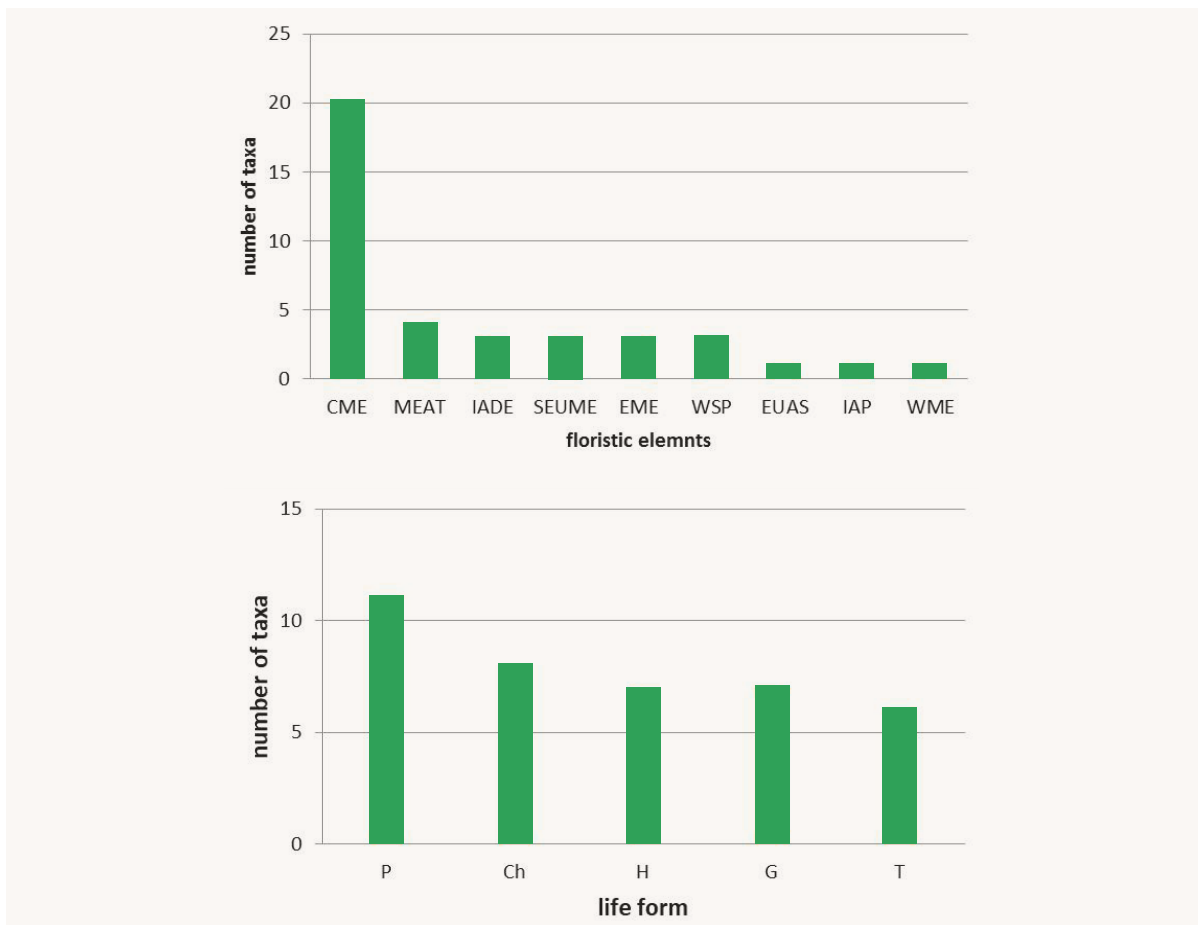


Figure 2. Floristic elements and life forms of the flora of the islet of Mlin. For abbreviations see Material and Methods.

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				
<i>Plantagino holostei-Limonietum cancellati</i> Horvatić (1934) 1939				
Relevé No.	1	2	3	Presences
No. of taxa	8	6	8	
Plot size (m ²)	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.				
<i>Limonium cancellatum</i>	1	+	2m	3
Charact. and diff. taxa of the upper units				
<i>Crithmum maritimum</i>	2m	2a	2m	3
<i>Silene vulgaris</i> ssp. <i>angustifolia</i>	1		+	2
<i>Lotus cytisoides</i>	1	+		2
<i>Silene sedoides</i>	+		+	2
Other species				
<i>Elymus pycnanthus</i>	1	1	+	3
<i>Dittrichia viscosa</i>		+		1
<i>Reichardia picroides</i>	+	+		2
<i>Inula crithmoides</i>			+	1
<i>Schoenus nigricans</i>			1	1
<i>Inula verbascifolia</i>	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				
<i>Myrto communis-Pistacietum lentisci</i> (Molinier 1954) Rivas-Mart. 1975				
Relevé No.	1	2	3	Presences
No. of taxa	8	6	7	
Plot size (m ²)	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.				
<i>Pistacia lentiscus</i>	3	3	2b	3
<i>Myrtus communis</i>	2a	2a	3	
Charact. and diff. taxa of the upper units				
<i>Smilax aspera</i>	+		+	2
<i>Asparagus acutifolius</i>	+			1
Charact. and diff. taxa of <i>Cisto-Micromerietalia julianae</i>				
<i>Erica multiflora</i>	+	1	2a	3
<i>Cistus incanus</i> ssp. <i>creticus</i>	+	+	+	3
<i>Cistus monspeliensis</i>	1		+	2
Other species				
<i>Coronilla emerus</i> ssp. <i>emeroides</i>		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				
<i>Erico manipuliflorae-Cistetum cretici</i> Horvatić 1958				
Relevé No.	1	2	3	Presences
No. of taxa	13	14	12	
Plot size (m ²)	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.				
<i>Cistus incanus</i> ssp. <i>creticus</i>	+		+	2
Charact. and diff. taxa of the upper units				
<i>Cistus monspeliensis</i>	2b	2b	2b	3
<i>Erica multiflora</i>	2b	2a	2b	3
<i>Rosmarinus officinalis</i>	2b	3	2b	3
<i>Fumana thymifolia</i>	+			1
Charact. and diff. taxa of <i>Pistacio lentisci-Rhamnetalia alaterni</i>				
<i>Pistacia lentiscus</i>	1		+	2
<i>Myrtus communis</i>	+	+		2
<i>Juniperus phoenicea</i>		r		1
Other species				
<i>Brachypodium retusum</i>	2m	1	2m	3
<i>Cladonia</i> sp.			+	1
<i>Linum strictum</i> ssp. <i>strictum</i>		+	+	2
<i>Blackstonia perfoliata</i>	+	+		2
<i>Allium flavum</i>	+	+		2
<i>Filago vulgaris</i>	+		+	2
<i>Carex flacca</i> ssp. <i>serrulata</i>	+	+		2
<i>Centaureum pulchellum</i>		+	+	2
<i>Koeleria splendens</i>	1		+	2
<i>Anagallis arvensis</i>		+	+	2
<i>Allium sphaerocephalon</i>		+		1
<i>Desmazeria rigida</i>		+		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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Notes on the genus *Erucastrum* (Brassicaceae) in Bosnia and Herzegovina

short scientific communication / kratko znanstveno priopćenje

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Maslo, S., Šarić, Š., Sarajlić, N. (2019): Notes on the genus *Erucastrum* (Brassicaceae) in Bosnia and Herzegovina. Glas. Hrvat. bot. druš. 7(1): 23-27.

Abstract

This paper presents a survey of *Erucastrum* taxa found in Bosnia and Herzegovina and includes an identification key, distribution data and map of localities in Bosnia and Herzegovina based on a revision of herbarium specimens from SARA, literature data and field observations. After 75 years, the occurrence of *E. gallicum* (Willd.) O. E.

Schulz (Brassicaceae) in Bosnia and Herzegovina was confirmed and its distribution is supplemented by new localities. Four populations were found in the central part of Bosnia and Herzegovina, near the town of Vareš. The field survey covered the central reaches of the river Stavnja.

Keywords: Balkans, Bosnia and Herzegovina, *Erucastrum*, taxonomy

Maslo, S., Šarić, Š., Sarajlić, N. (2019): Napomene o rodu *Erucastrum* (Brassicaceae) u Bosni i Hercegovini. Glas. Hrvat. bot. druš. 7(1): 23-27.

Sažetak

U radu je prikazan pregled taksona roda *Erucastrum* koji su zabilježeni u Bosni i Hercegovini i obuhvaća identifikacijski ključ i kartu distribucije u Bosni i Hercegovini na temelju revizije herbarijskih uzoraka iz herbarijuma SARA, literaturnih podataka kao i terenskih promatranja. Nakon 75 godina potvrđena je prisutnost *E. gallicum* (Willd.) O. E. Schulz

(Brassicaceae) u Bosni i Hercegovini, a distribucija vrste se dopunjuje novim lokalitetima. Četiri populacije su zabilježene u središnjem dijelu Bosne i Hercegovine, u blizini grada Vareša. Terenska istraživanja obuhvataju središnji tok rijeke Stavnje.

Keywords: Balkan, Bosna i Hercegovina, *Erucastrum*, taksonomija

Introduction

The genus *Erucastrum* C. Presl is distinguished by having usually quadrangular siliques; somewhat keeled, prominently one-nerved valves; oblong or oval, uniseriately arranged seeds; nonsaccate sepals and occasionally bracted inflorescences. The genus comprises approximately 20 species primarily distributed in the western Mediterranean region and in most of Africa (Al-Shehbaz 1985), with four representatives distributed in Europe. Of these species only two are distributed in the Balkan Peninsula: *E. gallicum* (Willd.) O. E. Schulz and *E. nasturtiifolium* (Poir.) O. E. Schulz. (Marhold 2011) and in Bosnia and Herzegovina (Bjelčić & Šoljan 2015).

Material and methods

After 75 years, the occurrence of *E. gallicum* (Brassicaceae) in flora of Bosnia and Herzegovina was confirmed and its distribution is supplemented by new localities. During fieldwork in 2015 and 2016, numerous specimens were found in four localities in the vicinity of the small town of Vareš (East Central Bosnia). Digital photographs and GPS coordinates were taken in the field. Identification of the specimens was done according to Rich (1991) and the nomenclature follows Marhold (2011). The specimens were collected and stored in the Herbarium of the National Museum of Bosnia and Herzegovina (SARA, 51834, 51835). All available materials of the genus *Erucastrum* have been studied, including the data gathered from references and from public (SARA) and private herbariums of the authors as well. Herbarium abbreviations are given according to Holmgren et al. (1990). The distribution of the species in Bosnia and Herzegovina is shown on the map using standard UTM grid 10x10 km. Localities gathered from literature and herbariums are indicated in black on the map, while new data are indicated in red (Fig. 1).

Results and discussion

In the flora of Former Yugoslavia only two species of the genus *Erucastrum* are present: *E. gallicum* and *E. nasturtiifolium*. To separate these two species, we offer the adjusted key according to Scoggan (1978) and Gómez-Campo (1993).

- 1a Basal lobes of the upper stem-leaves not clasping; inflorescence bracted in the lower part; flowers yellowish white; sepals erect; siliqua not stalked above the sepal-scars*E. gallicum*
- 1b Basal lobes of the upper stem-leaves downwardly directed and clasping the stem; inflorescence bractless; flowers bright yellow; sepals spreading; siliqua distinctly stalked above the sepal-scars*E. nasturtiifolium*

Erucastrum gallicum (Willd.) O. E. Schulz, in Bot. Jahr. 54 Beibl. 119: 56 (1916).

Synonyms: *Brassica ochroleuca* (Gaudin) Soy.-Will.; *Eruca erucastrum* (L.) P. Gaertn., B. Mey. et Scherb.; *Erucastrum obtusangulum* Hegetschw. & Heer, non (Schicher) Reichenb.; *Erucastrum pollichii* Schimp. et Spenn.; *Hirschfeldia pollichii* (G. W. Schimp. & Spenn.) Fritsch; *Sisymbrium gallicum* Willd.

Species description: *E. gallicum* is an annual or biennial (Fig. 2a). Stems are erect to decumbent, 20-80 cm high, branched below and above, with simple, deflexed hairs below. Leaves often in a dense rosette, up to 25 cm, petiolate, oblong to oblanceolate in outline but deeply cut to pinnately divided with an oblong to lanceolate, obtuse terminal lobe and 3-10 pairs of lateral lobes. Cauline leaves are alternate, not clasping the stem at the base, similar but increasingly smaller in size up the stem, passing gradually into floral bracts. Inflorescence crowded. Flowers arranged in terminal raceme, in at least the lower 1/3 of the

main raceme with leaf-like bracteoles (Fig. 2c). Sepals 4-6 mm long, oblong, erect to inclined. Petals 6-8 mm long, yellowish white, claw about as long as the limb, linear, pale (Fig. 2b). Petals about twice as long as sepals. Pedicels in fruit 5-19 mm long, slender, ascending to patent. Siliqua 20-50 x 1-2 mm, not stipitate; beak 2-4 mm long, without seeds. Seeds elliptic or obovate, orange-brown (Fig. 2d). Chromosome number is $2n=30$ (Rich 1991, Tutin & Akeroyd 1993).

The species is native to southwestern and central Europe, but widely introduced and naturalized in other parts of Europe (Rich 1991), Canada and the United States (Warwick & Wall 1998). *E. gallicum* is rare in the Balkans with insufficient studies in areas: Bosnia and Herzegovina (Maly 1919), Romania (Săvulescu 1955), Albania (Greuter 1986), Serbia (Sarić & Diklić 1986), Croatia (Nikolić 1997),

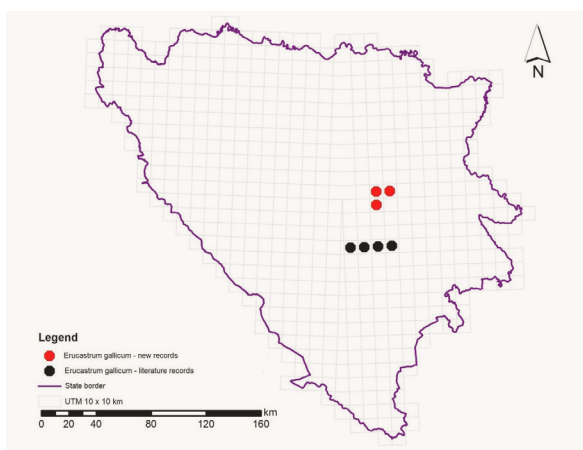


Figure 1. The distribution of *Erucastrum gallicum* in Bosnia and Herzegovina.



Figure 2. *Erucastrum gallicum* on the right bank of Stavnja river near Vareš: a – habitat; b – flower; c – inflorescence with leaf-like bracteoles; d – seeds (Photos: Š. Šarić 2016).

Slovenia (Martinčić et al. 1999) and Greece (Tan 2002).

During a floristic research in Central Bosnia in the valley of the Stavnja river we could confirm the presence of *E. gallicum* in the area of Bosnia and Herzegovina. The species was found in three localities around the town of Vareš (Fig. 1) in the different types of habitats: in roadsides, on fallow lands, waste grounds, trenches, silts of river and brooks.

Locality 1: Vareš, right bank of Ponikva Brook, about 4 km upstream from the mouth of Ponikva in Stavnja and about 5 km NE of Vareš ($44^{\circ} 10' 16.63''$ N. $18^{\circ} 23' 48.59''$ E; elevation 1035 m. a. s. l.). About 100 specimens were recorded along the road, at a linear distance of about 800 m.

Locality 2: Vareš, right bank of Stavnja river, about 300 m downstream from the mouth of Ponikva in Stavnja and about 2 km N of Vareš ($44^{\circ} 10' 40.63''$ N. $18^{\circ} 20' 13.27''$ E; elevation 925 m a. s. l.). About 10 specimens were recorded.

Locality 3: It is split into two main groups. The northernmost group is located in Vareš, Podjavor, right bank of Stavnja river, about 6 km S of Vareš ($44^{\circ} 07' 05.84''$ N. $18^{\circ} 18' 27.75''$ E; elevation 733 m a. s. l.). Only five specimens were recorded. The second one is located in Pajtov Han, right bank of Stavnja river, about 8 km S of Vareš ($44^{\circ} 05' 43.92''$ N. $18^{\circ} 18' 49.41''$ E; elevation 656 m a. s. l.). About 10 specimens were recorded.

It should be mentioned that there are confusions about the presence of a certain *Erucastrum* species in Bosnia and Herzegovina. Namely, *E. nasturtiifolium* was reported by Maly (1920) under the name *E. obtusangulum* (G. Haller ex Schleich.) Rchb. (synonym *E. pollichii* non Schimp. et Spenn). In the Herbarium of the National Museum of Bosnia and Herzegovina (SARA), eleven specimens of the genus *Erucastrum* were stored. All specimens were collected at four localities in the wider Sarajevo area and marked with four different names: *E. obtusangulum*, *E. nasturtiifolium*, *E. pollichii* and *E. gallicum*. With a detailed overview of the herbarium collection SARA we have found that all stored specimens belong to *E. gallicum*.

Specimina visa: Sarajevsko polje near Ilidža (SARA 14060; coll. Maly 1914 as *Erucastrum obtusangulum* (G. Haller ex Schleich.) Rchb.), Miljacka River valley near Sarajevo (SARA 14058; coll. Maly 1918 as *Erucastrum obtusangulum* Rchb.), Sarajevsko polje (SARA 14059; coll. Maly 1923 as *Erucastrum obtusangulum* (G. Haller ex Schleich.) Rchb.), Sarajevsko polje, Miljacka River valley near Sarajevo (SARA 14057; coll. Maly 1925 as *Erucastrum nasturtiifolium* (Poir.) O. E. Schulz.), Sarajevsko polje, Miljacka River valley near Sarajevo (SARA 14061; coll. Maly 1933 as *Erucastrum nasturtiifolium* (Poir.) O. E. Schulz.), Sarajevo, Osenik near Tarčin (SARA 14063, 14067;

coll. Ritter-Studnička 1936 as *Erucastrum pollichii* G. W. Schimp. & Spann.), Sarajevo, Zovik near Pazarić (SARA 14064, 14065, 14066; coll. Ritter-Studnička 1938), Sarajevo, Zovik near Pazarić, on track ballast along the railway (SARA 14062; coll. Ritter-Studnička 1938 as *Erucastrum nasturtiifolium* (Poir.) O. E. Schulz.).

Erucastrum nasturtiifolium (Poir.) O. E. Schulz, in Bot. Jahr. 54 Beibl. 119: 56 (1916).

Synonyms: *Brassica erucastrum* L.; *Brassica nasturtiifolium* Poir., *Erucastrum obtusangulum* (Schleich.) Rchb. f.; *Sinapis nasturtiifolia* Poir.

Species description: *E. nasturtiifolium* is biennial or perennial plant with a basal rosette and some erect stems that are often branched in terminal racemes. Stems are angular, 20-100 cm high, densely hispid with deflexed hairs, at least below. Basal leaves are lyrate-pinnatisect with 3 pairs of lateral lobes. Cauline leaves are alternate, clasping the stem at the base, similar to basal, but increasingly smaller in size up the stem, with 6-8 pairs of lateral lobes. Inflorescence bractless; flowers bright yellow; sepals spreading; fruit distinctly stalked above the sepal-scars. Sepals 5 mm long, patent. Petals 9 mm long, limb broadly obovate, yellow. Siliqua 25-60 x 1-2 mm, stipitate; beak 3-6 mm long, with 1-2 seeds. Seeds elliptic, light- to reddish-brown. Chromosome number is $2n=16$ (Gómez-Campo 1993, Tutin & Akeroyd 1993).

E. nasturtiifolium has a South-Western European distribution, extended from South-western Europe to Northern France and Southern Germany (Jalas et al. 1996). Elsewhere in Central and Eastern Europe it has an adventitious character. In the Balkans the species was only known in Romania (Săvulescu 1955), Albania (Greuter 1986) and Slovenia (Martinčič et al. 1999).

The literature data on the presence of the genus *Erucastrum* in the flora of Former Yugoslavia are at least confusing. Hayek (1927) and Tutin & Akeroyd (1993) mention only *E. nasturtiifolium* for the Balkans (Bosnia, Croatia). According to Trinajstić (1986) *E. nasturtiifolium* is present in Bosnia and Slovenia, and *E. gallicum* grows only in Slovenia. All confirmed findings indicate that *E. nasturtiifolium* in the territory of Yugoslavia is present only in Slovenia (Martinčič & al. 1999), and *E. gallicum* in Bosnia and Herzegovina (Maly 1919, 1920, 1940), Croatia (Nikolić 1997), Serbia (Sarić & Diklić 1986) and Slovenia (Martinčič et al. 1999).

The occurrence of *E. nasturtiifolium* in the flora of Bosnia and Herzegovina was firstly noted by Hayek (1927: 456), based on the erroneous mistaken naming of Maly (1920). Based on that

quotation, it was noted by Trinajstić (1986: 430) and also by Bjelčić & Šoljan (2015: 71). In the herbarium collection SARA there are no specimens of this species from Bosnia and Herzegovina. We therefore consider its occurrence in Bosnia and Herzegovina as doubtful. The presence of *E. nasturtiifolium* in Bosnia and Herzegovina needs to be confirmed and further field work is necessary.

Acknowledgements

We would like to thank to Aldin Boškailo for the mapping of distribution of species as well as Jessica Andersson for improving the English of this paper.

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Rare and threatened *Damasonium polyspermum* Coss. (Alismataceae) discovered in Krka National park

short scientific communication / kratko znanstveno priopćenje

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Šegota, V., Hršak, V., Kovačić, S. (2019): Rare and threatened *Damasonium polyspermum* Coss. (Alismataceae) discovered in Krka National park. Glas. Hrv. bot. druš. 7(1): 27-32.

Abstract

The species *Damasonium polyspermum*, exceptionally rare in Croatia, has been found within Krka National park. This is the fourth known site of this strictly protected species in Croatia. It is associated with amphibian vegetation of the drawdown zone around temporary Mediterranean

ponds, where livestock watering plays a key role in maintaining these fragile habitats. Propagation and ex-situ protection of *D. polyspermum* has been initiated within the Botanical Garden of Faculty of Science in Zagreb.

Keywords: drawdown zone, ex-situ protection, livestock watering, Mediterranean temporary pond, southeast Europe

Šegota, V., Hršak, V., Kovačić, S. (2019): Pronalazak rijetke i ugrožene vrste *Damasonium polyspermum* Coss. (Alismataceae) u Nacionalnom parku Krka. Glas. Hrv. bot. druš. 7(1): 27-32.

Sažetak

Iznimno rijetka vrsta *Damasonium polyspermum* pronađena je u Nacionalnom parku Krka. To je četvrto poznato nalazište ove strogo zaštićene vrste u Hrvatskoj. Vrsta je dio amfibijske vegetacije u pojasu oscilacije razine vode oko povremenih

mediteranskih lokvi, ugroženog staništa u čijem održavanju ključnu ulogu ima napajanje stoke. U Botaničkom vrtu Prirodoslovno-matematičkog fakulteta u Zagrebu započeo je uzgoj i ex-situ zaštita ove vrste.

Ključne riječi: ex-situ zaštita, jugoistočna Europa, napajanje stoke, pojas oscilacije razine vode, sredozemne povremene lokve

Introduction

Damasonium polyspermum Coss. is an annual species with predominantly western Mediterranean distribution (Rich & Nicholls-Vuille 2001). As an aquatic herbaceous annual, the species requires specific living conditions of shallow waters, or muds beside ponds exposed to full-sun (Vuille 1986). The plant develops aquatic and terrestrial forms, while particular phases of its life cycle strongly depend on the changes of the water regime, therefore ripening of fruits (stellately radiating, laterally compressed follicles) and dispersion of seeds occurs during the dry phase.

Assessed as vulnerable (VU) in both Global and Mediterranean IUCN Red-lists (de Bélair et al. 2010), it is relatively rare over its entire distribution range, being associated with Mediterranean temporary ponds, a very scarce and largely threatened European wetland habitat (Zacharias & Zamparas 2010). Apparently the species forms larger populations solely in Spain and Morocco, while the population in France shows strong decline. In Portugal, Sicily, Algeria, Libya and Syrian Arab Republic the species is extremely rare, with only one or just few sites hosting its populations (de Bélair et al. 2010). Most recently, the species has been found on the Apennine Peninsula, in the region of Puglia (Carruggio et al. 2016).

In southeastern Europe (Balkan Peninsula) *D. polyspermum* is known only from Croatia (Nikolić & Topić, 2005), where it has been recently assessed as (critically) endangered (Boršić & Posavec Vukelić 2012a) and statutorily strictly protected species (Anonymous 2013). Although Rich & Nicholls-Vuille (2001), revising several herbarium collections, confirmed the presence of this species in north-western part of Greece, de Bélair et al. (2010) still consider its presence in Greece uncertain. In Albania, *D. polyspermum* has not been recognized as a separate species, but is included within the aggregate *Damasonium alisma* sensu lato (Vangjeli et al. 2000), however, not mentioned in the most recent literature (Pils 2016, Barina 2017).

Only three localities of *Damasonium polyspermum* have been documented in Croatia

so far: the island of Murter (Trinajstić et al. 1995, Pandža 1998), Bunari pond (Boršić & Posavec Vukelić 2012a) and Vrana Lake Nature Park (Vuković & Jelaska 2015). Being found relatively recently, additional taxonomical, ecological and threat assessment data are available in Boršić & Posavec Vukelić (2012a).

Material and methods

The flora of the central part of the Krka National Park was investigated during October 2018. Garmin e-trex GPS device was used for recording coordinates. The nomenclature of the species follows Nikolić (2019).

One specimen of *D. polyspermum* has been collected, dried, pressed and stored within *Herbarium Croaticum* collection (ZA) (Thiers 2018). Ripen fruits and seeds were also collected. All the activities followed the Special Permit issued to the Botanical Garden of the Faculty of Science, for the years 2018/2019 (*Special Permit to collect seed of strictly protected species of Croatian autochthonous flora in the wild, for scientific purposes and ex-situ conservation in Zagreb University Botanical Garden of the Faculty of Science, issued by Croatian Ministry of Environment and Energy concerning the years 2018/2019: Class: UP/I-612-07/17-48/178; Reg. No.: 517-07-1-1-1-18-4; January 25th 2018.*)

The collected material was stored at room temperature for less than a month, and transported to the Botanical Garden facilities in mid-November 2018, for the purpose of preliminary studies of the germination and possible inclusion of *D. polyspermum* in the Programme of ex-situ protection of threatened and strictly protected species of Croatian flora (Sandev et al. 2013, Kovačić et al. 2014). Small amount of seeds has been preserved in the Carpological collections of the Botanical department in Zagreb.

Dry fruit pods were manually opened, and seeds counted under the magnifier. Approximately 70 seeds were sown in a lidded transparent plastic container on November 21st, using double autoclaved, heavily sodden sowing-mix, with some loam and petty

limestone gravel added. Particular references or techniques for cultivating *D. polyspermum* are not available, therefore the procedure followed the general terms of the Alismataceae family described by Baskin & Baskin (1998). Care was taken to design the procedure to mimic the conditions in the wild during wintertime. The sealed container was placed in a light, cold glasshouse surroundings, with the minimum night temperature approx. 10°C, and maximum day temperature approx. 20°C. The exact values of temperature depended on the amount of available sunlight. Water was added when necessary, to keep the compost saturated.

Results and discussion

Damasonium polyspermum was found on 25th October 2018 around a small pond on the plateau above the left bank of the Krka River, within the Krka National park (Fig. 1). The pond has not been recognized nor named on any topographic map available. The site (43° 56' 19.27"N, 15° 59' 51.57"E) is located northwest from the hamlet of Popovići (D. Bogetić) and southeast from the hamlet of D. Mudrinići, at the elevation of 234 m a.s.l.

The pond is oval shaped, around 4 m wide and 10 m long, surrounded by approximately 3 m wide drawdown zone with muddy substrate saturated with water at the time of our visit (Fig. 1). About ten

specimens of *D. polyspermum* were found on site, exclusively in terrestrial form, with developed fruits (Fig. 1). The scan image of collected specimen is publicly available in Virtual Herbarium (Rešetnik & Šegota 2019) under ZA49294 code. Half of the specimens were already completely dry with some umbels even detached from ground. No aquatic forms with floating leaves were noticed within the pond. The plant cover of the drawdown zone was very scarce, with only *Eleocharis palustris* (L.) Roem. et Schult. and *Mentha pulegium* L. being more abundant, while *Polygonum aviculare* L., *Agrostis stolonifera* L., *Juncus articulatus* L. and *Potentilla reptans* L. were rare. Within the pond, dense submersed macrophytic vegetation, comprised of *Ceratophyllum demersum* L., *Myriophyllum verticillatum* L. and *Potamogeton crispus* L., was developed. A typical sub-Mediterranean thicket vegetation (*Quercus pubescens* Willd., *Carpinus orientalis* Mill., *Paliurus spina-christi* Mill. and *Juniperus oxycedrus* L.) was encompassing the pond, however, some old, mature downy oak trees were preserved around the pond. We can not be certain about the current use of the pond, however, we presume that it is used for livestock watering. Namely, the presence of mature trees suggests that this site was in the past maintained for this purpose, whereas trees are usually kept to serve as a shaded shelter for livestock during the summer heat.

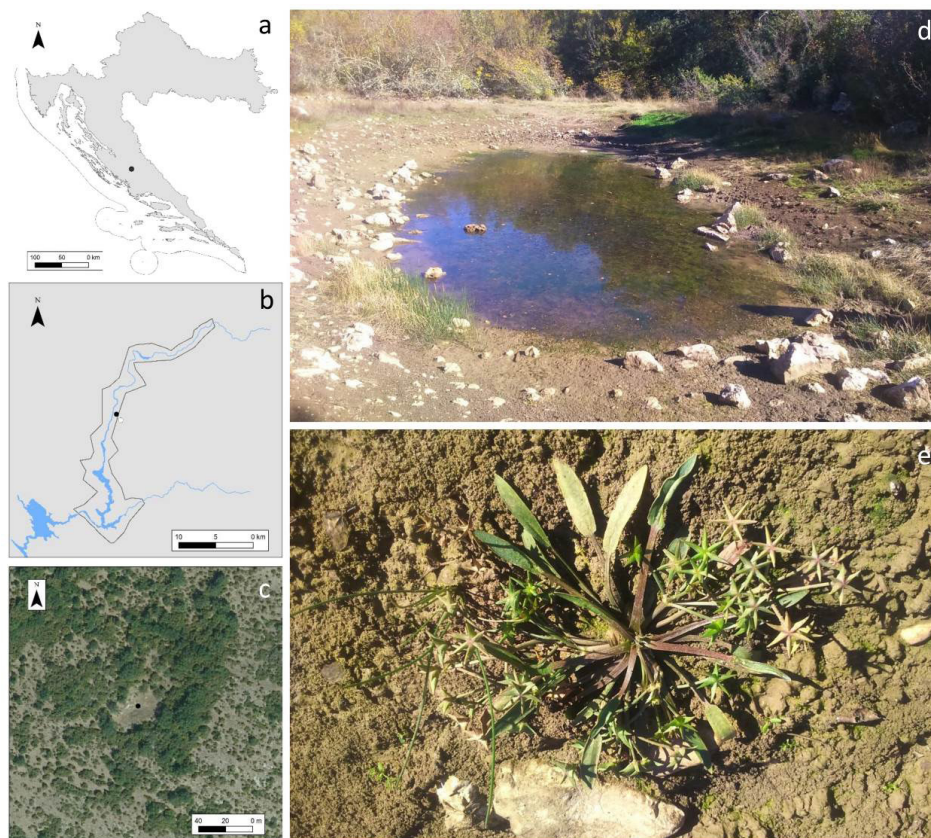


Figure 1. New finding site of *Damasonium polyspermum* in Croatia (a), within Krka National park (b); digital orthophoto (c) and a photograph of the finding site (d) with terrestrial form of the species (e) (Photos: V. Šegota).

This particular site is just one kilometre aerial distance northwest from the Bunari pond, located next to the border of the Krka National park, where *D. polyspermum* has been found six years ago (Boršić & Posavec Vukelić 2012a), and where livestock watering takes place regularly. Comparing the floristic composition of Mediterranean temporary ponds in Krka National park in general (Boršić & Posavec Vukelić, 2012b), we can see that the similarity between these two sites is relatively high. Therefore, we can assume that these two populations are interconnected through cattle and probably some wild animals (mammals and birds) playing a key role in their stability, through habitat maintenance (trampling and soil disturbance) and diaspore (fruits, seeds) dissemination.

A great ecological similarity between our site and all previously recorded sites in Croatia (Trinajstić et al. 1995, Pandža 1998, Boršić & Posavec Vukelić 2012, Vuković & Jelaska, 2015) points to a very narrow habitat preference of *D. polyspermum*. In the same time, these habitats are clearly threatened and facing decline due to the abandonment of traditional agriculture (Zacharias & Zamparas 2010, Rhazi et al. 2012). Keeping in mind that these habitats often host other rare and threatened plants (Rhazi et al. 2012, Vuković et al., 2018), they should be kept and maintained as temporary ponds, as a necessary measure of preserving these peculiar plants.

The examination of pods revealed six or seven seeds within each follicle. As for seed germination, first cotyledon of *D. polyspermum* appeared two weeks after sowing, on December 4th 2018, and during the following month the germination was erratic. As of January 4th 2019, a total of 15 seedlings have germinated; out of which five developed the first grass-like leaves until mid-January (up to 12 mm long), while the others were still in a cotyledon state (8-10 mm long) (Fig. 2). Every morning, when the lid is removed, the cotyledons carry a single droplet of water (guttation), and are allowed to aerate. The lid is then sealed again for the night. In February 2019 the second round of seeds (until then stored at cold glasshouse temperature) will be sown indoors, while in late March we are planning to sow the rest outdoors. It will be interesting to see if the germination occurs, as the Alismataceae family apparently have recalcitrant seeds (Baskin & Baskin 1998) in which viability is lost if the seed moisture content drops below 30-65%, depending on the species. The viability of many aquatic plants (incl. *Alisma plantago-aquatica*) is increased with scarification (Baskin & Baskin 1998); therefore, this treatment should be considered in future germination experiments. Adult individuals will eventually be added to the Botanical Garden collection of Croatian rare and statutorily protected species to obtain more seed for further studies.



Figure 2. Semi-ripen fruits (a) and seed (b) of *Damasonium polyspermum* (Photos: N. Koletić); sowing substrate on December 12th 2018 (c) (Photo: S. Kovačić) and young seedlings on January 4th 2019 (d) (Photo: V. Štamenković).

Conclusion

Newly found pond with *Damasonium polyspermum* within the Krka National park is the fourth known locality of this species in Croatia, representing a valuable contribution to the knowledge on the distribution of this rare plant. As a characteristic species of the Mediterranean temporary ponds, *D. polyspermum* should be regularly monitored and protected, as already suggested for some other species of this highly vulnerable habitat type (Vuković et al. 2018). Furthermore, efforts should be made to protect and maintain these threatened habitats, as valuable reservoirs of rare and threaten plants (Rhazi et al. 2012). If the germination and further cultivation in the facilities of Zagreb Botanical Garden of the Faculty of Science proves successful, the species will be added to the Garden collection of ex-situ protected plants of Croatian flora. This collection may even be used as source of plant material, should any reintroduction of *D. polyspermum* be planned in the future.

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Vijesti / News

Otkrivena i opisana nova vrsta bentičke dijatomeje u Crvenom jezeru (Imotski, Hrvatska)

A new benthic diatom species discovered and described from Crveno jezero (Imotski, Croatia)

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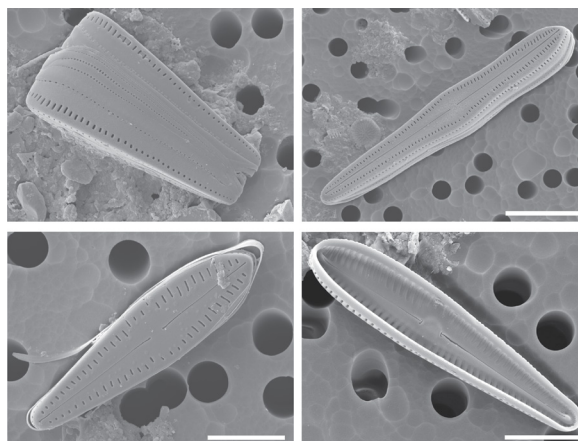
U sklopu speleološkog istraživanja "Speleoronička ekspedicija Crveno jezero 2017." koje je 5. i 6. svibnja 2017. godine provelo Društvo za istraživanje i očuvanje prirodoslovne raznolikosti Hrvatske (ADIPA) organizirana su do sada najopsežnija ekološka i biološka istraživanja Crvenog jezera kod Imotskog. Crveno jezero predstavlja jedinstveni krški fenomen Dinarida te jednu od najdubljih vrtača na svijetu, zbog čega je još 1964. proglašeno geomorfološkim spomenikom prirode, a od 2014. godine kroz ekološku mrežu RH uključeno je u europsku mrežu Natura 2000.

Prilikom povijesnog prvog uspješnog zarona na samo dno jezera, za potrebe taksonomskih istraživanja prikupljeni su uzorci sedimenta s dubine od 20 m te sa samog dna jezera pri dubini

od 245 m. Nakon čišćenja i obrade u uzorcima su utvrđene silikatne ljušturice dosad nepoznate vrste dijatomeje roda *Gomphosphenia* Lange-Bertalot.

Vrste roda *Gomphosphenia* nastanjuju pretežito hladne oligotrofne i alkalne slatkovodne sustave te dosad nisu zabilježene u Hrvatskoj. Rod se odlikuje specifičnim ultrastrukturnim obilježjima poput složenog oblika vanjskog i unutarnjeg kanala rafe, nedostatku apikalne pore te jedinstvenoj morfologiji strija i areola. Detaljnim morfološkim pregledom ultrastrukture pronađenih ljušturica tehnikama svjetlosne i elektronske mikroskopije, opisana je za znanost nova vrsta *Gomphosphenia plenkoviciae* Gligora Udovič & Žutinić. Vrstu *G. plenkoviciae* (Sl. 1) karakteriziraju gotovo linearne ili uske cilindrične blago heteropolarne valve koje

se pri vrhu lagano proširuju. Od srodnih se vrsta razlikuje prema obliku valvi, morfologiji strija te prema obliku aksijalnog i središnjeg polja. Vrsta je imenovana u čast Anđelke Plenković-Moraj, redovitoj profesorici na Biološkom odsjeku PMF-a u Zagrebu, znanstvenici koja je posvetila svoju karijeru unapređenju istraživanja ekologije i taksonomije slatkovodnih algi Republike Hrvatske. Vrsta je opisana u suradnji s kolegama s Biološkog odsjeka PMF-a, Odjela za fiziku Sveučilišta u Rijeci, Društva za istraživanje i očuvanje prirodoslovne raznolikosti Hrvatske (ADIPA) te Instituta za biologiju Prirodno-matematičkog fakulteta u Skopju, a opis nove vrste objavljen je u specijaliziranom časopisu Phytotaxa (Gligora Udovič i sur. 2018).



Slika 1. *Gomphosphenia plenkoviciae* Gligora Udovič & Žutinić.

Literatura

- **Gligora Udovič, M., Žutinić, P., Kavre Piltaver, I., Kulaš, A., Ozimec, R., Tofilovska, S. (2018):** *Gomphosphenia plenkoviciae* sp. nov. A new species from Crveno jezero, Croatia. *Phytotaxa* 351(3): 229-238.

Hrvatsko botaničko društvo – novosti i pregled zbivanja u 2018. godini

Croatian Botanical Society – news and an overview of developments in 2018

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U 2018. godini nastavljen je izuzetno aktivni rad Društva i njegovih članova što je vidljivo iz organiziranih predavanja i radionica, kao i vođenja i sudjelovanja članova Društva u većem broju stručnih i znanstvenih projekata. Ovo je ujedno bila i zadnja, četvrta, godina pod predsjedanjem izv. prof. dr. sc. Zrinke Ljubešić, dopredsjednice dr. sc. Ivane Rešetnik i tajnice dr. sc. Maje Mucko. Svim članovima zahvaljujemo na ukazanom povjerenju, podršci i suradnji u sudjelovanju u mnogim i raznolikim djelatnostima Društva. Na 15. redovnoj i 8. Izornoj skupštini Hrvatskog botaničkog društva održanoj 13. 12. 2018. jednoglasno je izabran prof. dr. sc. Nenad Jasprica za novog predsjednika Društva. Jednoglasno je izabran i novi Upravni odbor u sastavu Mara Vukojević (dopredsjednica),

mr. sc. Damira Tafra (tajnica), te dr. sc. Vanja Stamenković i prof. dr. sc. Toni Nikolić (članovi). Novi nadzorni odbor djelovat će u sastavu: dr. sc. Branka Salopek Sondi, izv. prof. dr. sc. Zrinka Ljubešić i doc. dr. sc. Martina Temunović.

Novoizabrani predsjednik istaknuo je da će se nastaviti s dosadašnjim djelatnostima Društva te da će više poraditi na popularizaciji Društva u javnosti i Društva kao više tolerantne zajednice. Nastavit će s organizacijom predavanja i radionica, publiciranjem Glasnika, obećava dovršiti web stranicu Društva u prvoj polovici 2019. godine, te će se rado primiti organizacije sljedećeg botaničkog simpozija za kojeg je dao i prijedlog loga. Novom predsjedniku i vodstvu Društva želimo uspješan rad i pozivamo sve članove da ih podrže i

pomognu im u radu i ostvarenju planiranih ciljeva.

Tijekom 2018. godine ostvareni prihodi društva iznosili su 322.856,00 kn (prihodi od pružanja usluga 275.062,00 kn, prihodi članarina 15.875,00 kn, financijski prihodi-kamate 34,00 kn, donacije iz državnog proračuna 31.885,00 kn), a ostvareni rashodi bili su 524.084,00 kn (službena putovanja 146.482,00 kn, usluge 336.401,00 kn, materijal i sirovine 19.738,00 kn, financijski rashodi 3.482,00 kn, ostali materijalni rashodi 17.981,00 kn).

Društvo je 2018. godine prvi put u suorganizaciji sa BIOM-om, HUSEK-om i HED-om organiziralo dvodnevni stručni izlet za članove svih navedenih društava. Botaničko-ornitološki izlet je organiziran 30. lipnja i 1. srpnja 2018. pod stručnim vodstvom dr. sc. Marije Pandže, dr. sc. Milenka Milovića i prof. dr. sc. Nenada Jasprice (botanika) te Ivana Budinskog (ornitologija). Prvi dan izleta obuhvaćao je terenski posjet lokalitetima izvor Cetine i Krčića, a drugi dan se boravilo na Svilaji. Ukupno je bilo 49 sudionika. Bio je omogućen prijevoz autobusom koji je iznajmljen na Agronomskom fakultetu, a spavanje je organizirano u Ekološkoj stanici 'Vrlika', Biološkog odsjeka PMF-a, smještenoj u selu Ježević, zaseoku Vučemilovići, na području grada Vrlike. Izuzetno nam je drago što smo ovim izletom ispunili želju članova Društva izraženu nakon prošlogodišnjeg izleta za povećanjem ovakvog tipa aktivnosti društva.



Slika 1. Stručni botaničko-ornitološki izlet na Svilaji (Foto: Z. Ljubešić).

Na inicijativu Hrvatskog mikrobiološkog društva u svibnju 2018. godine na Prehrambeno-biotehnološkom fakultetu je organiziran sastanak bio-društava. Ukupno se odazvalo 21 bio-društvo. Na sastanku, uz ostala društva, predstavio se i HBoD kroz kratku prezentaciju. Raspravljalo se o zajedničkim problemima i zajedničkom pristupu rješavanja istih.

Tijekom prošle godine započeta je i izuzetno uspješna i intenzivna suradnja sa Likovnom akademijom Sveučilišta u Zagrebu. U sklopu projekta Društva „Ljepota detalja, struktura i transformacije – kokolitoforidi Jadrana“ financiranog od Zaklade HAZU u veljači 2018. održan je „maraton crtanja“ na temu kokolitoforidi. Zatim je na Likovnoj akademiji 13. travnja 2018., u organizaciji HBoD-a i ALU postavljena izložba te održan umjetničko-znanstveni skup u organizaciji PMF-a i Likovne akademije. Suradnja se nastavila i u sklopu Noći biologije. Osim toga, na inicijativu HBoD-a u lipnju 2018. je potpisan ugovor o suradnji PMF-a i ALU, a u studenom 2018. izložba „Kokolitoforidi“ je postavljena u Dubrovniku (akvarij Instituta za more i priobalje i Prirodoslovni muzeja Dubrovnik). Otvorenje je bilo vezano uz održani kongres Ocean Optics XXVI. Sama izložba je bila iznimno dobro posjećena od strane većinom inozemnih sudionika kongresa, a veliki plakat o izložbi još je neko vrijeme bio postavljen na Pilama u Dubrovniku.

Na samom kongresu Ocean Optics XXIV održanom u studenom 2018. HBoD je bio lokalni organizator te smo i u sklopu kongresa imali izložbeni prostor na kojem smo promovirali naše Društvo i njegove aktivnosti.

S osobitim zadovoljstvom možemo istaknuti da je tijekom 2018. g. nastavljeno kontinuirano održavanje javnih predavanja koja sadržajem pokrivaju široki krug tema, te su redovito dobro posjećena, kako od strane botaničara tako i od strane ostale zainteresirane javnosti. Tijekom 2018. g. ukupno je održano 15 predavanja, od kojih je čak pet predavanja bilo od strane inozemnih predavača iz Belgije, Indonezije, Italije, Slovenije i Srbije.

Tablica 1. Predavanja HBoD-a u 2018. godini.

Datum	Predavač	Naziv predavanja
11. 01. 2018.	Nikola Koletić, mag. oecol. et prot. nat.	Fitokomponenta u biocenoza sedrenih barijera
25. 01. 2018.	izv. prof. dr. sc. Zrinka Ljubešić	Pacifik
08. 02. 2018.	dr. sc. Mirko Sardelić	Čovjek i drvo: kulturna i socijalna povijest
22. 02. 2018.	prof. dr. sc. Jasenka Topić	Japanski vrtovi
08. 03. 2018.	prof. dr. sc. Mladen Juračić	Hrvatska krška ušća – nastanak i mijene
20. 03. 2018.	izv. prof. dr. Nina Šajna	Bioraznolikost i njeni ekološki učinci
05. 04. 2018.	dr. sc. Sanja Đurović	Grupa <i>Silene saxifraga</i> : novi taksonomski koncept
19. 04. 2018.	dr. sc. Yeni Herdiyeni i dr. sc. Fifi Gus Dwiyaniti	Istraživanje bioraznolikosti u Indoneziji
03. 05. 2018.	Maja Maslač Mikulec	Tajland, Kambodža, Vijetnam – idealno adventsko putovanje
17. 05. 2018.	Anamarija Kolda	Toksične cijanobakterije u akvakulturi
18. 10. 2018.	dr. sc. Sanja Kovačić	Izgubljeni svjetovi – evolucija biljnog carstva u nekoliko slika
30. 10. 2018.	prof. dr. sc. Bart van der Vijeveer	Science in a cold paradise
05. 11. 2018.	Salvatore Cambria	Vegetation and phytogeography of Sicily
15. 11. 2018.	dr. sc. Nina Vuković	Dekoratívno samoniklo bilje na zagrebačkim tržnicama
29. 11. 2018.	izv. prof. dr. sc. Antun Alegro	Biljni svijet sedrenih barijera Plitvičkih jezera

Uspješan rad ostvarile su i sve Sekcije koje djeluju u sklopu Društva.

Sekcija Botaničkih vrtova i arboretuma održala je od 14. – 21. svibnja 2018. g. Osmi Tjedan botaničkih vrtova, arboretuma i botaničkih zbirki pod supkroviteljstvom Ministarstva zaštite okoliša i prirode, Ministarstva znanosti, obrazovanja i sporta, Ministarstva poljoprivrede i Hrvatske agencije za okoliš i prirodu. Svečano otvorenje Tjedna je bilo u Prirodoslovnom muzeju u Rijeci, a otvorili su ga zamjenik Župana PGŽ Petar Mamula, gradonačelnik Rijeke Vojko Obersnel i ravnateljica Prirodoslovnog muzeja u Rijeci Željka Modrić Surina. Predstavljen je novi dio vrta koji je u sklopu projekta LIKE (Living on the Karst Edge) preuređen i namijenjen ex situ uzgoju rijetkih i ugroženih vrsta. U Tjednu je bilo uključeno 20-tak vrtova i svi su izuzetno aktivni (čak i vrtovi bez ijednog zaposlenika) te uspješno promoviraju djelatnost vrtova koja postaje prepoznatljiva. Svi programi vrtova objavljeni su na stranicama HBoD-a. U Botaničkom vrtu PMF-a otvorena je u sklopu Tjedna izložba 'Izgubljeni svjetovi' koju je ukupno posjetilo 15417 posjetitelja, a od toga 9910 stranaca. BV Kotišina je prvi prema dobivanju novaca iz EU fondova (12,5 milijuna kuna), a BV Marijan je za revitalizaciju dobio 2,5 milijuna

kuna. Prirodoslovni muzej u Rijeci se proširuje na park Nikole Hoste gdje će biti novi botanički vrt, a BV Lokrum i BV Velebit imaju nove planove obnove. Botanički vrt PMF-a obnovio ciglenu kuću staklenika, te uređuje južnu ogradu koja će, u obliku pergole, povezati novoizgrađeni most preko Miramarske ceste i Crnatkovu ulicu. U svibnju i listopadu 2018. održani su redoviti sastanci Konzorcija europskih botaničkih vrtova (European Botanic Gardens Consortium, BGCI) na kojima se raspravljalo o zajedničkim aktivnostima europskih botaničkih vrtova te o polugodišnjim izvješćima o radu članova konzorcija.

Algološka sekcija je u veljači 2018. na PMF-u u Zagrebu organizirala radionicu „Molekularne metode u algologiji” na kojoj su sudjelovali svi laboratoriji u Hrvatskoj te je napravljen popis opreme i poslova koji se u njima odvijaju. U rujnu je na sastanku FEPS-a nakon Italije, Hrvatska izabrana kao novo predsjedništvo čime je ukazana velika čast. Veliki dio djelatnosti Algološke sekcije bio je usmjeren na planiranje međunarodnog kongresa 7. European Phycological Congress koji će se održati od 25. – 30. kolovoza 2019. godine u Zagrebu (<http://epcseven.biol.pmf.hr/>).

Dendrološka sekcija Društva tijekom 2018. g. radila je na digitalizaciji i nadopuni Dendrološke herbarijske zbirke Šumarskog fakulteta Sveučilišta u Zagrebu koja se nalazi na Zavodu za šumarsku genetiku, dendrologiju i botaniku. Kroz aplikaciju za administraciju i ažuriranje podataka web portala „Herbarium DEND“ kojoj se pristupa unosom korisničkog imena i zaporke na internet adresi <http://dendherbarij.sumfak.hr>, ukupno su u bazu unesena 4153 herbarska lista iz 113 porodica i 335 rodova (989 svojta). Tijekom 2018. godine unesena su 802 herbarska lista. Osim toga, zbirka je nadopunjena s 1200 novih herbarskih listova većinom drvenastih vrsta s prirodnih staništa u Hrvatskoj i Austriji. U tijeku je izrada stranica za pregled postavljenog sadržaja i baze podataka „Herbarium DEND“ Šumarskoga fakulteta Sveučilišta u Zagrebu s javnim pristupim (bez korisničkog imena i zaporke) koje će biti dostupne na internet stranici Šumarskoga fakulteta na podomenu: <http://dendherbarij.sumfak.unizg.hr>.

U sklopu Sekcije za herbarijske zbirke 2018. godine održan je sastanak kustosa herbarijskih zbirki ZA, ZAHO, ZAGR i CNHM. Na sastanku su raspravljani problemi koji se javljaju prilikom sistematizacije i digitalizacije herbarijskog materijala u bazu podataka Flora Croatica (FCD) koju kontinuirano provode svi članovi Sekcije. Povezivanje i značenje herbarijskih zbirki je na dobrom putu što je i potvrdila anketa prezentirana na Balkanskom kongresu u Novom Sadu u rujnu 2018. u sklopu predavanja prof. dr. sc. N. Jogan: „Balkan herbaria – Do we have to worry about them?“. Izrađena je web stranica Herbarium Croaticum <http://herbariumcroaticum.biol.pmf.hr/> koja omogućuje nesmetan prikaz svog do sada

sistematiziranog i digitaliziranog materijala u ZA i ZAHO zbirka.

Od daljnjih aktivnosti Društva valja istaći i izdavanje ovog Glasnika u sklopu Nomenklaturno-taksonomske sekcije. Ovo je bila šesta godina izlaska časopisa Glasnik i u 2018. godini objavljeno je ukupno 13 priloga u 4 kategorije (izvorni znanstveni članak, kratko znanstveno priopćenje, stručno priopćenje, kratko stručno priopćenje). Dosadašnji glavni urednik Glasnika prof. dr. sc. T. Nikolić prepušta nakon šest godina vođenja časopisa drugima, te je na godišnjoj skupštini 13. 12. 2018. jednoglasno izabran izv. prof. dr. sc. Sandro Bogdanović. Asistenti urednika su dr. sc. Igor Boršić – lektura i Ana Vujasić – grafička urednica, dok Odbor čine: izv. prof. dr. sc. Antun Alegro, prof. dr. sc. Nenad Jasprica, prof. dr. sc. Zlatko Liber, dr. sc. Milenko Milović, prof. dr. sc. Anđelka Plenković Moraj, prof. dr. sc. Toni Nikolić, prof. dr. sc. Branka Pevalek Kozlina, prof. dr. sc. Željko Škvorc. Na godišnjoj skupštini su ukazani i problemi povezani s nomenklaturnim promjenama koje su objavljene u Glasniku te koje bi bilo dobro ažurirati i u bazi podataka FCD. Prihvaćen je prijedlog o formiranju upravnog odbora FCD-a koji bi se ustrojio tijekom 6. Hrvatskog botaničkog simpozija u kolovozu 2019. godine.

Članovi društva bili su aktivni i prilikom provođenja stručnih i znanstvenih projekata. Tako je tijekom 2018. g. Društvo pod vodstvom svojih članova provodilo ukupno 16 projekata različitih naručitelja, od koji su četiri projekta i zatvorena u 2018. g. Projekti su temama vezani za floristička i vegetacijska istraživanja, praćenje stanja (monitoring) određenih vrsta i staništa i izradu programa za praćenje stanja.

Tablica 2. Prikaz projekata vođenih preko HBoD-a tijekom 2018. godine.

Voditelj	Naziv projekta (Naručitelj)
A. Alegro	NP Plitvička jezera – Flora i vegetacija mahovina i vaskularnih biljaka sedrenih barijera Plitvičkih jezera
A. Alegro	NP Sjeverni Velebit – Centar za posjetitelje Krasno, Grupa VI. Flora i vegetacija
A. Alegro	PP Papuk – Istraživanje flore mahovina otvorenih stijena i stjenovitih padina na području PP Papuk
A. Alegro	PP Vransko jezero - Istraživanja sastava vrsta algi porodice Characeae
A. Alegro	Istraživanje stanišnih tipova u NATURA 2000 područjima „Klinča selo“, „Gornji Hruševac – potok Kravaršćica“ i „Klasnići“
A. Alegro	Natura Jadera – Inventarizacija flore i vegetacije Spomenika prirode Vrelo Une
M. Gligora Udovič	NP Krka – Dijatomeje rijeke Krke, od izvora do ušća
V. Hršak	NP Krka - Istraživanje flore starog dijela Nacionalnog parka „Krka“ (I i II faza)

Voditelj	Naziv projekta (Naručitelj)
V. Hršak	NP Krka – Revitalizacija kamenjarskih travnjaka u nacionalnom parku Krka kontroliranim paljenjem
T. Nikolić	HAOP – Analiza postojećih podataka za strane i invazivne strane vrste biljaka
Z. Ljubešić	7. European Phycological Congress
Z. Ljubešić	Zaklada HAZU - Ocean Optics XXIV
V. Šegota	Općina Klis – izrada i tisak popularno-znanstvenog vodiča Biljke tvrđave Klis
V. Šegota	NP Sjeverni Velebit - Monitoring travnjaka pod režimom ispaše na području NP Sjeverni Velebit u 2018. godini
I. Ternjej	JU Sisačko-moslavačke županije - Revitalizacija cretnog staništa posebnog botaničkog rezervata Đon-Močvar
N. Vuković	JU Dubrovačko-neretvanske županije - Istraživanje i kartiranje invazivnih stranih vrsta <i>Myriophyllum heterophyllum</i> Michx. i <i>Egeria densa</i> Planchon u području ekološke mreže Delte Neretve

Tablica 3. Prikaz završenih projekata preko HBOD-a tijekom 2018. godine.

Voditelj	Naziv projekta (Naručitelj)
V. Hršak	NP Mljet - Istraživanje vegetacije Nacionalnog parka Mljet
Z. Ljubešić	Zaklada HAZU – Ljepota detalja, transformacije i strukture - Kokolitoforidi izložba
I. Stanković	NP Plitvička jezera - Procjena stanja izvorišnog područja Plitvičkih jezera (Bijela Rijeka) u odnosu na referentno stanje na temelju bioloških elemenata
I. Stanković	NP Plitvička jezera - Sastav i značaj bentičkih algi na sedrenim barijerama Plitvičkih jezera

Na kraju želimo istaknuti da je na godišnjoj skupštini prihvaćen prijedlog da se sljedeći 6. Hrvatski botanički simpozij organizira u Zagrebu, od 30. – 31. 08. 2019., te će se vremenski i prostorno nadovezati na EPC7. Predsjednik organizacijskog odbora bit će prof. dr. sc. N. Jasprica. Rana prijava za kongres bi bila do 01. 06. 2019., a predaja sažetaka do 01. 05. 2019. Ovim putem pozivamo sve članove za doprinos uspješnom simpoziju putem prijava svojih znanstvenih i stručnih priloga i sa aktivnim sudjelovanjem.

Sve navedeno ukazuje da Hrvatsko botaničko društvo uspješno ostvaruje sve planirane aktivnosti, kao i na činjenicu je zauzelo značajno mjesto u stručnom i znanstvenom životu hrvatske biološke zajednice. Svim članovima Društva se najljepše zahvaljujemo na svom uloženom trudu i dobrovoljnom radu u mnogobrojnim aktivnostima Društva, a novom vodstvu Društva želimo uspješan rad i nove zanimljive djelatnosti.

Andrija-Željko Lovrić (5. 6. 1943. – 11. 5. 2018.)

In memoriam



Jedanaesteročlana multidisciplinarna grupa istraživača isplovljava iz šibenske luke put otoka Visa i Palagruže – hrvatskih prirodoslovnih bisera koji su davno izronili sred Jadranskoga mora – u sklopu postnovogodišnjeg, siječanjskog terenskog istraživanja. I dok gledam, stojeći među prijateljima i kolegama na palubi jedrilice, prema našem cilju koji se još niti ne nazire na horizontu, ljeskanje i ljuljanje mora oko brojnih malih otočića rogozničkog akvatorija prisjeća me na posljednje veliko i nezaboravno terensko istraživanje Jadrana, obuhvativši tada i osebujni pučinski otok Jabuku, koje sam ovdje proveo s Andrijom-Željkom Lovrićem prije 12 godina. Tako su moje misli nezaustavljivo potekle prema čovjeku s kojim sam ranije bio provodio nebrojene dane i sate na različitim plovilima, stotinama otoka, otočića, škojeva i plitvaca našega Jadrana još od davne 1992., uključujući i vanjske otoke kao što su Vis, Svetac, Sušac i Palagruža. Upravo zahvaljujući njegovoj viziji o multidisciplinarnom istraživanju bioraznolikosti Dinarida i Jadrana, na tim izoliranim, mnogobrojnim i raznolikim djelićima kopnenih staništa, ali i onih na granici kopna i mora, zaiskrila su i ubrzo se rasplamsala mikološka istraživanja koja se ne bi ni do danas dogodila da nije bilo toga čovjeka. Zapravo, da nije bilo njega veliko je pitanje kakva bi bila temeljna

mikologija u Hrvatskoj, gdje bi se ona mogla razvijati i bi li bilo takve mikologije ovdje uopće. Kao njegov dugogodišnji kolega čast mi je stoga osvrnuti se na život i rad dr. sc. Andrije-Željka Lovrića, prirodoslovca s vizijom integrativnog pristupa u temeljnoj biologiji i nekadašnjeg voditelja Grupe za biocenološka istraživanja od kojega sam *in situ* toliko mnogo naučio o ekologiji Jadrana, njegovih otoka i priobalnih Dinarida, utjecaju klime i klimatoloških elemenata na živi svijet, kao i o tome da se zaključci u fundamentalnoj biologiji mogu i trebaju temeljiti isključivo na terenskoj stvarnosti.

Andrija-Željko Lovrić rođen je 5. lipnja 1943. u Zagrebu, s porijeklom iz malog, moru izrazito orijentiranog mjesta, Baške na otoku Krku. Maturirao je na Klasičnoj gimnaziji u Zagrebu 1962. gdje se upoznaje s klasičnim jezicima o važnosti kojih će, osim što se njima kasnije služio baveći se temeljnom biologijom (botanikom) i jezikoslovljem, pisati i u posebnim člancima (npr. u časopisu *Latina et Graeca* i *Zborniku zagrebačke klasične gimnazije*). Nakon mature upisao je studij biologije na Prirodoslovno-matematičkom fakultetu Sveučilišta u Zagrebu (eksperimentalna biologija i botanika), gdje je diplomirao 1967. iz problematike biogeografije i taksonomije s temom *Rasprostranjenost ilirskih Centaurea*. Nakon diplome radio je u razdoblju od 1967. do 1970. na Botaničkom zavodu Prirodoslovno-matematičkog fakulteta Sveučilišta u Zagrebu kao honorarni asistent, a kasnije na Institutu za botaniku Sveučilišta u Zagrebu (1970. - 1976.) kao redovni asistent sa stalnim zaposlenjem gdje je i magistrirao (1970.) s temom *Ornitogene biocenoze Kvarnera* u sklopu svoje postdiplomske specijalizacije ekološkog smjera. Tijekom svoga rada u Institutu za botaniku odlazi u dva navrata (1973. i 1975.) na usavršavanje u Francusku. U to vrijeme izrađuje disertaciju o ekološkom djelovanju vjetrova na Dinarskom kršu na kojoj će tek znatno kasnije doktorirati (obuhvaćajući mnogo širi geografski prostor) zbog toga što 1976. u reorganizaciji Sveučilišta nepravedno ostaje bez posla po svoj prilici radi „prišivenih“ političke nepodobnosti. Godine 1978. zapošljava se na Institutu Ruđer Bošković gdje radi kao znanstveni asistent u razdoblju od 1978. - 1995. tijekom kojega odlazi na dodatna usavršavanja u Francusku (1981., 1987. i 1993.), izrađuje habilitacijsku tezu o izumrlim paleocenzama Balkana i ekološkom učinku aktualnih klimatskih promjena koju naposljetku prerađuje u znanstvene radove te postaje voditelj Grupe za biocenološka

istraživanja (1987. - 1998.). S dolaskom na Institut Ruđer Bošković osniva znanstvenu zbirku *Herbarium Adriaticum*, Zagreb (ADRZ) kojoj je bio i kurator. Godine 1995. doktorira disertacijom iz područja biogeografije s naslovom *Eolski kserobiomi od Jadrana do Irana (Biocenoške osobitosti obala i vrhova duž Taurodinarskog velekrasa)*. pod mentorstvom dr. sc. Nikole Ljubešića. Nakon disertacije radi na Institutu u zvanju viši asistent (1996. - 1998.) te znanstveni suradnik (1999. - 2008.) kao voditelj Laboratorija za biocenotiku (1998. - 2008.). Na tom mjestu radio je do svog umirovljenja 29. prosinca 2008. Bio je glavni istraživač na projektnim temama Grupe za biocenoška istraživanja odnosno Laboratorija za biocenotiku u razdoblju 1978. - 1999. s fokusom na hrvatskim endemima, halofitima, borafitima, flori jadranskih otoka, etnobotanici i ekologiji primorskoga krša. U posljednjim desetljećima intenzivno se bavio i etnogenezom Hrvata. Kroz čitavo vrijeme bio je aktivan kroz međunarodnu suradnju s francuskim, bosansko-hercegovačkim, grčkim, turskim i iranskim znanstvenicima i stručnjacima. Bio je dugogodišnji tajnik Međunarodne komisije za prirodoslovna istraživanja Mediterana sa sjedištem u Monaku, međunarodni ekspert pri IUCN-u za mediteranske otoke te utemeljitelj i jedan od pročelnika Znanstvenog društva za proučavanje podrijetla Hrvata.

Znanstveni rad dr. sc. Andrije-Željka Lovrića bio je prije svega usmjeren na botaničku biogeografiju i ekologiju te općenito biocenologiju. U okviru svoje iznimno obimne znanstvene aktivnosti koju je danas teško sagledati i pobrojati, objavio je više od 450 različitih publikacija, od čega većina spada u domenu botanike. Osobito su vrijedna njegova istraživanja ekozonacije i vegetacije na područjima izloženim olujnim vjetrovima. Posebno se detaljno bavio biljnim vrstama koje su se razvile u uvjetima ekstremnih ekoloških prilika (olujni vjetrovi, reljef, posolica i dr.) u okviru čega je otkrio i znanstveno opisao kao nove za znanost - desetak biljnih vrsta i niz primorskih fitocenoza. Izradio je florno-fitocenoške preglede za mnoge jadranske otoke, riječne kanjone, dinarske planine i dr. Osim toga bavio se algologijom, citotaksonomijom, fito-indikatorima, a u ranijem razdoblju i prostornim planiranjem. Istraživao je i fosilne arheocenoze te paleoekologiju na području Hrvatske, kao i predhistorijske i antičke antropogene utjecaje na ekosustave. U okviru svojeg bogatog doprinosa botanici, stotinjak radova objavio je u inozemnim edicijama akademija i sveučilišta sa sjedištima u Beču, Zürichu, Ženevi, Hagu, Amsterdamu, Uppsali, Parizu, Montpellieru, Lilleu, Grenobleu, Madridu, Firenci, Padovi, Ateni, Patrasu, Sofiji, Petrogradu, Washingtonu itd.

Među najvažnije svakako spadaju brojni radovi u ediciji Mediteranske znanstvene komisije (CIESM; 1973. - 1995.), rad o biocenoškoj ekozonaciji mediteranskog krša zapadnih Dinarida, jadranskih otoka i morskoga dna (1981), jastučastim trnjacima tipa tragantida na olujnom kršu Dinarida (1987, s Marijom Bedalov) i numeričkoj analizi vegetacijskih kompleksa na priobalnim Dinaridima (1996, s Olegom Antonićem), kao i njegova serija priloga u ediciji *Ecosystems of the World* (1993-1997). Sa Stjepanom Bertovićem izrađuje osnovnu kartu prirodno-potencijalne vegetacije prema tada novim istraživanjima (*Tuxenia*, 1992) u kojoj se revidira i upotpunjuje dotadašnje nepotpuno poznavanje ekozonacije na našem Jadranu kao i razmještaj određenih tipova vegetacije na primorskim Dinaridima te nekih područja krškog zaleđa pod utjecajem reljefa i toplih zračnih struja. U monografiji *Šume u Hrvatskoj* (1992) detaljno opisuje hrvatske biljne endeme u suradnji sa Želimirom Borzanom i suradnikom Mladenom Racom. Među posljednjim znanstvenim priložima valja istaknuti radove objavljene u časopisu *Jadranska meteorologija*, koji promatraju kserotermne florne elemente, vegetaciju i njenu ekozonaciju u svjetlu klimatskih promjena (2011 i 2012), o čemu je već na samom početku 90-tih godina prošloga stoljeća dalekovidno raspravio u habilitacijskoj tezi koju je preoblikovao u niz priloga (1991, 2001, 2004 i dr.) u inozemnoj periodici. Suradivao je na regionalnim i nacionalnim projektima kao što su Planovi prostornog uređenja (Istra, Kordun i Banovina, Boka Kotorska i dr.), *Vegetacijsko kartiranje Jugoslavije*, *Analitička flora Jugoslavije*, projektu Jadran, na međunarodnim projektima *Čovjek i biosfera* (MAB) te monitoring-projektu FAO-UNEP. Bio je aktivan član mnogih međunarodnih prirodoznanstvenih organizacija kao što su Međunarodna komisija za prirodoznanstvena istraživanja Mediterana (CIESM-Monaco), Organizacija za fitotaksonomiju Mediterana (OPTIMA-Berlin), Međunarodna asocijacija za fitoekologiju (IAVS – Heidelberg), Međunarodno fitocenoško društvo (Lille) i dr. Svoja opsežna poredbena terenska istraživanja provodio je diljem Sredozemlja, od Španjolske do Iranskog Kurdistanu, a najviše na dinarskom kršu i jadranskim otocima. Njegov *Herbarium Adriaticum*, Zagreb (ADRZ), registriran u *Index Herbariorum*, izrastao iz tih istraživanja obuhvaća brojne eksikate biljaka i alga uzorkovanih tijekom 50-ak godina njegovog terenskog rada fokusiranog na jadranski akvatorij (otoci, školjevi, morske plićine i strmci), dinarske planine i drugdje po Sredozemlju, na područjima s ekstremnim ekološkim prilikama. Ne treba izostaviti ni Lovrićeve edukativne aktivnosti. Istaknuo bih najprije njegove izrazito inspirativne članke namijenjene mladima u časopisu *Priroda*

o buri (1982), osobitostima kanjona i potrebi njihove zaštite (1985), biokemiji i saznanjima o razvoju života (1986), zatim u *Šumarskom listu* o poluzimzelenim hrastovima na primorskom kršu (1981) koji su udarili prve pečate moje znanstvene pismenosti, zapalili terensko-istraživački duh te snažno utjecali na moje vlastito opredjeljenje za istraživanje divlje prirode daleko prije nego što ću se zaposliti upravo u njegovom laboratoriju. Posebno su vrijedni njegovi brojni prilozi (neke je napisao sa Stjepanom Bertovićem) objavljeni u enciklopedijama: Šumarska enciklopedija (sva tri sveska), *Enciklopedija Jugoslavije*, i *Hrvatska enciklopedija*. Dr. sc. Andrija-Željko Lovrić je nakon Bogoslava Šuleka jedan od nekolicine hrvatskih prirodoslovaca koji su se tijekom cijeloga svog života ustrajno bavili terenskim prikupljanjem i poredbenom analizom narodne dijalektalne onomastike, fitonimije i zoonimije te time dali značajan doprinos očuvanju hrvatske jezične kulture. U svojim brojnim djelima obradio je na desetke tisuća toponima, fitonima i zoonima s područja sjeverne, zapadne i južne Hrvatske te Hercegovine objavivši svoj prvi prilog već 1970. o onomastici na području senjskog arhipelaga. Upravo njegovo djelo *Naravoslovne natuknice dijalektalnih rječnika od Belostenca do danas* (2012) koje je zajedno s još nekoliko ranijih priloga objavio u zbornicima *Kajkavski u povijesnom i sadašnjem obzorju*, obilježilo je i završetak njegovih tiskanih publikacija. Tijekom posljednja dva desetljeća svojeg djelovanja intenzivno se bavio etnogenezom Hrvata i s tim

u vezi, prirodoznanstvenim proučavanjima rane etnogeneze u jugoistočnoj Europi i prednjoj Aziji o čemu je objavio više od 50 različitih rasprava i knjiga. Samostalno je ili u suradnji s drugima objavio niz autorskih i uredničkih knjiga te značajnih priloga u monografskim ili zborničkim posebnim izdanjima (iz područja botanike, dijalektalne onomastike, fitonimije, zoonimije i etnogeneze) kao što su *Being alive on land* (1984), *Prostor i čovjekova okolina u dugoročnom razdoblju* (1984), *Zaštita endema u živom svijetu Jugoslavije* (1987), *Osnove zaštite šuma od požara* (1987), *Šume u Hrvatskoj* (1992), *Ecosystems of the World (Dry Coastal Ecosystems, dva volumena* 1993 i 1997), *Tko su i odakle Hrvati* (1994), *Staroiransko podrijetlo Hrvata* (1998), *Gan-Veyān oscé Bascānski besidār* (2004), *Old-Croatian Medieval Archidioms* (tri volumena, 2004-2006), *Jen agramerski slovar* (dvije knjige, 2005 i 2006), *Podrijetlo Hrvata* (2007), *Kajkavski u povijesnom i sadašnjem obzorju* (tri zbornika 2002-2012) i dr.

Dr. sc. Andrija-Željko Lovrić je u punom smislu bio svestran i integrativan istraživač za kojega možemo reći da je bio ustrajni borac za mijenjanje i dopunjavanje svega onoga što terenska stvarnost determinira kao pogrešno ili nepotpuno. Kritičnost, integrativnost, originalnost i odvažnost izviru iz njegovog rada što bi danas trebale biti odlike svakog prirodoslovca i istraživača. Mnogostruki rezultati njegova rada pozivaju na daljna istraživanja s ciljem boljeg sagledavanja i razumijevanja života u prostoru i vremenu kroz promatranje utjecaja koji oblikuju sam njegov razvitak.

Neven Matočec, veljača 2019.

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