



# Eastern Alpine and Dinaric Society for Vegetation Ecology **(EADSVE)**

39th Meeting,  
May 4-7, 2022  
Dubrovnik, Croatia

**BOOK OF ABSTRACTS**



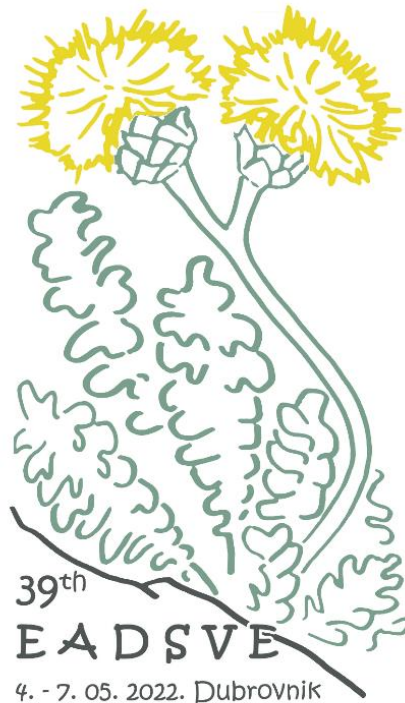
SVEUČILIŠTE  
U DUBROVNIKU  
UNIVERSITY  
OF DUBROVNIK

**Eastern Alpine and Dinaric Society for Vegetation Ecology (EADSVE)**

**39<sup>th</sup> EADSVE Meeting**

**Dubrovnik, Croatia, May 4 - 7, 2022**

# **BOOK OF ABSTRACTS**



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**Vzhodnoalpsko-dinarsko društvo za proučevanje vegetacije  
Источноалпско-динарско друштво за проучување на вегетација  
Istočnoalpsko-dinarsko društvo za istraživanje vegetacije  
Ostalpin-dinarische Gesellschaft für Vegetationskunde  
Società estalpino-dinarica di Fitosociologia  
Shoqata për Hulumtimin e Vegjetacionit të Alpeve Lindore dhe Dinarikeve  
Eastern Alpine and Dinaric Society for Vegetation Ecology**

**39<sup>th</sup> EADSVE Meeting**

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# **BOOK OF ABSTRACTS**

## PREFACE

Dear Colleagues and Friends,

On behalf of the University of Dubrovnik, Croatia, and Eastern Alpine and Dinaric Society for Vegetation Ecology (EADSVE), we would like to welcome you to the 39<sup>th</sup> EADSVE Meeting. We are in Croatia again, but for the first time here in Dubrovnik at the Student Centre Dormitory of the University of Dubrovnik. We have been looking forward to this event for three years!

For those of you who now return to EADSVE Meeting again and again, thank you for your continued friendship, scientific endeavours, and support. Of course, we wish a very warm welcome to new participants on our meetings.

The beginnings of higher education and scientific activity in Dubrovnik go back to the distant past, which is especially true for maritime, social, and natural sciences. In 1624, the Jesuits established the 'Collegium Ragusinum', and in 1654 the Senate of the Republic of Ragusa promulgated it into a public institution of higher learning for the study of arts and sciences. Ruđer Bošković, the most famous Croatian scientist and the precursor of the dynamic theory of atoms, studied at Collegium Ragusinum before going to Rome for his doctoral studies. Actually, the Collegium Ragusinum was the forerunner of the University of Dubrovnik, i.e., modern higher education in Dubrovnik. The City has always been keen on preserving its identity in all aspects, which is also true when it comes to the higher education. Dubrovnik is also a place where Lujo Adamović (1864-1935), a world-famous Croatian botanist, spent youth and later life until his death.

The 39<sup>th</sup> EADSVE Meeting program includes 15 oral and 12 poster presentations. The total number of authors is 99 from 17 countries. We are proud to announce the invited speaker Dr Massimo Terzi from Institute of Bioscience and Bioresources, Italian National Council of Research, Bari (Italy).

We will not only learn, but also enjoy and explore the streets and monuments, many gastronomic and horticultural treasures, particularly the renaissance gardens of the city of Dubrovnik listed at the UNESCO World Heritage List in 1979. All participants will take a part in two one-day botanical trips – on the Pelješac Peninsula and the Konavle region.

We must sincerely thank the presenters, chairpersons, and the students, who contributed so magnificently to the success of this meeting. We tried hard to ensure that the conference would go well-organized. We hope that it met your expectations.

Dear colleagues, once again – warm welcome to Dubrovnik and we wish you fruitful and constructive meetings and a productive exchange of ideas. We are convinced after this gathering we will be even more ready for new scientific challenges.

Prof. Dr. Nenad Jasprica  
Prof. Dr. Željko Škvorc  
Prof. Dr. Daniel Krstonošić

## MEETING ORGANIZERS



SVEUČILIŠTE U DUBROVNIKU  
UNIVERSITY OF DUBROVNIK



***Eastern Alpine and Dinaric Society for Vegetation Ecology***



*Prirodoslovni muzej Dubrovnik*  
Dubrovnik Natural History Museum

# PROGRAMME



## Wednesday, May 4, 2022

Venue: Dubrovnik Student Centre, Marka Marojice 2a, Dubrovnik, Croatia

15:00 Registration

19:00 – 20:00 Welcome Reception

## Thursday, May 5, 2022

08:00 Registration

08:25 Opening Ceremony

**Nenad Jasprica**, University of Dubrovnik, on behalf of the Committees of the 39<sup>th</sup> EADSVE Meeting

**Marijana Pećarević**, University of Dubrovnik, Vice-Rector for Science and International Cooperation

**Jelka Tepšić**, Deputy Mayor of the City of Dubrovnik

Chair: **Christian Eichberger**

### P L E N A R Y

08:45 – 09:15

Massimo Terzi: **Syntaxonomy of grasslands with *Salvia officinalis* in the Western Balkans**

### ORAL PRESENTATIONS

09:15 – 09:30

Nenad Jasprica: **The vegetation of the Special Reserve Mali Ston Bay, south Dalmatia, Croatia**

09:30 – 09:45

Katija Dolina: **A review of the Lokrum Botanical Garden development**

09:45 – 10:00

Janez Kermavnar, Lado Kutnar, Valerija Babij, Aleksander Marinšek, Erika Kozamernik, Anica Simčič, Ajša Alagić, David Štefanič, Ruben Šprah: **Distinction between different subtypes of the *Tilio-Acerion* forests (NATURA 2000) based on field mapping**

10:00 – 10:15

Lado Kutnar, Janez Kermavnar, Marko Sabovljević: **Bryophyte assemblages in different forest types across Slovenia**

10:15 – 10:30

Gergely Pápay, Attila Fűrész, Eszter S.-Falusi, Károly Penksza: **Phytosociology of *Festuca* taxa in open sandy grasslands along the Danube**

10:30 – 11:00

## POSTER SESSION – 1 WITH REFRESHMENTS

Chair: **Katija Dolina**

Naim Berisha, Renata Ćušterevska, Fadil Millaku, Vlado Matevski: **The *Blyssmo-Eriophoretum latifoliae* association nova prov.**

Nenad Jasprica: **Phytosociology and ecology of the vegetation with *Brassica mollis*, South Croatia**

Jasnica Medak, Ivana Sirovica, Sanja Perić, Nikola Zorić, Dinka Matošević, Andrija Jukić, Ivica Samardžić, Mario Bjeliš: **Invasive capacity of *Prunus serotina* (Rosaceae) and its host *Rhagoletis cingulata* (Diptera, Tephritidae) – a case study in Croatia**

Krunoslav Sever, Antonia Vukmirović, Saša Bogdan, Ida Katičić Bogdan, Daniel Krstonošić, Tomislav Karažija, Marko Bačurin, Željko Škvorc: **Functional adaptation of common beech and sessile oak to drought**

Dániel Balogh, Attila Fűrész, Ferenc Pajor, Péter Norbert, Tímea Kiss, Károly Penksza: **Data of content values and grassland management analysis of sandy grasslands along the Danube**

Zsuzsanna Fenyősi, Jenő J. Purger, Attila Lengyel, Dragica Purger: **Monitoring of *Colchicum hungaricum* in dry grassland on the *locus classicus* (South Hungary)**

## ORAL PRESENTATIONS

Chair: **Daniel Krstonošić**

11:00 – 11:15

Dejan Mandžukovski, Andraž Čarni, Idoia Biurrun, Jan Douda, Željko Škvorc, Vladimir Stupar, Michal Slezák, Renata Ćušterevska, Patricia María Rodríguez-González, Carlos Salazar Mendías, Estêvão Portela-Pereira, Kiril Vassilev, Đorđije Milanović, Ali Kavgacı, Dmytro Iakushenko, Remigiusz Pielech, Nenad Jasprica, Marta González del Tánago, Simon Dufour, Mária Šibíková, Jozef Šibík: **Interpretative Manual of European riparian forests and shrublands**

11:15 – 11:30

Imelda Somodi, Ákos Bede-Fazekas, Andraž Čarni, Mirjana Ćuk, Zoran Galić, Adrienn Gyalus, Alen Kiš, Annamária Laborczi, László Pásztor, Ivan Pilaš, Klára Szabados, Gábor Szatmári, Ivana Vitasović-Kosić: **Climate change impact assessment with regards to the potential natural vegetation of Hungary and the role of the Balkan vegetation-environment patterns in the assessment**

11:30 – 11:45

Ivana Vitasović-Kosić, Ivan Pilaš, Ákos Bede-Fazekas, Adrienn Gyalus, Imelda Somodi: **Representativeness of actual vegetation maps – a gap analysis for lowland Croatia**

11:45 – 12:00

Željko Škvorc, Mirjana Ćuk, Igor Zelnik, Jozo Franjić†, Ružica Igić, Miloš Ilić, Daniel Krstonošić, Dragana Vukov, Andraž Čarni: **Diversity of wet and mesic grasslands on the southern edge of the Pannonian Plain**

12:00 – 12:15

Renata Ćušterevska, Vlado Matevski, Mitko Kostadinovski, Cvetanka Cvetkoska, Sara Cvetanoska, Angela Ivanova: **Plant assessment process for the national Red List according to the IUCN methodology in North Macedonia**

13:00 – 15:00

**LUNCH**

## **ORAL PRESENTATIONS**

Chair: **Andraž Čarni**

15:00 – 15:15

Antun Car: **Medicinal plants used to treat diseases in the Dubrovnik Region at the end of 19<sup>th</sup> century**

15:15 – 15:30

Dragica Purger, Jenő J. Purger, Sándor Csete: **The effect of the elevated water level on the aquatic vegetation of an oxbow of the Drava River**

15:30 – 15:45

Attila Fűrész, Gergely Pápay, Zsuzsa Lisztes-Szabó, Eszter S.-Falusi, Ildikó Turcsányi-Járdi, Dániel Balogh, Antal Szőke, Tímea Kiss, Károly Penksza: **Occurrence of taxa of *Festuca vaginata* agg. along the Danube**

15:45 – 16:00

Vladimir Stupar, Đorđije Milanović, Jugoslav Brujić: **Vascular flora of the Republic of Srpska – Catalogue of taxa**

16:00 – 16:30

## **POSTER SESSION – 2 WITH REFRESHMENTS**

Chair: **Nenad Jasprica**

Elez Krasniqi, Naim Berisha: **Characteristics of oak vegetation in the Mirusha River Basin – Kosovo**

Skerdilaid Xhulaj: **New data on lichens from the most southern areas of Albania (Delvina and Saranda District)**

Ivan Pilaš, Mateo Gašparović, Marko Subašić, Damir Klobučar, Ivana Zegnal: **Earth observations and artificial intelligence for the NATURA 2000 floodplain forests mapping**

Adrienn Gyalus, Zsolt Molnár, Ákos Bede-Fazekas, Imelda Somodi: **Difference of actual and potential vegetation – indicators of the vegetation types stability**

Milenko Milović, Marija Pandža: **A floristic study of the islet of Ošljak, Zadar Archipelago (North Dalmatia)**

Mirjana Ćuk, Miloš Ilić, Dragana Vukov, Ružica Igić, Andraž Čarni: **Status and temporal dynamics of the vegetation of the sandy areas in Serbia**

16:45 – 17:45

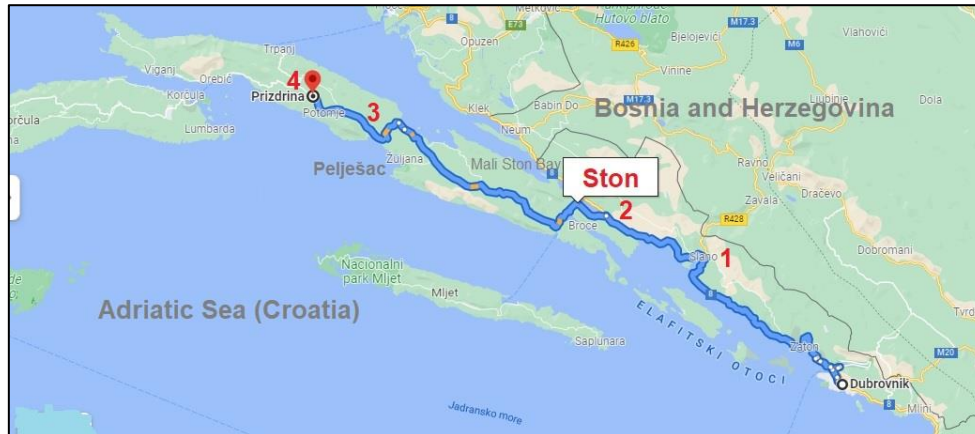
## **CLOSING REMARKS AND GENERAL ASSEMBLY**

Moderators: **Christian Eichberger, Andraž Čarni, Željko Škvorc, Daniel Krstonošić**

**Friday, May 6, 2022**

**Botanical Field Excursion – 1, the Pelješac Peninsula**

08:00 Departure from the Dubrovnik Student Centre.

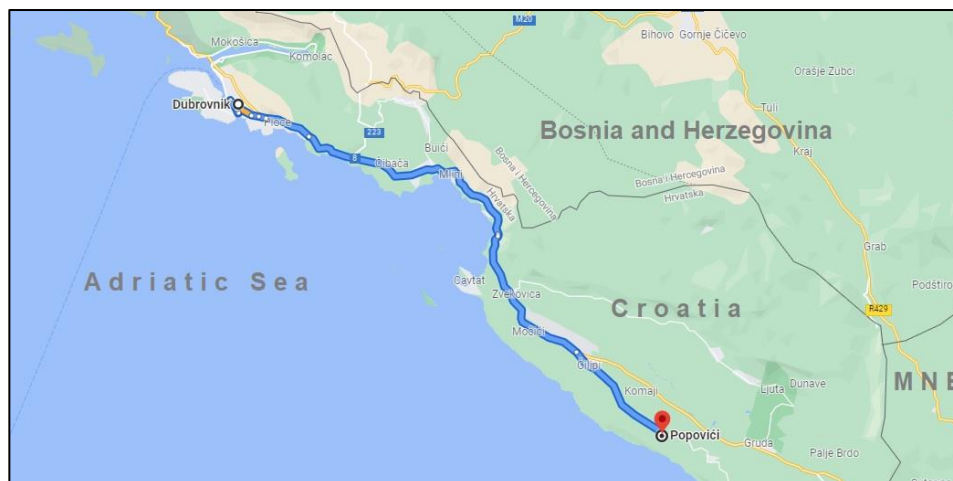


**Fig. 1.** Route map with stopping points: 1 – Slano, 2 – Mali Ston Bay, 3 – Tabor (Pijavičino), 4 – Prizdrina. Driving distance from Dubrovnik to Prizdrina is 98 kilometers. [derived and adapted from Google map].

**Saturday, May 7, 2022**

**Botanical Field Excursion – 2, Konavle Region**

08:00 Departure from the Dubrovnik Student Centre.



**Fig. 2.** Route to the village of Popovići in the Konavle Region. Driving distance from Dubrovnik to Popovići is 29 kilometers [MNE – Montenegro; derived and adapted from Google map].

20:00 Gala Dinner at the Dubrovnik Student Centre.

# PLENARY

## Syntaxonomy of grasslands with *Salvia officinalis* in the Western Balkans

Massimo Terzi

Institute of Bioscience and Bioresources, National Research Council (CNR), via Amendola 165, Bari, Italy (massimo.terzi@ibbr.cnr.it)

*Salvia officinalis* L. is known since ancient times for its medicinal properties and has been traditionally used as a folk medicine, spice, and food. Having been widespread and cultivated in many southern European countries, it is often difficult to distinguish natural from naturalized populations. However, many authors consider *S. officinalis* endemic to Italy and the Western Balkans, where two subspecies have been reported: *S. officinalis* subsp. *officinalis* and *S. officinalis* subsp. *multiflora*. In the Western Balkans, *S. officinalis* is common in many habitat types, but it is more frequent in open to semi-open, sunny, rocky grasslands on shallow calcareous soils. The aim of this paper is to identify the syntaxonomic pattern of grasslands with *S. officinalis* in the Western Balkans and the main associated environmental drivers. A data set of 346 phytosociological relevés (sharing 739 taxa) was subjected to cluster analysis (flexible beta method,  $\beta = -0.25$ ) and ordination (non-metric multidimensional scale). Joint plots were used to show relationships between the main groups of relevés and environmental variables (climatic variables, and Ellenberg Ecological Indicator Values). Two associations, one from Sićevo Gorge, in Serbia (*Artemisio albae-Salvietum officinalis*), and the other from southern Albania, were found to be clearly distinct from each other and from all the others. They were classified into the classes *Festuco-Brometea erecti* and *Ononido-Rosmarinetea*, respectively. In the most xerothermic habitats of Croatian islands, *S. officinalis* occurs in the *Cymbopogono-Brachypodietum ramosi*, of the *Cymbopogono-Brachypodion ramosi* alliance (*Lygeo sparti-Stipetea tenacissimae* class). All other grasslands with *S. officinalis* in our dataset belong to the *Saturejion subspicatae* and the *Chrysopogono grylli-Koelerion splendentis*, differentiated along a thermal and altitudinal gradient. *Salvia officinalis* was found to have greater coverage in the *Chrysopogono grylli-Koelerion splendentis*. These alliances are here classified in the order *Koelerietalia splendentis* and in the class *Helianthemo cani-Seslerietea nitidae*, whose presence in the Western Balkans is a syntaxonomic novelty.

**Keywords:** *Helianthemo cani-Seslerietea nitidae*, *Koelerietalia splendentis*, phytosociology, Sage, vegetation

# **ORAL SESSION**



## Medicinal plants used to treat diseases in the Dubrovnik Region at the end of 19<sup>th</sup> century

Antun Car

Dubrovnik General Hospital, Roka Mišetića bb, HR-20000 Dubrovnik, Croatia (antunc@bolnica-du.hr)

Dubrovnik's population at the end of the 19<sup>th</sup> century shared the same causes of the mortality with other parts of Europe. People were dying from tuberculosis, pneumonia, malaria, syphilis, heart failure. There were not significant differences in treatments, too. During the study of the medicine orders in Dubrovnik Hospital Pharmacy in 1896, some medicinal plants were more abundant. For example, in the treatment of tuberculosis the following plant taxa have been used: *Thymus serpyllum* L., *Origanum majorana* L., *Achillea millefolium* aggr., *Polygonum aviculare* aggr., *Ocimum basilicum* L., *Smilax aspera* L., *Arum italicum* Mill. and *Melissa officinalis* L. Sage (*Salvia officinalis* L.) has been used as antituberculous drug for the centuries, mostly in the form of decoction. The basic medicine for the therapy of heart failure was tincture of *Digitalis purpurea* L. *Atropa bella-donna* L. ("Belladonna") was used in a case of excessive sweating, cramps, gastric hyperacidity and anxiety. *Hyoscyamus niger* L. was used in the constipation. In the case of migraine headache, *Oleum Crotonis* (*Croton tiglium* L., Euphorbiaceae), opium with Agaricin (agaric acid) and *Secale Cornutum* (*Claviceps purpurea* (Fr.) Tul., Clavicipitaceae) were used. *Arnica* spp. and *Extractum Rhei* (*Rheum officinale* Baill., Polygonaceae) were taken in the case of anorexia and constipation. *Oleum Terebinthinae* (*Pinus palustris* P. Mill.) was used against cough. For the expectorating *Sirupus Ipecacuanhae* (*Cephaelis ipecacuanha* (Brot.) A. Rich, *C. acuminata* Karsten, Rubiaceae) was applied. In the case of haemoptysis, *Aquae cinammoni* (*Cinnamomum aromaticum* Nees.) or decoction of *Folii hamamelidis* (*Hamamelis virginiana* L.) with the cinnamon and the combination of codeine and papaverini were employed. *Cortex chinae* (*Cinchona pubescens* Vahl, Rubiaceae) was prescribing and considered as tonic for pneumonias, flu and malaria. In addition, cocaine, opium, morphine and cannabis were also used for pain or dry cough. Bowel tuberculosis was treating with *Tormentillae rhizoma* (*Potentilla erecta* (L.) Raeusch.) or *Radix Pentaphylli* (*Potentilla* spp.) with or without *Extractum Belladonnae*. In Dubrovnik area, parts of *Cercis siliquastrum* L. were collected, dried and used against asthma or dyspnoea. In the case of high fever, leaves of nuts, pomegranates, mulberry or grapevine were applied on the chest. With all lung diseases tinctures of elderberry (*Sambucus*), absinth (traditionally prepared from a distillation of neutral alcohol, various plant species, spices and water) or nettle (*Urtica* spp.) were used. For this purpose, *Ruta graveolens* L. was also used or nettle cooked with young butter. From the mid-20<sup>th</sup> century, due to description disease-causing microbes and development of scientific medical practices, herbal medicine has been replaced with modern medical treatments.

**Keywords:** diseases, ethnobotanical data, local society, medicinal plants, southeastern Europe

## Plant assessment process for the national Red List according to the IUCN methodology in North Macedonia

Renata Ćušterevska<sup>1</sup>, Vlado Matevski<sup>2</sup>, Mitko Kostadinovski<sup>1</sup>, Cvetanka Cvetkoska<sup>1</sup>, Sara Cvetanoska<sup>1</sup>, Angela Ivanova<sup>1</sup>

<sup>1</sup> Institute of Biology, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, MK-1000 Skopje, R. North Macedonia (renatapmf@yahoo.com)

<sup>2</sup> Macedonian Academy of Sciences and Arts, Bul. Krste Misirkov, 2, P. O. Box 428, MK-1000 Skopje, R. North Macedonia

These are preliminary findings on the plant assessment process at the National level according to the IUCN methodology in North Macedonia. IUCN Red List assessment of Macedonian flora begun in 2018, with preparation of Priority List of plants that should be assessed in future. In total 480 plants are listed in the Priority List. During 2018 and 2019, 14 non-endemics international Policy Species were assessed. In 2020 and 2021 additional 11 endemics species were assessed. With the implementation of a number of field activities – population size, distribution area, potential threats, appearance and quality of habitat and other parameters required for quality assessment were determined and entered in the IUCN Species Information Service (SIS). Of the species evaluated so far (25 in total), 5 plant taxa (*Angelica palustris* (Besser) Hoffm., *Astragalus physocalyx* Fisch., *Aldrovanda vesiculosa* L. *Lycopodium clavatum* L. and *Dianthus galicicae* Micevski) are Critically Endangered (CR), 9 (*Marsilea quadrifolia* L., *Galium rhodopeum* Velen., *Echium russicum* S. G. Gmel., *Menyanthes trifoliata* L., *Trapa natans* L., *Centaurea galicicae* Micevski, *Helichrysum zivojinii* Černjavski & Soška, *Rindera graeca* (A. DC.) Boiss. & Heldr. and *Centaurea soskae* Košanin) are Endangered (EN), 7 (*Ramonda serbica* Pančić., *Lindernia procumbens* (Krock.) Philcox, *Gentiana lutea* subsp. *symphyandra* (Murb.) Hayek, *Salvinia natans* (L.) All., *Campanula abietina* Griseb., *Jurinea micevskii* Stevan. & al. and *Crocus cvijicii* Košanin) are vulnerable (VU) and 4 (*Festuca galicicae* Markgr.-Dann., *Edraianthus horvatii* Lakušić, *Sempervivum galicum* (Sm.) Micevski and *Laserpitium ochridanum* Micevski) have Least Concern (LC) status. Most often, the species were assessed according to criteria B and criteria D, given the fact that the most appropriate data for these criteria were observed and the selected plants have limit distribution areas and small population size.

**Keywords:** evaluation, IUCN, Species Information Service, twenty-five taxa

## A review of the Lokrum Botanical Garden development

Katija Dolina

University of Dubrovnik, Institute for Marine and Coastal Research, P.O. Box 83, HR-20000 Dubrovnik, Croatia (katija.dolina@unidu.hr)

The island of Lokrum, with surface area of 72 ha is a special reserve of forest vegetation, statutorily protected since 1948. The introduction of non-native plant species to the island began with the Benedictines in the 11th century. The diversity and abundance of the islands exotic flora was enriched by Archduke Ferdinand Maximilian of Habsburg, who started a planned cultivation of exotic plants, and the Dubrovnik seamen, who brought unusual plants from their voyages to far-away lands. The National Academy of Science and Art continued this tradition with the establishment of a Botanical Garden within the institutional frame of the Biological Institute in 1959. The purpose of the garden was to investigate the introduction and adaptation of tropical and sub-tropical plant species to our region's typically Mediterranean climate: hot, dry summers and mild, rainy winters. Special attention was given to introducing species of importance to forestry, horticulture, and pharmaceutical use. These plants, mostly of Australian and American origin, were obtained as seeds through an active exchange program with botanical gardens from around the world. In 1991-1992, during Croatia's War of Independence, the garden suffered more than 50 direct artillery hits that damaged many of its plants and destroyed much of its infrastructure. One particular casualty was the library's collection of botanical treatises and research files, a large portion of which was lost in a fire sparked by one of these attacks. Restoration of the garden and its facilities began in earnest in 1993 and is still ongoing. Until now, the Lokrum Botanical Garden continuous to be an active part of the Institute for Marine and Coastal Research of the University of Dubrovnik. It covers an area of 3.3 ha, of which the exhibition section encompasses 1.6 ha with more than 450 plant species, mostly trees and shrubs. The most common plant family in the garden is the myrtle (*Myrtaceae*), counting over a hundred species. In addition to its botanical research mission, the Garden plays an important role in education and tourism considering that it attracts a large number of tourists and fans of nature each year.

**Keywords:** Croatia, botanical collections, non-native plants, restoration project, sustainable tourism

## Occurrence of taxa of *Festuca vaginata* agg. along the Danube

Attila Fűrész<sup>1</sup>, Gergely Pápay<sup>1</sup>, Zsuzsa Lisztes-Szabó<sup>2</sup>, Eszter S.-Falusi<sup>1</sup>, Ildikó Turcsányi-Járdi<sup>1</sup>, Dániel Balogh<sup>1</sup>, Antal Szőke<sup>3</sup>, Tímea Kiss<sup>4</sup>, Károly Penksza<sup>1</sup>

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In botany, the status of *Festuca* taxa has long been a controversial issue that needs to clarify before they can be clearly defined. The literature describes several specific techniques that determine *Festuca* taxa by measuring morphological parameters, by examining genetic factors or by studying sclerenchyma, but all of these methods show only partial results, however, the combination of these methods is the best for the definition of *Festuca* taxa. But it is still not known that this combination has been implemented. Based on this, the following research questions have been formed: Which *Festuca* taxa are found along the Danube? In this study we investigated the vegetation of sand grasslands along the Danube and we collected *Festuca* taxa for morphological and genetic analyses to clarify the occurrence of *Festuca* taxa. We described, based on the results of morphological and ploid level analyses, the occurrence of *Festuca vaginata*, *F. pseudovaginata*, *F. wagneri* and *F. tomanii* certainly in the study areas. In order to determine exact taxa, more molecular genetic research is necessary. We expect that this method can reveal which taxa are really found.

**Keywords:** clarification, dominant species, grassland, sclerenchyma, stereomicroscope

## The vegetation of the Special Reserve Mali Ston Bay, south Dalmatia, Croatia

Nenad Jasprica

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The Mali Ston Bay is enclosed by the Pelješac Peninsula and the mainland in the South Croatia, the southeastern Adriatic coast. It is 21 km long and has a maximum breadth of 2.2 km. The Bay was declared by Croatian Government as a Special Natural Reserve in 1983. The surface area of the Reserve is 48.4 km<sup>2</sup>, and reaches the maximum altitude of 471 m a.s.l. A small area is occupied by 24 islets with range of their surfaces from 190 m<sup>2</sup> to 25 ha. The maximum sea depth is 28 m. As a part of the Pelješac Peninsula, the Bay belongs to a Important Plant Areas (IPAs) in Croatia and the NATURA 2000 European Ecological Network important for the conservation of species and habitat types. According to the Bioclimatic Classification of Europe, the Bay belongs to the Mediterranean pluviseason-oceanic bioclimate, and it is located within the lower mesomediterranean belt. The vegetation of the meso-Mediterranean *Fraxino ornitho-Quercion ilicis* Biondi, Casavecchia et Gigante in Biondi et al. 2013 occupies the largest surface areas in the Mali Ston Bay. This study was based on 21 relevés used from the available literature and 145 vegetation relevés recently collected in the field using Braun-Blanquet approach. The European syntaxonomic framework of the EuroVegChecklist (EVC) was applied. The aim of the study was to provide a first phytosociological description of the plant communities occurring in the Mali Ston Bay, define their syntaxonomic position and importance in the Mediterranean context. Altogether, 36 plant associations, two subassociations, and two stands were identified and classified within 23 alliances, 22 orders, and 20 vegetation classes. Ruderal and weed plant communities, i.e., those that have not yet been sufficiently investigated in the coastal part of Croatia, were also included in the survey. For more practical point of view, ecological stability of the Mali Ston Bay mainland is a prerequisite for development and successful economic activities related to the shellfish farming. Anyway, stability is greater if the catchment area is covered by forest cover. Urbanization of the area and increased activity on the mainland increase the risk of import alien species which might change the current structure of both the terrestrial and marine communities. From a merely scientific standpoint, comparable research of all islets will be required (only three were fully investigated) for a more complete understanding and a rational management of this complex system and important regional resource.

**Keywords:** Mediterranean climate, numerical analysis, syntaxonomy, phytosociological relevés, *Quercetia ilicis*, vegetation diversity

## Distinction between different subtypes of the *Tilio-Acerion* forests (NATURA 2000) based on field mapping

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*Tilio-Acerion* forests of slopes, screes and ravines (9180\*) are a priority habitat type in the Natura 2000 network. They have a high value for biodiversity conservation and are also interesting from an economic point of view. However, the conservation status of these forests is often unfavourable due to small, fragmented stands and other natural or anthropogenic threats. As part of the LIFE-IP NATURA.SI project, we conducted a field mapping of *Tilio-Acerion* forests in the Natura 2000 site Boč-Haloze-Donačka gora (eastern Slovenia). During field mapping, the subtype approach was used to define the following four habitat subtypes: a) stands dominated by *Acer pseudoplatanus* and *Ulmus glabra* growing mostly on concave terrain (assoc. *Lamio orvalae-Aceretum pseudoplatani*, *Dentario polyphyllae-Aceretum pseudoplatani*); b) *Fraxinus excelsior* stands growing on slopes (assoc. *Hacquetio-Fraxinetum excelsioris* var. *geogr. typica*); c) *Tilia platyphyllos*/*T. cordata* stands with thermophilous broadleaves occurring on ridges and steep slopes (assoc. *Tilio cordatae-Aceretum platanoidis*); d) stands on more acidic soils with *Acer pseudoplatanus* as the dominant tree species and frequent admixture of *Castanea sativa* (assoc. *Dryopterido affini-Aceretum pseudoplatani* var. *geogr. Dentaria trifolia*). The first three subtypes are restricted to calcareous bedrock. The shrub and herb layers contain nitrophilous and mesotrophic forest species, frequently including ferns. The associations of forests of valuable broadleaved trees are often without character species; they are either described by differential species or based on a combination of ecological groups of species. Constant plant species across the studied habitat type are *Allium ursinum*, *Lunaria rediviva*, *Lamium orvala*, *Stellaria nemorum* agg., *Dryopteris filix-mas*, *Polystichum setiferum*, *Phyllitis scolopendrium*, *Urtica dioica*, *Symphytum tuberosum*, *Scopolia carniolica*, *Doronicum austriacum* and *Geranium robertianum*. Differential species for each subtype are the following: a) *Cardamine kitaibelii*, *Cardamine waldsteinii*, *Isopyrum thalictroides*, *Impatiens noli-tangere*, *Glechoma hirsuta*, *Corydalis solida*; b) *Hacquetia epipactis*, *Aposeris foetida*; c) *Tamus communis*; d) *Dryopteris affinis*, *D. dilatata*, *Luzula luzuloides*. Field mapping results showed that subtypes of *Tilio-Acerion* forests differ significantly in most of the estimated characteristics, i.e., habitat patch size, tree species composition, relief features and various threats, such as habitat fragmentation, rapid mortality of key tree species, ungulate browsing pressure and invasion of non-native plants. Some of these threats are common to all subtypes, while others are more subtype specific. For improved management and conservation of the studied habitat type, its assessment and application of appropriate measures should be based on subtype approach. In our further analyses, the information obtained from field mapping will be complemented with remote sensing data (e.g., LiDAR).

**Keywords:** *Acer pseudoplatanus*, conservation status, *Fraxinus excelsior*, Slovenia, *Tilia* spp.

## Bryophyte assemblages in different forest types across Slovenia

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Bryophytes represent an important component of forest biodiversity and vegetation. Monitoring the status of bryophyte assemblages and understanding their variation along environmental gradients provide valuable insights in the context of forest biota response to global change. Within the LIFE-IP NATURA.SI project, we studied bryophyte assemblages on 57 monitoring plots (400 m<sup>2</sup>) across wide spectrum of temperate forest types in Slovenia. Bryophytes growing on different substrates, i.e. forest soil, deadwood/living trees, and rocks/stones were collected in each plot. A total of 200 bryophyte species were recorded; 105 species from forest soils, 125 species from wood and 114 species from rocks/stones. Almost one quarter of all species were ubiquitous and occurred in all three studied substrate types and 52% of species were rather substrate specific. The most frequent bryophyte species were *Hypnum cupressiforme* (present on 52 plots), *Brachytheciastrum velutinum* (36) and *Polytrichum formosum* (35). Species pool included some threatened species as well (e.g., *Dicranum viride*, *Fissidens exilis*). Mean plot-level species richness was 19.4 (min: 5, max: 36). Considering data on forest tree layer composition, geology and soil type, the plots were classified into five groups: the stands dominated by i) broadleaves on carbonate bedrock, ii) broadleaves on intermediate bedrock/soil, iii) broadleaves on silicates, iv) conifers on carbonates and v) conifers on silicate bedrock. Among broadleaves, *Fagus sylvatica* most frequently dominated forest stands while *Picea abies* was the dominant coniferous tree species. Variation in the composition of bryophyte assemblages was best explained by two main gradients: bedrock and forest type. Beside taxonomic aspect, the integrating trait-based approach in identification of long-term bryophytes response to environmental factors would be beneficial in further studies.

**Keywords:** assemblage composition and diversity, bedrock type, bryophyte, forest type, substrate

## Interpretative Manual of European riparian forests and shrublands

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Riparian ecosystems comprise the physical environment and biological communities that develop at the interface of freshwater and terrestrial ecosystems. They are recognized as ecosystems that are highly diverse and contain special ecological communities, as well as providers of multiple ecosystem services.

This manual of riparian forests and shrublands of European rivers offers phytosociological overview of the variety of existing species, communities and vegetation types at European scale. It presents an unavoidable tool for their knowledge and management, including systematic insights of floristic composition (i.e., diagnostic, dominant and constant species), as well as practical synecological information, comments on threats and challenges for the management and conservation of each type of forests. Thus, it represents very valuable information, not only for the scientific community but also for managers as well as for river restoration and conservation practitioners. In fact, this material comprises an overview of the riverine, swamp, floodplain forests and scrub throughout the continent from the Canary Islands to European part of Russia. The preparation of this study was supported by the COST



Knowledge conversion for enhancing management of European riparian ecosystems and services (CONVERGES).

This booklet offers an overview of the forests and shrublands along European rivers, and neighbouring areas, river islands, depressions and oxbows. These forests are subject to constant change and are maintained by periodic/regular flooding or high groundwater. We call them paraclimactic because they are maintained by occasional catastrophes caused by water. We may find one type of forest in one place, but after a flood it may move to another place the next year. Erosion and sedimentation, the destruction of the vegetation and new establishment alternate. We should keep in mind that these forests also contain different biota. They are very rich and dynamic ecosystems. We can admire this eternal dynamism of life caused by water and we should be aware that these ecosystems are endangered and need to be protected.

**Keywords:** forests, determination, diagnostic, dominant and constant species, Europe, riparian ecosystems, shrublands

## Phytosociology of *Festuca* taxa in open sandy grasslands along the Danube

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In this study we examined the vegetation of sandy areas along the Danube. Our goal is to study the open sandy grasslands in Austria, Slovakia, Hungary, Serbia, Romania and Bulgaria. In Hungary 20 sample areas were examined in every May between 2018 and 2021. Beside coenological studies, biomass and soil data were also recorded and valued. Older literature regarded *Festuca vaginata* as the only dominating grass species of open sandy grasslands. During the studies the vegetation type dominated by *Festuca pseudovaginata* was also recorded and analysed. This species was recorded in 2003. Besides, vegetation types of *F. wagneri* and *javorkae* were isolated too; the former can be found also in Romania and Bulgaria, the latter is prevalent mainly in the central, more closed parts of the Carpathian Basin. Detailed comparison was conducted between the vegetation types of *F. vaginata* and *F. pseudovaginata*. Both were examined as natural, degraded, even pastured populations. On pastured areas *F. pseudovina* appeared as a dominant, disturbance tolerant species. *F. pseudovaginata* vegetations were more significant considering species count and diversity; they can be found mainly in forest-grassland patches, even under *Populus alba* populations. We also examined degraded patches of this type, where weed and natural pioneer species became dominant in the autumn records. These patches formed secondarily on cut or disturbed areas. The vegetation type of *Festuca vaginata* had fewer species, but weed did not appear in them. According to nature conservational valuing, *F. vaginata* patches were more valuable; populations of *F. pseudovaginata* showed natural and disturbed conditions, but they appeared along a larger oecological spectrum as patches with individual species combinations, showing that this newly recorded species is more adaptive to changing environmental conditions.

**Keywords:** Carpathian Basin, European flora, mowing, pasturing, taxonomy

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## The effect of the elevated water level on the aquatic vegetation of an oxbow of the Drava River

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Aquatic habitats are fragile dynamic systems exposed to natural processes and anthropogenic influences. The decrease of water level and changes in diversity of aquatic vegetation were observed in the Old-Drava near Barcs, the 17 km long oxbow of the Drava River which represents the state border between Croatia and Hungary. The protected area is attractive for tourists and anglers. In the frame of the „LIFE Old-Drava” project with participants of both countries restoration measures, e.g., the increase of water supply and sludge dredging were performed in 2019. The objective of our study was to detect the magnitude and direction of the effects of water regime changes on aquatic vegetation. We collected baseline data in the period of 2016-2018, while monitoring was performed in between 2019 and 2021, after the project implementation. The coenological samplings were recorded from a boat, in 4 m<sup>2</sup> plots, arranged in five lines across two sections of the waterbed. The percentage cover values were estimated for each species. Our results indicated that significant NATURA 2000 habitat: 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* type of vegetation occurred in the study area. Stands of several aquatic communities were detected: *Trapaetum natantis* V. Kárpáti, 1963, *Nymphaeetum albo-luteae* Nowinski 1928, *Lemno minoris-Spirodeletum* W. Koch 1954 and *Ceratophylletum demersi* Hild 1956. Before restoration the proportions of the indicator species and the protected plants were found to be high in all of the sampling lines, signifying the high naturalness of valuable and undisturbed plant associations. In the deeper parts of the oxbow the vegetation cover was higher, both in the submersed and floating plant strata, while species number and species density was similar. After oxbow restoration the cover of the dominant aquatic species (e.g., *Trapa natans*, *Nymphaea alba*, *Nuphar luteum*) significantly decreased. Such unexpected rapid changes cannot be caused by water regime changes only. We assumed that human impact can be more significant since with increasing water level considerably increased number of anglers and their activity were detected. According to the anglers, during restoration, the oxbow was illegally inhabited by grass carp (*Ctenopharyngodon idella*), which is a herbivore that significantly affects aquatic vegetation. The invasive aquatic fern *Azolla filiculoides* was recorded for the first time in 2020 in all sample lines, however, the cover of this species remained below 1%. The results of our study showed that the complex ecological systems should be assessed simultaneously from different aspects since one-sided approach may give wrong conclusions.

**Keywords:** coenological sample, *Magnopotamion*, monitoring, naturalness, water regime

## Climate change impact assessment with regards to the potential natural vegetation of Hungary and the role of the Balkan vegetation-environment patterns in the assessment

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Potential natural vegetation (PNV) expresses the site potential for vegetation types regarding self-sustainability without active human management. Multiple PNV (MPNV) provides further details by assessing this potential as a probability distribution of vegetation types. MPNV models for Hungary have been developed by gradient boosting to establish preference relationships between the abiotic background and observed distribution of vegetation types. Through updating climate conditions within the abiotic background in the models they also offer the opportunity to assess future MPNV under climate change scenarios. Differences between contemporary and future MPNV reveal the expected impact. Our existing assessment already reveals significant changes in potential vegetation type distributions. However, climate change introduces environmental conditions suitable for vegetation types currently not present in Hungary, training the model within the boundaries of Hungary only becomes insufficient. Therefore, we started to extend the training area to include vegetation-environment relationships from the southern neighbourhood. As a foundation to this we initiated studies of model transferability in the southern Pannonian region. The project will provide improved basis for the prediction of expected climate change impact within Hungary and allow the first steps of impact assessment in the southern countries.

**Keywords:** climate change, impact assessment, MPNV, predictive vegetation maps, training area

## Vascular flora of the Republic of Srpska – Catalogue of taxa

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Catalogue of vascular flora of the Republic of Srpska (RS) is the first attempt to list, quantify and georeference vascular flora of this entity of Bosnia and Herzegovina (BiH). We digitized and georeferenced all available literature data (including grey literature), and supplemented it by our own research, which resulted in 191,287 species/occurrence data. In all, vascular flora of RS numbers 3697 taxa (2843 species and 854 subspecies in 775 genera and 135 families) which, concerning the number of taxa per area, puts the territory of RS (25,053 km<sup>2</sup> or 49% of BiH), among the areas with the highest vascular plant diversity in Europe. This number is for about 700 taxa smaller than the estimated number of taxa at the level of BiH, which is conditioned by the fact that the other half of BiH harbors some habitats that are not present in RS (e.g., eumediterranean ecosystems of Neum area or silicate mountain system of Vranica Mt. in central Bosnia, which is the only locality in BiH for numerous species that are otherwise common on silicate mountain massifs in Europe). Hybrids, as well as allochthonous taxa that are not spreading subspontaneously, were not considered. A total of 43 taxa that were registered in the literature were excluded from the checklist based on horological reasons, our field investigations, or expert judgment. The largest families are *Compositae* with 612 taxa followed by *Fabaceae* with 265 and *Poaceae* with 230 taxa. Eight biggest families account for more than a half of all species and subspecies. A total of 131 taxa were registered for the first time for the area of RS while 16 taxa are new for BiH. Catalogue of taxa with spatial (dynamic UTM grid maps), taxonomical and nomenclatural information, as well as list of references for every taxon is available as web application “Flora Srpske – GIS Database about Vascular Flora of the Republic of Srpska” at: <http://florasrpske.rs.ba/>. As we continue our research on flora and vegetation of BiH and RS we expect that the vascular flora of the Republic of Srpska will be richer by a few hundred taxa.

**Keywords:** Bosnia and Herzegovina, checklist, inventory, plant diversity, web GIS application

## Diversity of wet and mesic grasslands on the southern edge of the Pannonian Plain

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Grasslands of the class *Molinio-Arrhenatheretea* have been intensively studied on the southern edge of the Pannonian plain in NW Balkan Peninsula. There were many similar communities described differently in various countries, so elaboration of their floristic composition, ecological condition, functional diversity and classification on regional scale is needed. Our research took place in the northern part of the NW Balkan (NE Slovenia, N Croatia and N Serbia), where are mountains gradually passes to the Pannonian plain. In this area, we can find a strong macroclimatic gradient from wet (sub)Atlantic climate in the west to dry (continental) climate in the east. A database of 2565 vegetation plots originally assigned to *Molinio-Arrhenatheretea* communities was compiled. Semi-supervised classification based on the K-means algorithm was applied to assign plots into 12 alliances recognisable in EVC (EuroVegChecklist). We also found two well recognisable new groups (*Alopecurion* and *Salvio nemorosae-Arrhenatherion*). The plots within each alliance were further classified into associations using the beta flexible method. Generally, analysed communities show a typical Central European feature in the western part, but changes their floristic composition and ecological conditions towards the eastern part of research area. The vegetation structure and plant species composition in the studied area were influenced by soil moisture and soil nutrient availability as well as by strong biogeographical and climatic gradients. Additionally, we correlated alliances' functional groups, ecological strategies, habitat preferences, major floristic gradients, management, and forage quality. We found that forage quality mainly depends on moisture conditions and that nutrients and grazing are less important.

**Keywords:** environmental gradient, meadows, *Molinio-Arrhenatheretea*, pastures, vegetation classification

## Representativeness of actual vegetation maps – GAP analysis for lowland Croatia

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Actual vegetation maps depicting the contemporary distribution of vegetation types are important input of a wide range of ecological analyses, such as predictive mapping including modelling the potential natural vegetation, connectivity analyses and also that of conservation planning. Large-scale modelling campaigns cannot carry out extensive vegetation mappings in the typically limited time frames, thus they naturally rely on existing maps. However, vegetation mappings are carried out for a range of purposes, which does not necessarily ensure representativeness. We collected existing vegetation maps from lowland Croatia and analyzed them with regards to representativeness of vegetation types regarding their distribution in the geographic and environmental space. The spatial range was restricted to the Croatian lowlands neighbouring Hungary in the current analysis. Data availability was mapped for individual vegetation types as the distance to the closest mapped stand (also an inverse proxy of connectivity). Environmental space considered included climatic, topographic, soil and water availability gradients. Frequency of vegetation type occurrences was identified along sections of the gradient. The gaps discovered will be utilized in planning a field campaign to complement the existing vegetation maps so as to achieve representativeness. This way they will also feed into the validation of potential natural vegetation models of the area.

**Keywords:** connectivity, environmental gradients, gap analysis, potential natural vegetation, vegetation mapping

# POSTER SESSION



## Data of content values and grassland management analysis of sandy grasslands along the Danube

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*Festuca* taxa are important grassland species in the Pannonian vegetation and they are a dominant component of the Pannonian vegetation where conditions are too extreme for most plants. Based on the grassland management surveys, the habitats of narrow-leaved or small *Festuca* species are indicators of poor productivity, but they are still important from the conservation point of view. As climate change and the expansion of dry habitats increase, the importance of these grasslands is likely to rise. Cut samples of biomass were made along the Danube from 37 areas, beginning in the north-western part of the Little Hungarian Plain, across the central great sandy plains of the Carpathian Basin (divided into three parts: north, middle, south) to the southernmost part of the Basin at Deliblato, Serbia. The last samples were made beyond the Carpathians on the Romanian Great Plain and Bulgaria. Weende analysis of the cut samples was carried out in the laboratory of the Department of Animal Husbandry of Szent István University. Their original dry matter and crude protein, crude fat and crude fibre content were analysed according to MSZ-6830, Harris et al. (1972) and NRC (1989), and fibre fractions (NDF, ADF, ADL) were measured. Samples were classified based on the dominant *Festuca* species, including separate assessments of dominant *Festuca* samples and separate assessments of samples with co-occurring species. Values of absolute dry matter were high in all samples of *Festuca vaginata*, but there was a slight increase towards the southern area, the highest values were found in the Deliblato (DFv) sample, which were above 500 mg kg<sup>-1</sup>. Crude protein values were low, in none of the samples reached the 100 mg kg<sup>-1</sup> limit. Crude fat was the lowest, fluctuating between 18 and 25 mg kg<sup>-1</sup>. Crude fibre content did not show a significant difference between the sample areas, and it was around 300 mg kg<sup>-1</sup>. In contrast, there were different ratios of the fiber fraction. In general, the highest values of the fiber fraction were measured in the NDF (neutral detergent fiber) data, around 500 mg kg<sup>-1</sup>. ADF (acid detergent fiber) fiber content was higher in the samples from the Danube-Tisza area (Szigetmonostor/SzFv, Sandstones TT/HFv) and decreased again towards the south. Similar ratios were observed in the amount of ADL (acid-detergent lignin). Thus, all in all, the analysed samples suggest an increasing tendency in dry matter towards the southern areas. There were also significant differences between the analysed species. Based on the separated samples, we distinguished five *Festuca* species and their component grassland samples. Based on the content values, they provided a suitable feed base for species of small ruminants, and within this, the green-coloured *Festuca wagneri* sample types were considered to be the most suitable.

**Keywords:** biomass, feed value, fescue

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## The *Blyssmo-Eriophoretum latifoliae* association nova prov.

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Fen plant communities of the *Scheuchzerio palustris*-*Caricetea fuscae* class are known to be of great importance for biodiversity, as these natural habitats are among the most endangered in continental Europe. Therefore, phytosociological data on fen vegetation classification, together with the presentation of detailed ecological, floristic and hydrological data, remain of particular importance, especially in the region of SE Europe. Our study brings the results of a phytosociological survey in well-preserved fens of the Mt. Luboten (Sharri Mountains) in Kosovo. Based on the analyzes of relevés carried out over several years in these fen habitats, it has clearly resulted that within the order *Caricetalia fuscae* and the alliance *Caricion fuscae* there is a new plant association with very unique ecological and floristic characteristics. OptimClass analysis at JUICE was performed to analyze the correlation between our set of relevés and the ones added to the database from available literature sources. The resulting dendrogram - hierarchical classification of the class - showed the formation of five clusters, with *Blyssmo-Eriophoretum latifoliae* ass. nova prov. (cluster 2) appearing as distinctive group. On the basis of numerous classical and computerized phytosociological comparisons and analytical procedures, this distinctive association was supported. As for the syntaxonomic affiliation of this newly proposed plant association, its affiliation to the correct class, order, and alliance was clearly argued. This was evident from the diagnostic taxa at each syntaxonomic level, and these taxa generally had high constancy values. The plant community closest to what we newly report from the Sharri Mts. was the Association *Blysmus compressus* & *Juncus thomasi* - as described by Quézel (1964) from Greece (Skasmada Island). Again, there was great distinctiveness in every respect, including the floristic composition of the two plant communities. The *Blyssmo-Eriophoretum latifoliae* ass. nova prov. - was dominated mainly by *Eriophorum latifolium*, *Juncus conglomeratus*, *Caltha palustris*, *Blysmus compressus*, *Alchemilla hybrida*, *Juncus thomasi* and *Geum coccineum*. It thrived in environments with flowing water in banks with an average slope of 10°. The total number of plant taxa from 15 relevés was 35, with an average of 22 taxa per relevé. This indicates that these plant communities were floristically poor, living in nutrient-poor gradient habitats. Yet they are very valuable and important, as they contain many rare and endangered plant taxa and thrive in deeply isolated natural habitats. We assume that a better knowledge of their vegetation characteristics, local distribution, and general ecology would help design appropriate management and conservation plans for these habitats in SE Europe.

**Keywords:** biodiversity conservation, Kosovo, phytosociology, plant taxonomy

## Status and temporal dynamics of the vegetation of the sandy areas in Serbia

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Sandy habitats are very dynamic and fragile. Vegetation types on the sand implies a rapid change of successive stages from pioneer sandy communities of low total diversity and cover of species to species-rich grassland communities with high biomass production and closed canopy. Sandy areas in Serbia are largely forested and the natural succession of vegetation on the sand has changed considering these conditions. The aim of the study was to determine the recent state and basic characteristics and dynamics of the vegetation on the sand in the Republic of Serbia. One of the aims was to analyze the successive stages in the sandy vegetation and the prediction of their direction and quality. In total, 282 phytosociological relevés were taken using the Braun-Blanquet method. The vegetation overview presents the most significant vegetation (already known vegetation units), three associations of indigenous vegetation and two stands of anthropogenic communities - presented for the first time. Classification of pioneer sandy vegetation in the Republic of Serbia is clarified, to the level of subassociations. The vegetation dynamics were analyzed by monitoring successive stages of pioneer grasslands, steppe and shrub vegetation. Monitoring also included pedological analyzes at sites of different vegetation types. As part of the monitoring of vegetation dynamics, research has been carried out in areas where steppe stands are being revitalized. The results indicate that the revitalization has achieved good results but not optimal conditions for the survival and development of steppe and other natural vegetation types on the sand. The results of this survey provide a good basis for vegetation research in the sandy areas and a significant contribution to the study of the flora and vegetation of Serbia.

**Keywords:** classification, succession of vegetation, pioneer sandy vegetation

## Monitoring of *Colchicum hungaricum* a in dry grassland on the *locus classicus* (South Hungary)

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*Colchicum hungaricum* Janka (Colchicaceae) is a plant species with Balkan distribution range, its northernmost occurrence is in the southern part of Hungary, in the Villány hills, on the southern slope of the Szársomlyó. The species was discovered by Viktor Janka on February 18<sup>th</sup> 1867, and this area is the *locus classicus* of the species and the only occurrence in the country. The plant grows on dry grasslands (*Sedo sopianae-Festucetum dalmaticae* Simon 1964) on limestone bedrock. It has become the first protected plant species in Hungary, currently it is strictly protected and its distribution area is also strictly protected, belonging to the Danube-Drava National Park. The first estimation of the population size was done in 2007, then repeated every three years by the staff of the National Park. The methodology of the surveys has changed several times and the results are different, therefore it is difficult to predict the population trend based on those data. Our goal was to estimate the population size of *Colchicum hungaricum* and to establish its long-term monitoring. The first step was to delimit the area of occupancy as accurately as possible and then within it to select randomly 100 permanent plots (2×2 m). Each plot was divided to four 1 m<sup>2</sup> subplots in which flowering and juvenile individuals were counted. The estimation process consisted of calculating the average number of individuals per sampling unit after screening each additional sampling unit. The total number of individuals was estimated by extrapolation to the area occupied by the species. The surveys were conducted between 15th January and 15th March 2022. According to the results of our study, the local area of occupancy of *Colchicum hungaricum* is 0.341 km<sup>2</sup>, which is 12% smaller than in previous surveys. The estimated population size is 3 200 292 plants, which is 400 000 more than a year earlier. The estimated number of flowering individuals is 2 466 092 (77%), while the number of juvenile plants is 732 200 (23%). It is important to point out that in our study estimated number of flowering individuals is 1 million higher than the number estimated three years earlier. Despite our sampling was performed in a smaller area of occupancy compared to previous surveys, the estimated population size has become much larger. The fact that the sample area is larger than 1% of the total area of occupancy, i.e. representative, may have contributed to our result. With the sampling started in 2022 in the permanent plots, we will follow the population dynamics of *Colchicum hungaricum*. To reveal the relation between the population density of this species and the surrounding vegetation we will also estimate the cover of the other plant species. A special attention will be paid to the causes of threats e.g. spreading of the invasive species (*Ailanthus altissima*) on rocky grasslands. This knowledge can contribute to the long-term preservation and survival of the populations and habitats of *Colchicum hungaricum*.

**Keywords:** area of occupancy, estimated, extrapolation, permanent plot, population size

## Difference of actual and potential vegetation – indicators of the vegetation types stability

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Since there is a global scale habitat loss caused by direct and indirect human impact, conservation and ecological restoration aim to slow or reverse these processes. It is important to have reliable data about the present distribution and state of habitats and predict how these will be possibly changed by successful conservation and restoration efforts. We propose that combination of predictions made by multiple potential natural vegetation (MPNV) models (that assess potential natural vegetation as a probability distribution of self-sustainable vegetation types) and presence-absence data can be used as indicators of stable and vulnerable areas of a given vegetation type. We applied the indicators to Hungary as a case study, where both extensive information on the actual distribution of (semi-)natural vegetation and MPNV estimations were available in full spatial cover. Analyses were carried out for all the 47 major vegetation types of Hungary. Among others, we got indicators for vegetation inertia or extinction debt (low predicted probability of occurrence, but observed presence), stable vegetation (high probability of occurrence and observed presence) and replaced/removed vegetation which could be restored (high probability of occurrence with observed absence). Indicator values per vegetation types and their spatial distribution were assessed. For example, in case of beech and oak-hornbeam woodlands, the extinction debt indicator was low, but the map revealed clustering of this indicator on the Little Hungarian Plain. We also interpreted combinations of indicators. For example, the ratio of all presences to the sum of all presences and high probability of occurrence with absence can be interpreted as the extent a vegetation type fills its “niche” (i.e., the environmental domain suitable for it). This “habitability” indicator was typically high for closed and rocky woodlands and low in loess and sand grasslands and open woodlands. Finally, we applied PCA on the indicators to detect related sets of vegetation types.

**Keywords:** extinction debt, MPNV, potential natural vegetation, predictive vegetation maps, vegetation inertia

## Phytosociology and ecology of the vegetation with *Brassica mollis*, South Croatia

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*Brassicaceae* represents a monophyletic group with 338 genera and 3700 globally distributed taxa. Alongside the indigenous taxa, the genus *Brassica* L. includes the vegetables, and oilseeds and their products of great importance in our global economy. The genus includes about 40 taxa, distributed mainly in the Mediterranean, southwestern Europe and north-western Africa. The easternmost boundary of its range is in Central Asia. In Croatia, there are 24 *Brassica* taxa. Among them, three were considered as endemics: *Brassica botteri* Vis. (distributed in the Palagruža Archipelago), *B. cazzae* Ginz. et Teyber (the Middle Adriatic islands of Vis, Kamik, Svetac – St. Andrija and Sušac), and *B. mollis* Vis. (the southern Adriatic islands and islets within Dubrovnik Region). Regarding their taxonomic status, some authors more recently consider them as a varieties of *Brassica oleracea* L. ssp. *incana* (Ten.) Gl. et Hm. (= *B. incana*). Phytosociology of *B. mollis* was studied on the islet of Kosor within Korčula Archipelago, and on the island of Koločep near the city of Dubrovnik. The relevés were recently collected in the field using Braun-Blanquet method. The European syntaxonomic framework of the EuroVegChecklist (EVC) was applied. The main aim of the study was to provide a phytosociological description of the plant communities with *B. mollis*. Our data showed that *B. mollis* does not occur within the *Seslerio robustae-Putorietum calabricae* Horvatić ex Birač 1973 (*Centaureo cuspidatae-Portenschlagiellion ramosissimae* Trinajstić ex Terzi et Di Pietro 2016) as has been previously reported from the literature (Horvatić 1971). On the contrary, *B. mollis* was found within the communities of the *Limonion anfracti-cancellati* (Horvatić 1934) Mucina in Mucina et al. 2106, *Anthyllidion barbae-jovis* S. Brullo et De Marco 1989, *Oleo-Ceratonion siliquae* Br.-Bl. ex Guinochet et Drouineau 1944, and *Pistacio lentisci-Pinion halepensis* Biondi, Blasi, Galdenzi, Pesaresi et Vagge in Biondi et al. 2014. Communities distribution along the altitudinal gradient and the degree of the sea influences was clearly shown from the rupicolous herb-rich vegetation of salt-sprayed rocky cliff to thermomediterranean calcicolous macchia or Aleppo pine forests. Comparable phytosociology and ecology of all Croatian endemics *Brassica* will require further research.

**Keywords:** biodiversity, distribution, eastern Adriatic islands, coastal plant communities, vegetation

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## Characteristics of oak vegetation in the Mirusha River Basin – Kosovo

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The Mirusha River basin is located in the central part of the Republic of Kosovo. Administratively it belongs to the municipalities of Malisheva, Suhareka, Rahovec and Klina. The terrain of the basin is flat to hilly and mountainous. The climate is continental temperate. The area consists of various substrates (limestone, silicate, serpentine and alluvial). The average air temperature is 10 °C, while the average annual precipitation is 600 to 800 mm. Although the area is under the influence of anthropogenic factors, according to the previous studies, there is a rich floristic diversity in this area. From the total number of plant species, especially from the vascular flora, the plant species that belong to the Balkan floristic element are worth mentioning. In the area there are also plant species classified as endangered according to the criteria of IUCN and published in the Red List respectively in the Red Book of Vascular Flora of the Republic of Kosovo. Particularly in the basin area, the forest vegetation is noticeable, which in the hilly-mountainous area is covered by a considerable area of oak vegetation. Based on the principles and methods of the Zurich-Montpellier school (Braun-Blanquet 1964, Mucina et al. 2016), phytocoenosis have been ascertained from the oak forests in this area which belong to the class *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959 [*Querco-Fagetea* Br. Bl. et Vlieger 1937].

**Keywords:** flora, forests, phytodiversity, *Quercus*, syntaxonomy



## **Invasive capacity of *Prunus serotina* (Rosaceae) and its host *Rhagoletis cingulata* (Diptera, Tephritidae) – a case study in Croatia**

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Previous study of Black cherry (*Prunus serotina* Ehrh.) species in Pedunculate oak (*Quercus robur* L.) forest regeneration area of Jastrebarsko forest management unit have shown a considerable spread, indicating its invasive character and alteration in current vegetation. In this respect, the continuation of this research is focused on monitoring of spreading area and its impact on the native plant species. Also, as a part of the detection programme of *Rhagoletis* species in Croatia, this research includes defining potential occurrence of Cherry fruit fly (*Rhagoletis cingulata*) species, naturally associated with the *P. serotinas*' presence. With the aim of sampling both infected and uninfected parts of the monitored area, our survey consists of 20 polygon network plots created in QGIS programme and equally distributed into polygon of the regeneration area (15 plots), as well as the surrounding forest area (five plots). In order to investigate current habitat characteristics, phytosociological approach is applied. Furthermore, the area is surveyed by the use of the unmanned aerial vehicles (UAV) DJI Mavic 2 Pro and DJI Matrice 600, both equipped with multispectral cameras and DJI Ground Station Pro for comparing results. Data analysis is performed by the use of Agisoft Metashape Professional (ver.1.5.5) programme. In addition, monitoring of *Rh. cingulata* species includes yellow sticky board traps located on the edges of the regeneration area. This research reveals spreading capacity and the expansion rate of *P. serotina* as well as *Rh. cingulatas*' presence in the monitored area. With better understanding of ecology changes over a certain period of time, this also contributes to drawing conclusions about the effectiveness of the control measures being implemented.

**Keywords:** ecological factors, Jastrebarsko forest office, monitoring, spreading area, unmanned aerial vehicles

## A floristic study of the islet of Ošljak, Zadar Archipelago (North Dalmatia)

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The islet of Ošljak (44.075341 N, 15.210299 E) on the eastern Adriatic coast is a part of the Zadar Archipelago in the North Dalmatia. It is situated in the Zadar Channel between the city of Zadar and the island of Ugljan. The distance between islet and the island of Ugljan is 0.8 km. The islet has an area of 0.34 km<sup>2</sup>, with a coastline length of 2.25 km, and a maximum altitude of 89 m a.s.l. The lithology consists of highly permeable Cretaceous and Paleogene limestones. The climate is Mediterranean, with mild and rainy winters and hot summers (Csa type of the Köppen–Geiger climate classification system). Ošljak is an area of old settlement. It has been mentioned in documents since 1320. It is the smallest inhabited islet in the Adriatic Basin. In 1931, the population was almost 200; after the Second World War numbers gradually diminished and nowadays there are only 29 permanent inhabitants (Census 2011 Report). In this Eu-Mediterranean zone, climazonal vegetation of holm oak (*Quercus ilex* L.) represents special value and a particular asset. In 1985, the islet was declared as the Significant Landscape. On the higher altitudes, macchia and the abandoned arable areas occur. On the eastern slopes, the Aleppo pine (*Pinus halepensis* Mill.) stands are developed. The Aleppo pine was planted especially after World War II. The flora of Ošljak is almost unknown. The oldest data date back to the early 19<sup>th</sup> century, when Host (Host in Visiani 1826) reported 15 plant taxa. Visiani (1842-1852) in *Flora Dalmatica* lists three other taxa: *Arthrocnemum macrostachyum* (Moric.) C. Koch, *Prasium majus* L. and *Teucrium flavum* L. Until now, plant taxa list is not completed. The study was carried out from 2016 to 2022 in different seasons. Altogether, 350 taxa were recorded on the islet. Among them, several are endemics (*Rhamnus intermedia* Steud. et Hochst, *Tanacetum cinerariifolium* (Trevir.) Sch. Bip., etc.) and endangered taxa (*Lathyrus ochrus* (L.) DC.; Critically Endangered taxon) and *Salsola soda* L.; Vulnerable taxon). Several orchids (Orchidaceae) were also found, i.e., *Limodorum abortivum* (L.) Sw., *Ophrys bertolonii* Moretti, *O. liburnica* Devillers et Devillers-Tersch. and *Serapias parviflora* Parl. The present study offers a contribution to the knowledge of the insular vascular flora, a description of the vegetation units, and phytogeographical comments. The floristic data have been used to analyze life-form and chorological spectra and to assess species-area relationship, the occurrence of islet specialists and to assess the risk of alien plant invasion.

**Keywords:** Croatia, eastern Adriatic, floristic survey, islet, vascular plant richness

## Earth observations and artificial intelligence for the NATURA 2000 floodplain forests mapping

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Earth Observation data in combination with Machine learning (ML) algorithms present a very powerful tool for accurate mapping and updating the state of the vegetation cover. The Sentinel 1 and 2 space missions, as part of the EU Copernicus Earth observation program, enable the monitoring of the vegetation cover in almost real-time, in high spatial resolution (10 m). On the other hand, advanced ML algorithms are very data-intensive approaches; for the construction, validation, and testing of the ML model, a large number of points or samples (in the range of 1000-10000) is required. The problem with mapping vegetation at the scale of the forest communities or phytocoenoses is often the lack of quality “Ground truth” data for training ML algorithms. Existing phytocoenological maps are often outdated (at the level of several decades) and often do not accurately reflect the current situation. Also, the boundaries between different types are most often determined by field assessments and therefore quite unreliable. In addition, the existing methods of field determination of floral composition require significant professional expertise and are thus very expensive and time-consuming. The new project “Earth observations and artificial intelligence for the NATURA 2000 floodplain forests mapping” approved for funding by the European Space Agency (ESA) aims to bridge the gap between “Ground truth” requirements for ML applications. The main objective of the project is to tailor and prototype suitable Artificial Intelligence (AI) pipeline for the rapid high-resolution mapping of the NATURA 2000 floodplain forest habitats based on the Copernicus EO information i.e. to demonstrate the capabilities of EO-based AI approaches as a powerful alternative to traditional and widely used field survey methods. A particular emphasis of this concept is related to the rapid generation of the ground truth information from variable external data sources thus reducing the required time-consuming field survey to a minimum (only necessary field locations for the final testing of the algorithm). In this way, the idea is to establish the concept of fast and reliable habitat mapping, using a combination of EO and expert domain knowledge, which could be applicable for the circular periodic mapping and monitoring of similar NATURA 2000 habitats in the entire territory of the Republic of Croatia.

**Keywords:** floodplain forests, machine learning, NATURA 2000, phytocoenoses, sentinel

## Functional adaptation of common beech and sessile oak to drought

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This research was conducted on four-year-old saplings of common beech and sessile oak originating from two mature mixed beech-oak stands from the Republic of Croatia (RH), which are characterized by similar orographic and edaphic (chemical composition and mechanical soil structure) conditions. In addition, both stands belong to the same phytosociological association, *Epimedio-Carpinetum betuli* (Horvat 1938) Borhidi 1963. However, during the development of the studied saplings in the period from 2016 to 2020, stands from north-western part of the RH near Karlovac (KA) were more frequently exposed to drought periods than stands from eastern part of RH near Slavonski Brod (SB). Therefore, the aim of this study was to examine the impact of drought on the functional adaptation of growth and dry mass production of common beech and sessile oak saplings. Differences between stands (KA vs. SB) and species (beech vs. oak) were examined using two-factorial ANOVA with respect to a growth and dry mass production parameters, including their allometric relationships. According to the obtained results, the saplings from the KA stand had a thicker and lower stem, rooted deeper, and had a higher dry mass of coarse and fine roots compared to the saplings from the SB stand. This indicates that the saplings from the KA stand could be functionally more adapted to the drought habitat than the saplings from the SB stand due to more frequent exposure to drought periods. Such a result could be the consequences of different phenotypic modifications (drought reactions) and/or actual genetic differences between the studied stands, which could not be more accurately distinguished on this occasion. Furthermore, sessile oak saplings rooted deeper and had a higher dry mass of coarse roots than the common beech saplings that rooted shallower and had a higher dry mass of fine roots. This result corresponds to the previous knowledge on pattern of functional adaptation of sessile oak and common beech to moisture and/or dryness of the habitat, which differs in that sessile oak is oriented to absorb water from deeper soil layers by taproot, while common beech is oriented to absorb precipitation water from shallower layers of soil by fine roots.

**Keywords:** allometric growth, coarse root, dry mass, drought, *Fagus sylvatica* L., fine root, *Quercus petraea* (Matt.) Liebl., stem

## New data on lichens from the most southern areas of Albania (Delvina and Saranda District)

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A list of 93 taxa of lichens is presented including 35 taxa newly reported to the country and 51 to the investigated area. The findings show many aspects. A rich vegetation on three old *Castanea* trees on the roadside. Might be the remnants of an original forest, indicated by the following species: *Pectenaria atlantica*, *Fuscopannaria mediterranea*, *F. olivacea*, *Scytinium teretiusculum*, *S. tenuissimum*, *Varicellaria hemisphaerica*, *Pertusaria coccodes*, *P. hymenea*, *Nephroma laevigatum*. In the old monastery of St. Nicholas in Mesopotam, on scattered *Olea* trees around the church, 17 species were recorded, which is much considering the substratum. However, the species which are specific for olive trees are absent here, nor were they found elsewhere on the journey. This indicates that olive trees were not a natural element of the vegetation in the places visited, but it does not show whether olive trees were perhaps growing wild in the area sometime in the past. Notable in Mesopotam are: *Staurolemma omphalarioides* and *Lecanora horiza*, both common Mediterranean species, and *Coenogonium luteum* and *Porina aenea*, which appear in the shadow on the bark of the stems. In the small forest and the ruins of ancient Butrint, only a few samples were taken, but some were recorded without collection. Remnants of a column consisting of acid stone were overgrown with species characteristic of this substratum although the entire area consists of basic rocks (limestone). Therefore, *Xanthoparmelia conspersa*, *X. pulla* and *Aspicilia cinerea* are present. Remarkable small black rosettes of *Scytinium* cf. *massiliense* on calcareous stones in the amphitheatre. The following species can be considered of interest because of their biogeography and conservation importance: *Arthonia meridionalis*, *Huneckia pollinii*, *Physcia biziana* var. *biziana*, *Physconia venusta*, *Usnea articulata*, *Varicellaria velata*.

**Keywords:** biodiversity, biogeography, flora of Albania, Mediterranean lichens, new records

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