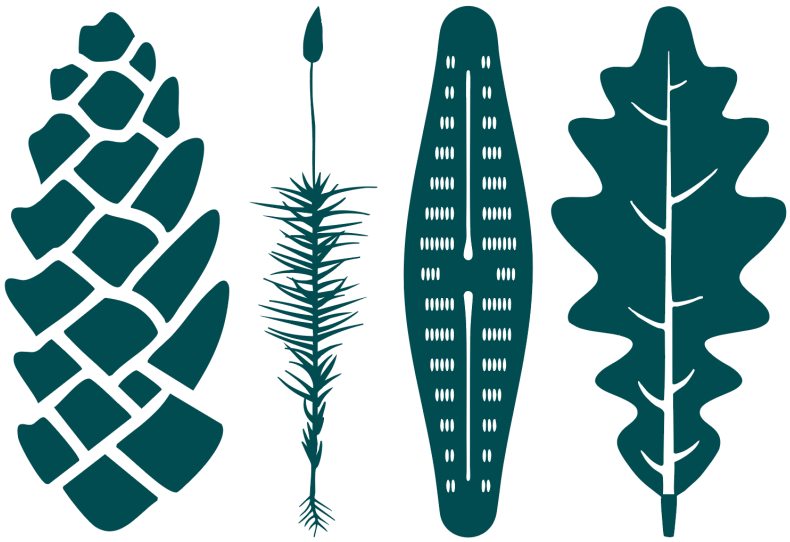
KNJIGA SAŽETAKA

BOOK OF ABSTRACTS

8. HRVATSKI BOTANIČKI SIMPOZIJ
s međunarodnim sudjelovanjem

8TH CROATIAN BOTANICAL SYMPOSIUM
with International Participation



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BOOK OF ABSTRACTS

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Predgovor

S iznimnim ponosom i radošću predstavljamo *Knjigu sažetaka* 8. Hrvatskog botaničkog simpozija s međunarodnim sudjelovanjem, koji se prvi put održava na istoku Hrvatske, u gostoljubivom Osijeku! Ove godine simpozij također po prvi puta nosi pečat zajedničke organizacije Hrvatskog botaničkog društva i Fakulteta agrobiotehničkih znanosti u Osijeku, a poseban povratak u program bilježi i zasebna sekcija *Edukacija za nastavnike*, namijenjena povezivanju znanstvene i obrazovne zajednice.

Službeni jezik simpozija je engleski, čime želimo podržati sve veću međunarodnu prepoznatljivost i suradnju, no svjesni smo i važnosti razvoja hrvatskog jezika u znanosti i struci, pa je dio programa i dalje na hrvatskom jeziku. Iako je naš simpozij regionalnog karaktera, i tu tradiciju želimo njegovati, iznimno nas veseli sve veći broj stranih znanstvenika koautora u ovoj knjizi sažetaka.

Od prvog simpozija 2004. godine do danas, Hrvatski botanički simpozij izrastao je u središnje nacionalno okupljanje botaničara, ali i stručnjaka drugih područja, u mjesto gdje se povezuju generacije istraživača i širi suradnja s međunarodnim kolegama. I ovog puta cilj nam je isti: razmjena znanja, iskustava i ideja, poticanje interdisciplinarnog pristupa te otvaranje novih istraživačkih horizonata.

Program koji je oblikovao Međunarodni znanstveni odbor obuhvaća sedam tematskih cjelina i pozvana predavanja iz područja floristike, filogenije i biogeografije, ali i nova, hrabro otvorena područja poput urbane ekologije, primjene strojnog učenja u obradi florističkih podataka te holističkog pristupa proučavanja i istraživanja utjecaja klimatskih promjena na šumske ekosustave.

Tradicionalno, najzastupljenije teme ostaju flora i filogenija te biogeografija i vegetacija, no sve je izraženiji porast interdisciplinarnih istraživanja. Pri odabiru usmenih priopćenja vodili smo se načelom ravnomjerne zastupljenosti svih tema, s naglaskom na nova istraživačka područja i autore, posebice studente koji još nisu imali priliku usmeno izlagati. Uz četiri plenarna predavanja, čak 30 usmenih i 62 posterska priopćenja, Osijek ovih dana postaje mjesto živog dijaloga, novih suradnji i inspiracije. Iznimno nas veseli ugostiti 140 sudionika, koji će prezentirati svoje radove u kojima je sudjelovalo 318 znanstvenika prvenstveno iz Hrvatske i susjednih zemalja, ali i iz cijelog svijeta. Ističemo nastavničku sekciju, otvorenu svim sudionicima, kao priliku da znanstvenici i nastavnici zajednički oblikuju budućnost botaničkog obrazovanja.

Ovogodišnji simpozij ujedno je i proslava dviju velikih obljetnica: Glasnik Hrvatskog botaničkog društva navršava 12 godina izlaženja, dok Acta Botanica Croatica, časopis s impresivnom poviješću započetom 1925. godine, obilježava stotu obljetnicu. Jedna večer bit će posvećena proslavi tih jubileja, a druga popularnom predavanju Stribora Markovića o društvenoj percepciji biljaka.

Dobrodošli u Osijek, grad na Dravi, grad parkova i zelenila, i u našu botaničku zajednicu koja raste i jača baš poput biljaka kojima posvećujemo svoje živote i znanstvenu strast.

Preface

It is our great pleasure and honour to present the *Book of Abstracts* of the 8th Croatian Botanical Symposium with international participation, which is being held for the first time in eastern Croatia, in the welcoming city of Osijek! This year, the Symposium also bears for the first time the mark of joint organization by the Croatian Botanical Society and the Faculty of Agrobiotechnical Sciences in Osijek, and it also welcomes back into the program a special *Education Section for Teachers*, aimed to connect the scientific and educational communities.

The official language of the Symposium is English, as we wish to support its growing international recognition and collaboration. However, we are also aware of the importance of developing the Croatian language in science and professional fields, so part of the program is still in Croatian. Although our Symposium has a regional character, and we intend to preserve that tradition, we are delighted to see an increasing number of international scientists among the co-authors in this Book of Abstracts.

From the first Symposium in 2004 until today, the Croatian Botanical Symposium has grown into the central national gathering of botanists, as well as experts from other disciplines, a place where generations of researchers connect and where cooperation with international colleagues expands. This time, our goal remains the same: the exchange of knowledge, experiences, and ideas, the promotion of an interdisciplinary approach, and the opening of new research horizons.

The program shaped by the International Scientific Committee encompasses seven thematic sections and invited lectures covering fields such as floristics, phylogeny, and biogeography, as well as newly and boldly opened areas such as urban ecology, the application of machine learning in the processing of floristic data, and holistic approaches to studying and researching the impact of climate change on forest ecosystems.

Traditionally, the most represented topics remain flora and phylogeny, as well as biogeography and vegetation, but there is a steadily growing increase in interdisciplinary research. In selecting oral presentations, we adhered to the principle of balanced representation of all topics, with emphasis on new research areas and authors, especially students who have not yet had the opportunity for oral presentation. Along with four plenary lectures, as many as 30 oral and 62 poster presentations will make Osijek these days a place of lively dialogue, new collaborations, and inspiration. We are especially pleased to welcome 140 participants, who will present works involving 318 scientists, primarily from Croatia and neighboring countries, but also from all over the world. We highlight the *Education Section for Teachers*, open to all participants, as an opportunity for scientists and teachers to jointly shape the future of botanical education.

This year's Symposium also celebrates two major anniversaries: the *Glasnik Hrvatskog botaničkog društva* journal marks its 12th year of publication, while *Acta Botanica Croatica*, a journal with an impressive history that began in 1925, celebrates its centenary. One evening will be dedicated to celebrating these jubilees, and another to a popular lecture by Stribor Marković on the social perception of plants.

We would like to welcome you to Osijek, the city on the Drava River, the city of parks and greenery, and welcome to our botanical community that grows and strengthens just like the plants to which we dedicate our lives personally and professionally.

U ime Organizacijskog i Znanstvenog odbora 8. Hrvatskog botaničkog simpozija,

On behalf of the Organizing and Scientific Committees of the 8th Croatian Botanical Symposium,

Dubravka Sandev & Zrinka Ljubešić

Program 8. Hrvatskog botaničkog simpozija s međunarodnim sudjelovanjem

Program of the 8th Croatian Botanical Symposium with International Participation

Srijeda 3. rujna 2025. / Wednesday September 3rd 2025

Edukacijsko-promotivni atrij (prizemlje) / Education and Promotion Atrium (groundfloor)

17:00 20:00 Registracija sudionika / Participant Registration

18:00 20:00 Piće dobrodošlice / Welcome Reception

Četvrtak 4. rujna 2025. / Thursday September 4th 2025

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

8:00 9:00 Registracija sudionika / Participant Registration

9:00 9:30 Svečano otvaranje / Opening ceremony

9:30 10:10 **1. Plenarno predavanje / 1st Plenary Lecture**

Božo Frajman – *EVOLUTIONARY PATTERNS AND DIVERSIFICATION OF Euphorbia IN THE BALKAN PENINSULA*

(10:10 11:10) **Flora, sistematika, evolucija i filogenija / Flora, Systematics, Evolution, and Phylogeny**

Predsjedavajući / Chairs: Ivana Rešetnik, Nevena Kuzmanović

10:10 10:25 Ćato, S. – *IS Cirsium greimleri (ASTERACEAE) REALLY EXTINCT IN CROATIA?*

10:25 10:40 Bogdanović, S. – *MOLECULAR AND MORPHOLOGICAL ANALYSES REVEAL THE RECOGNITION OF Campanula brulloi (CAMPANULACEAE), A NEW SPECIES FROM ALBANIA*

10:40 10:55 Temunović, M. – *ENVIRONMENTAL NICHES BETWEEN PLOIDY LEVELS AND SUBSPECIES OF Dianthus ciliatus s.l. (CARRYOPHYLLACEAE)*

10:55 11:10 Rumin, P. – *A NEW GENETICALLY AND MORPHOLOGICALLY STENOTYPIC SPECIES OF Schistidium FROM NORTH AMERICA RELATED TO TWO SPECIES WIDESPREAD IN EUROPE, INCLUDING THE MEDITERRANEAN, S. crassipilum AND S. helveticum*

Edukacijsko-promotivni atrij (prizemlje) / Education and Promotion Atrium (groundfloor)

11:10 11:45 Stanka za kavu / Coffee break

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

(11:45 13:00) **Edukacija, promocija i profesionalne aktivnosti / Education, Promotion, and Professional Activities**

Predsjedavajući / Chairs: Božena Mitić, Igor Boršić

11:45 12:00 Eršegović, A. – *BRIOŠKOLA AND PTERIDOŠKOLA – EDUCATIONAL AND POPULARIZATION BOTANICAL PROJECTS*

12:00 12:15 Vuković, N. – *FLORA CROATICA DATABASE IN ITS PRIME – NEWS AND UPDATES*

12:15 12:30 Kletečki, N. – *STUDENTS' VIEWS ON PLANTS AND SCHOOL BOTANY*

12:30 12:45 Bosak, S. – *150 YEARS OF DIVISION OF BOTANY, DEPARTMENT OF BIOLOGY, FACULTY OF SCIENCE AT UNIVERSITY OF ZAGREB*

12:45 13:00 Maslać Mikulec, M. – *LAUNCHING A LICHEN MODULE IN THE FLORA CROATICA DATABASE*

13:00 15:00 Stanka za ručak / Lunch Break

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

15:00 15:40 **2. Plenarno predavanje / 2nd Plenary Lecture**

Ana Ješovnik – *WILD POLLINATORS OF ZAGREB AND MANAGEMENT OF URBAN GREEN SPACES*

Edukacijsko-promotivni atrij (prizemlje) / Education and Promotion Atrium (groundfloor)

15:40 16:30 **Posterska sekcija* / Poster Session***

16:30 17:00 Stanka za kavu / Coffee break

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

(17:00 18:15) **Konzervacijska biologija i urbana ekologija / Conservation Biology and Urban Ecology**

Predsjedavajući / Chairs: Nina Šajna, Damir Viličić

17:00 17:15 Ozimec, S. - *NEW RECORDS ON DISTRIBUTION OF TARGET HABITATS AND THREATENED PLANTS IN NATURA 2000 AREAS IN THE CROATIAN DANUBE REGION*

17:15 17:30 Papp, B. - *RED LIST OF BRYOPHYTES OF SERBIA*

17:30 17:45 Turkalj, L. - *DEVELOPING SPECIES-SPECIFIC MONITORING FRAMEWORKS FOR CONSERVATION REPORTING IN CROATIA*

17:45 18:00 Kušen, M. - *ORNAMENTAL PLANTS AS A SOURCE OF INVASIVENESS: FIRST-YEAR RESULTS OF THE LIFE ORNAMENTALIAS PROJECT IN CROATIA*

18:00 18:15 Stojchevska, C. - *FIRST NATIONAL IUCN ASSESSMENT OF SOME RARE AND ENDEMIC PLANTS FROM GALICHICA NP IN THE REPUBLIC OF NORTH MACEDONIA*

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

18:15 20:00 **Večernji program / Evening Programme**

Promocija hrvatskih znanstvenih časopisa / Promotion of the Croatian scientific papers

Šegota, V. - *TWELVE YEARS OF THE JOURNAL OF THE CROATIAN BOTANICAL SOCIETY*

Jasprica, N. - *CENTENNIAL CELEBRATION OF THE JOURNAL ACTA BOTANICA CROATICA*

Petak 5. rujna 2025. / Friday September 5th 2025

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

9:00 9:40 **3. Plenarno predavanje / 3rd Plenary Lecture**

Branimir Hackenberger – *CHALLENGES OF ADVANCED TECHNOLOGIES IN DATA PROCESSING FOR FLORISTIC AND BOTANICAL RESEARCH*

(9:40 10:40) **Ekologija, biogeografija, vegetacija i klimatske promjene / Ecology, Biogeography, Vegetation, and Climate Change**

Predsjedavajući / Chairs: Antun Alegro, Zlatko Levkov

9:40 9:55 Matek, A. - *SPATIAL DISTRIBUTION OF PRIMARY PRODUCTION DURING SUMMER AT LASTOVO ISLAND, SOUTH ADRIATIC*

9:55 10:10 Mifka, B. - *IMPACT OF DESERT DUST DEPOSITION ON THE BIOLOGICAL PRODUCTION IN THE ADRIATIC*

10:10 10:25 Rogošić, M. - *WHAT THE SEA TAKES, PEOPLE SHOULD GIVE BACK: EMBRYONIC DUNE RESTORATION ON MLJET ISLAND*

10:25 10:40 Bučar, M. – *AQUATIC VEGETATION OF EASTERN SLAVONIAN WATERCOURSES: DIVERSITY AND ECOLOGY*

Edukacijsko-promotivni atrij (prizemlje) / Education and Promotion Atrium (groundfloor)

10:40 11:15 Stanka za kavu / Coffee Break

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

(11:15 12:15) **Biljke i društvo / Plants and Society; Genetika, genomika, metablomika i transkriptomika / Genetics, Genomics, Metabolomics, and Transcriptomics; Fiziologija stresa, anatomija i morfologija / Stress Physiology, Anatomy and Morphology**

Predsjedavajući / Chairs: Zrinka Ljubešić, Branka Salopek Sondi

11:15 11:30 Sutlović, A. – *NATURAL TEXTILE DYES EXTRACTED FROM MADDER (Rubia tinctorium L.)*

11:30 11:45 Nišević, M. – *BOTANICAL ILLUSTRATION: WHEN ART MEETS SCIENCE*

11:45 12:00 Jurčević Šangut, I. – *CHANGES IN PIGMENT COMPOSITION DURING LEAF YELLOWING IN GINKGO (Ginkgo biloba L.)*

12:00 12:15 Radić Brkanac, S. – *ASSESSMENT OF HEAVY-METALS CONTAMINATED MICROPLASTICS AND WEAR TYRE MIXTURE ON DUCKWEEDS*

12:15 14:30 Stanka za ručak / Lunch Break

13:30 18:00 **Paralelne sekcije / Parallel Session A/B**

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

(14:30 18:00) **A**

14:30 15:10 **4. Plenarno predavanje / 4th Plenary Lecture**

Stjepan Mikac – *ECOSYSTEM FACING THE CHALLENGE OF THE CENTURY: CLIMATE CHANGE AND THE PATH TO RESILIENCE*

(15:10 16:10) **Biogeografija, ekologija, vegetacija i klimatske promjene / Biogeography, Ecology, Vegetation and Climate Change**

Predsjedavajući / Chairs: Beata Papp, Snežana Dragićević

15:10 15:25 Somodi, I. – *COORDINATED POTENTIAL VEGETATION PREDICTION IN CONTINENTAL CROATIA AND HUNGARY*

15:25 15:40 Megyery, T. – *MAPPING OF NATURA 2000 HABITAT TYPE 6210 (DRY CONTINENTAL GRASSLANDS) USING UAS AND LiDAR*

15:40 15:55 Krstonošić, D. – *A DECADE OF VEGETATION CHANGE: TRACKING BIODIVERSITY LOSS IN DRY GRASSLANDS OF PSUNJ MT.*

15:55 16:10 Šegota, V. – *CROATIAN PEATLANDS ON THE VERGE OF DISAPPEARANCE? RESULTS OF AN EXTENSIVE CONSERVATION STATUS ASSESSMENT*

Edukacijsko-promotivni atrij (prizemlje) / Education and Promotion Atrium (groundfloor)

16:10 16:30 Stanka za kavu / Coffee Break

16:30 17:00 **Posterska sekcija* / Poster Session***

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

(17:00 18:00) **Flora, sistematika, evolucija i filogenija / Flora, Systematics, Evolution, and Phylogeny**

Predsjedavajući / Chairs: Nenad Jasprica, Branka Salopek Sondi

17:00 17:15 Mucko, M. - *LOST IN THE PLANKTON: Entomoneis translucida sp. nov., A GHOST DIATOM REVEALED*

17:15 17:30 Purger, D. - *THE FLORA OF THE ISLAND OF IŽ (ZADAR ARCHIPELAGO, CROATIA)*

17:30 17:45 Vidaković, A. - *HYBRIDIZATION DYNAMICS IN CROATIAN PEAR SPECIES: GENETIC INSIGHTS AND CONSERVATION CHALLENGES*

17:45 18:00 Husnjak Malovec, K. - *FILLING THE GAP IN KNOWLEDGE ABOUT STENOENDEMIC Alyssum pluscanescens (Raim. ex Jos.Baumgartner) Španiel, Lihová & Marhold*

Fakultetska vijećnica (1. kat / 158) / Faculty Council Hall (1st floor / 158)

(13:30 18:00) **B - Botanika u nastavi biologije u osnovnim i srednjim školama (In Croatian)**

13:30 14:30 Sirovina, D. - *BOTANIČKI SADRŽAJI ZA OSTVARIVANJE ISHODA IZ KURIKULUMA NASTAVNOG PREDMETA BIOLOGIJA*

14:30 15:00 Škrtić, D. - *PRAKTIČNE VJEŽBE IZ BOTANIKE ZA USPJEŠNO OSTVARIVANJE KURIKULARNIH ISHODA*

15:00 15:30 Poduje, J. - *METODOLOGIJA ISTRAŽIVAČKOG RADA U BOTANICI: LIŠAJI KAO MODELNI ORGANIZMI*

15:30 16:00 Radić Brkanac, S., Babić, M., Galeković, M. - *KAKO PRIBLIŽITI FOTOSINTEZU UČENICIMA? DOKAZIVANJE ŠKROBA U BILJKAMA*

Edukacijsko-promotivni atrij (prizemlje) / Education and Promotion Atrium (groundfloor)

16:00 16:30 Stanka za kavu

Fakultetska vijećnica (1. kat / 158) / Faculty Council Hall (1st floor / 158)

16:30 17:00 Gligora-Udovič, M. - *DIJATOMEJE U NASTAVI PRIRODE I BIOLOGIJE*

17:00 17:30 Kodžoman, A., Musović, B. - *DRVOKOD - PRIMJER POSTAVLJANJA, KOORDINIRANJA I REALIZACIJE PROJEKATA IZ BOTANIKE*

17:30 18:00 Okrugli stol

Aula Magna (2. kat / 222) / Aula Magna (2nd floor / 222)

18:15 19:00 **Popularno javno predavanje Hrvatskog botaničkog simpozija (in Croatian)**

Stribor Marković - *DRUŠTVENA PERCEPCIJA BILJAKA*

Restoran "Projekt 9." Gornjodravska obala bb

20:00 1:00 Svečana večera / Gala Dinner

Subota 6. rujna 2025. / Saturday September 6th 2025

9:00 17:00 Simpozijska ekskurzija Park prirode "Kopački rit"

Symposium excursion Nature Park "Kopački rit"

*Posterska sekcija 8. Hrvatskog botaničkog simpozija

*Poster Session of the 8th Croatian Botanical Symposium

Flora, Systematics, Evolution and Phylogeny

F01 *TWO NEW Romulea TAXA (IRIDACEAE) IN THE FLORA OF CROATIA*
Bogdanović, S., Brana, S., Rimac, A., Doboš, M., Bučar, M., Maslać Mikulec, M., Šegota, V.

F02 *Carex brevicollis AND Gymnadenia × suaveolens, TWO NEW PLANT TAXA IN THE CROATIAN FLORA*
Bogdanović, S., Temunović, M., Milanović, Đ., Čičmir, R.

F03 *FIRST FINDING OF Galanthus elwesii Hook.f. (AMARYLLIDACEAE) IN MONTENEGRO*
Bubanja, N., Vuksanović, S.

F04 *FLORISTIC DIVERSITY OF BIJELE I SAMARSKE STIJENE STRICT RESERVE (CROATIA)*
Buzjak, S., Boršić I.

F05 *CATALOGUES OF VASCULAR PLANTS OF MONTENEGRO*
Caković, D., Stešević, D., Stanišić Vujačić, M., Bubanja, N.

F06 *ELEVEN NEW PLANT TAXA IN THE CROATIAN FLORA*
Ćato, S., Bogdanović, S.

F08 *WINTER PHYTOPLANKTON DIVERSITY IN HIGHLY PRODUCTIVE COASTAL AREA (BOKA KOTORSKA BAY)*
Grgurević, F., Mucko, M., Pestorić, B., Hartkamp, J., Drakulović, D., Ljubešić, Z.

F09 *NEW FLORISTIC DATA FOR THE VRLJIKA SPECIAL RESERVE*
Gučanin-Gazibarić, K., Mitić, B., Hruševar, D., Piasevoli, G., Ujević, I., Jukić, B., Vladović, D.

F10 *FLORA OF LAKE LAPOVAC (CITY OF NAŠICE)*
Hruševar, D., Becker, B., Gučanin-Gazibarić, K., Vladović, D., Mitić, B.

F11 *NEWLY DESCRIBED DIATOM SPECIES FROM A KARSTIC REGION IN CROATIA, DEPOSITED IN THE CROATIAN NATIONAL DIATOM COLLECTION*
Kulaš, A., Gligora Udovič, M., Jurina, D., Žutinić, P., Levkov Z.

F12 *ENDEMIC Festuca SPECIES IN THE CENTRAL SANDY AREA OF THE CARPATHIAN BASIN*
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USMENA PRIOPĆENJA

Plenarna predavanja

ORAL PRESENTATIONS

Plenary Lectures

EVOLUTIONARY PATTERNS AND DIVERSIFICATION OF *Euphorbia* IN THE BALKAN PENINSULA

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The Balkan Peninsula is a hotspot of European biodiversity, and it also represents one of the diversification centres of leafy spurges (*Euphorbia* subgen. *Esula*; Euphorbiaceae). Extensive sampling across the Balkan Peninsula in the past decade followed by phylogenetic analyses based on DNA sequences uncovered cryptic species, confirmed presence and taxonomic status of neglected taxa, inferred phylogeographic patterns and provided new distributional data. In the talk I will review some of the most interesting aspects of *Euphorbia* diversification in the Balkan Peninsula, among others triggered by allopatric speciation in different refugia, adaptation to heterogeneous environments and, to a lesser extent, polyploidy. I will emphasise the application of an integrative approach encompassing morphological, ecological, cytogenetic, genetic and genomic methods in the disentangling of diversification patterns and the uncovering of underlying processes. Finally, not only the variety of methodological approaches, but also extensive collaborations across the Balkan Peninsula provide a solid basis for current and future explorations of biodiversity in this European diversity hotspot.

Keywords: Balkan Peninsula, biogeography, diversification, *Euphorbia* subgen. *Esula*, evolution, taxonomy

WILD POLLINATORS OF ZAGREB AND MANAGEMENT OF URBAN GREEN SPACES

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Urban green spaces are increasingly recognized for their importance in wild pollinator conservation. Pollinator diversity can sometimes be higher in cities than in surrounding rural or natural areas, although the evidence is stronger for wild bees than for other pollinating taxa. The capacity of individual urban green spaces to provide habitats for wild pollinators depends on various ecological factors, such impervious surface cover, temperature, nesting habitat availability, and the availability of floral resources – frequently measured as abundance and richness of entomophilic plants. The importance of individual factors varies between regions and studies, highlighting the need for local studies to inform pollinator-friendly management. Using Zagreb as a case study, I will provide an overview of the most important ecological factors and management interventions to increase the biodiversity of urban insect communities, focusing on bees (clade Anthophila) and hoverflies (family Syrphidae), important pollinator taxa with different ecological requirements. Like many cities, Zagreb hosts rich wild bee and hoverfly communities, and this includes species of conservation concern at the European level. The importance of floral abundance for pollinator species richness in Zagreb shows that simple interventions, such as reducing intensive mowing regime or adopting mosaic mowing, can significantly benefit urban pollinator diversity. For threatened pollinator species, protecting and restoring semi-natural grassland remnants is critical, especially those supporting host plants for pollen-specialist bees. Diverse urban pollinators have a key role in maintaining genetic diversity and adaptive potential of urban plant communities, which provide irreplacable ecosystem services.

Keywords: wild bees, hoverflies, Cro Buzz Klima, mowing

CHALLENGES OF ADVANCED TECHNOLOGIES IN DATA PROCESSING FOR FLORISTIC AND BOTANICAL RESEARCH

Hackenberger, B.

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Botanical science has entered a new data-intensive era in which the amount of plant information is growing exponentially. From field observations and digitised herbaria to drone imagery, satellite data and cutting-edge omics analysis, researchers now have an unprecedented wealth of biological data at their fingertips. However, this abundance presents us with enormous challenges: Data sets remain frustratingly heterogeneous, spatially and temporally misaligned, error-prone, and raise critical ethical questions about the sharing of sensitive species locations. This talk explores how revolutionary technologies are reshaping botanical data science. We will look at drones equipped with hyperspectral sensors for precise vegetation mapping, satellite time series processed via Google Earth Engine for phenological monitoring, and artificial intelligence systems that are achieving remarkable accuracy in automated species identification. We will also discover how OCR/HTR technologies combined with large-scale language modelling are breathing new life into centuries-old herbarium collections, and we will explore new digital ecosystem twins that seamlessly link botanical models with climate projections. Using three compelling case studies, invasive species detection in wetlands, the digital renaissance of herbarium collections and phenological monitoring of Croatian forests, we will show how the synergy of cutting-edge technology and botanical expertise is leading to faster, more accurate and ethically responsible biodiversity research. The talk will conclude with an urgent call for collaboration in building open, interoperable and high quality datasets. The future of botanical science depends on our collective ability to unite science, technology and community in the service of understanding and conserving plant diversity.

Keywords: floristics, botany, data processing, artificial intelligence, hyperspectral imaging, Darwin Core, digital twins, Google Earth Engine, data ethics

ECOSYSTEMS FACING THE CHALLENGE OF THE CENTURY: CLIMATE CHANGE AND THE PATH TO RESILIENCE

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Climate change has a profound impact on the stability and resilience of forest ecosystems, especially in Central European and Mediterranean regions. Rising air temperatures, intense droughts, biotic stressors, and increasingly frequent wildfires are altering the composition, structure, and function of forests worldwide, including those in Croatia. This paper examines how climate change affects forest vitality and regenerative capacity, emphasizing the need for adaptive forest management. Nature-based solutions are highlighted, such as the development of resilient and stable mixed stands, conservation of native species, and afforestation of degraded areas. Long-term forest resilience is essential not only for biodiversity conservation but also for maintaining vital ecosystem services such as carbon sequestration, water regulation, and soil protection. In Croatia, concerning negative trends have already been widely documented, including reduced forest growth, increased tree mortality since the 1980s, and significant damage caused by droughts, fires, storms, bark beetles, invasive species, and extreme weather events. The total volume of damaged timber currently exceeds 30 million m³. Although elevated CO2 concentrations may temporarily stimulate tree growth, recent research suggests a decline in tree vitality and resilience. In this context, forest conservation and adaptation become priorities for mitigating climate change and preserving key ecosystem functions. This study analyses the biological and economic aspects of climate change impacts on Croatian forests, with a focus on the importance of nature-based solutions (e.g., native species conservation, structural and functional diversity) and the legislative framework for adaptation (EU guidelines, national strategies). The need for an integrated approach is emphasized—one that includes continuous monitoring, climate risk assessment, and the adaptation of current forestry practices as a foundation for long-term forest resilience.

Keywords: climate change, forest ecosystems, resilience and vulnerability, adaptation and mitigation

USMENA PRIOPĆENJA

Flora, sistematika, evolucija i filogenija

ORAL PRESENTATIONS

Flora, Systematics, Evolution and Phylogeny

IS *Cirsium greimleri* (ASTERACEAE) REALLY EXTINCT IN CROATIA?

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Cirsium Mill. (Asteraceae) is a widespread plant genus represented by 19 species in the Croatian flora. One of the species was presumed to be regionally extinct, namely *C. greimleri* Bureš. This recently described diploid species of *C.* sect. *Cirsium* occurs in the Eastern Alps and the Dinarides and is distinguished from its close relative Carpathian tetraploid *C. waldsteinii* Rouy in genetics, morphology, and distribution. Fieldwork conducted in July 2023 in the Gorski Kotar region near the Slovenian border not only confirmed the presence of *C. greimleri* in Croatia but also uncovered a new hybrid taxon for the Croatian flora, *C.* × *scopolii* Khek. Both parental species, *C. erisithales* (Jacq.) Scop. and *C. greimleri,* were found at the locality, with the latter represented by over 200 individuals forming a stable population in the ground layer of the beech forest. Hybrid individuals (*C.* × *scopolii*) were confirmed by morphology and by genome size that was intermediate between those of the parental species. These new findings bring the total number of confirmed *Cirsium* taxa in Croatia to 20.

Keywords: *Cirsium* × *scopolii*, Dinarides, hybrids, new taxa, taxonomy

MOLECULAR AND MORPHOLOGICAL ANALYSES REVEAL THE RECOGNITION OF *Campanula brulloi* (CAMPANULACEAE), A NEW SPECIES FROM ALBANIA

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In the context of taxonomic research on *Campanula* Ser. *Garganicae* Trinajstić, a new species is described from central Albania, and here proposed as *C. brulloi*. This isophyllous group of the genus *Campanula* is distributed in the Mediterranean amphi-Adriatic and Ionian territories, and it is represented by chasmophytes often very localized or with a punctiform distribution. Phylogenetic analyses based on nuclear and plastid (ITS and cpDNA) genomes emphasized that *C. brulloi* is well differentiated from other species of this group. Its morphological characteristics of vegetative and reproductive structures, seed testa micromorphology, ecology, distribution and a detailed iconography are also provided. For some peculiarities regarding the habit, leaves and flower, it shows close relationships mainly with *C. debarensis* Rech.f., an endemic species occurring in some localities of Crni Drim canyon in the nearby North Macedonia. However, they differ in relevant features that allow them to be distinguished from a taxonomic viewpoint

Keywords: Balkan Peninsula, *Campanula garganica* complex, new species, taxonomy

ENVIRONMENTAL NICHES BETWEEN PLOIDY LEVELS AND SUBSPECIES OF *Dianthus ciliatus* s.l. (Caryophyllaceae)

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Polyploidisation is a major evolutionary force in flowering plants, often accompanied by niche evolution of polyploids relative to their diploid ancestors. Here, we analyzed the ploidy levels, their geographical distribution and relative genome size variation in three subspecies of the amphi-Adriatic *Dianthus ciliatus* s.l. (Caryophyllaceae). We sampled 84 populations and found 24 diploid (2x) and 60 tetraploid (4x) populations, with the diploids being restricted to the Balkan Peninsula. We then compared the environmental niches between pooled diploid and tetraploid populations and between the three subspecies: *D. ciliatus* subsp. *ciliatus, D. ciliatus* subsp. *dalmaticus,* and *D. ciliatus* subsp. *medunensis*. We tested for niche conservatism, the tendency of polyploids to retain niche traits of their diploid ancestors. We found low overlap between the niches of pooled diploids and tetraploids (26.3%), with the diploid niche almost completely nested within the wider tetraploid niche. Different environmental requirements for each subspecies were suggested by their pairwise comparisons. We did not confirm niche conservatism between pooled diploids and tetraploids. Nevertheless, niche conservatism was significant between diploid and tetraploid *D. ciliatus* subsp. *ciliatus*, suggesting an autopolyploid origin of the tetraploids, with 76% niche expansion relative to the ancestral diploids. Significant niche conservatism was also detected between the diploid *D. ciliatus* subsp. *ciliatus* and *D. ciliatus* subsp. *medunensis*, suggesting their close relationship, whereas niches were not conserved in other pairwise comparisons. Our results suggest an allopolyploid origin of the tetraploid *D. ciliatus* subsp. *dalmaticus*. In conclusion, the dispersal of polyploids to the Apennine Peninsula and their establishment in novel environments was possibly facilitated by their broader niches.

Keywords: niche conservatism, niche overlap, polyploidy, relative genome size

A NEW GENETICALLY AND MORPHOLOGICALLY STENOTYPIC SPECIES OF *Schistidium* FROM NORTH AMERICA RELATED TO TWO SPECIES WIDESPREAD IN EUROPE, INCLUDING THE MEDITERRANEAN, *S. crassipilum* AND *S. helveticum*

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Taxonomy of the genus *Schistidium* has historically been quite conservative, underestimating the genus' true diversity, due to morphological plasticity blurring the species' boundaries. In 1996. H. H. Blom published a revision of the *Schistidium apocarpum* complex, splitting it into numerous species. That work, along with development of molecular techniques, has paved the way for many subsequent discoveries of new *Schistidium* species, as researchers turned their attention to the genus. In our work, we present yet another new *Schistidium* species from the *atrofuscum* clade. It appears to be morphologically similar to *S. crassipilum*, while sequencing of ITS region showed genetical similarity to *S. helveticum*. Interestingly, all samples of the new species appeared to be both morphologically and genetically homogeneous. Its distinct morphological characters, with regard to *S. crassipilum*, are more appressed perichaetial leaves and more longly deccurent hair point on some perichaetial leaves. All of the known localities so far are in the US State of Arizona. Furthermore, unlike other species from the *atrofuscum* clade which prefer calcareous rocks, the new taxon was predominantly collected from siliceous rocks. At the same time, opposed to the new taxon, our data show that *S. crassipilum* and *S. helveticum* are genetically diverse and might be worth reviewing taxonomically considering specimens across their ranges.

Keywords: *atrofuscum* clade, bryophytes, ITS, mosses, substrate differentiation, taxonomy

LOST IN THE PLANKTON: *Entomoneis translucida* SP. NOV., A GHOST DIATOM REVEALED

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Diatoms (Bacillariophyta) are photosynthetic heterokonts with intricately ornamented siliceous frustules. Despite their ecological abundance and diversity across marine, freshwater, and terrestrial habitats, a large fraction of diatom diversity remains unexplored. During phytoplankton surveys in the South Adriatic Sea and the St. Lucie estuary, a lightly silicified, morphologically unusual diatom was observed and three monoclonal strains were isolated into culture. Strains were analyzed using an integrative approach: light and electron microscopy with morphometric analysis, and multigene phylogeny (SSU rDNA, *rbc*L, and *psb*C).
Light microscopy revealed features consistent with the genus *Entomoneis* Ehrenberg, including a panduriform frustule with a winged, bilobate, sigmoid keel, and numerous girdle bands. However, cells displayed multiple plastids—previously not recorded for *Entomoneis* but common in other diatom genera such as *Plagiotropis* (Naviculales, Plagiotropidaceae). These and more detailed electron microscopy discrepancies led to the proposal of a species within the genus: *Entomoneis translucida* sp. nov., named after its hyaline appearance. Morphologically, the most similar species was found to be a hyaline *E. vertebralis*, though the latter possesses only two plate-like plastids. *E. translucida* was also previously observed in the Gulf of Mexico but was incorrectly identified as *Plagiotropis lepidoptera*.
Phylogenetic analyses revealed a paraphyletic *Entomoneis* in SSU and *psb*C, with SSU showing the lowest resolution of the genus and of the *E. translucida* strains, but a monophyletic genus in the *rbc*L phylogeny. Combined gene phylogeny confirmed the monophyly of *Entomoneis* with high node support. *Entomoneis translucida* was distinguished a basal lineage relative to *E. vertebralis* and other lightly silicified planktonic *Entomoneis* taxa, most of which were originally described from the oligotrophic Adriatic Sea. These findings highlight the complex evolutionary history of the genus and the need for broader taxonomic revision.

Keywords: Diatom taxonomy, *Entomoneis*, *Plagiotropis*, multigene phylogeny, microscopy

FILLING THE GAP IN KNOWLEDGE ABOUT STENOENDEMIC *Alyssum pluscanescens* (Raim. ex Jos.Baumgartner) Španiel, Lihová & Marhold

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Alyssum pluscanescens is a perennial herbaceous species belonging to the mustard family (Brassicaceae), with dense stellate hairs covering leaves and giving them a silver-grey appearance. Flowering stems bear racemes of small yellow flowers, which elongate in fruit. It is ecologically specialized to open, calcareous rocky habitats, growing on dolomite outcrops and scree in subalpine areas with only known populations restricted to two localities in Slovenia and Croatia, reflecting an extremely narrow biogeographical range. In these sparsely vegetated habitats, *A. pluscanescens* functions as a pioneer species that colonizes shallow soils and crevices, contributing to early successional plant communities. However, it is a poor competitor and both habitat degradation and overgrowth by successional vegetation has led to declines in population size and habitat quality. Previously described as a subspecies of *A. montanum*, recent integrative studies recognise it as a separate species, demonstrating clear morphological and genetic divergence from its relatives. It is a hexaploid species whose origin is hypothesized to involve allopolyploid hybridization of previously isolated lineages – a phenomenon observed in several Balkan endemics. Since 2016, when the population of *A. pluscanescens* in the only Croatian locality was estimated, significant reduction in the number of individuals has been observed. This underlines the species' conservation importance and the need for further studies on its ecology and long-term viability. In previous investigations of *A. montanum* in Central Europe, morphometric analysis included individuals of *A. pluscanescens* from Slovenia only. Based on the samples collected this year from Croatian locality, this study of morphological characteristics has shown significant deviations in number of trichomes as a crucial determining factor (over 50% less per unit of leaf area), compared to the data available in relevant identification keys.

Keywords: Brassicaceae, endemic pioneer species biogeographical range, morphology, population decline

HYBRIDIZATION DYNAMICS IN CROATIAN PEAR SPECIES: GENETIC INSIGHTS AND CONSERVATION CHALLENGES

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The genus *Pyrus* L. exhibits high interspecific compatibility, facilitating both natural and artificial hybridization, which has played a significant role in shaping its evolutionary history and genetic diversity. This study examines hybridization patterns among *Pyrus* species in Croatia, focusing on interactions between cultivated and wild pears, as well as between two sporadically sympatric wild species: the European wild pear (*Pyrus pyraster* (L.) Burgsd.) and the almond-leaved pear (*P. spinosa* Forssk.). Genetic analyses were conducted on a sample of 740 individuals using nine pear-specific microsatellite markers. The results confirmed the presence of 14 hybrids between the European wild pear and almond-leaved pear, all located in sympatric zones within the Istrian Peninsula and Dalmatian hinterland. In addition, in areas where cultivated and wild pears coexist, 45 hybrids between the cultivated pear (*P. communis* L.) and the European wild pear, along with 10 hybrids between the cultivated pear and the almond-leaved pear, were identified. Hybrid individuals were not always morphologically distinguishable, exhibiting a range of traits, some intermediate, others cryptic due to unilateral trait dominance. The difference in hybrid frequency between the two wild species and cultivated pears likely reflects regional agricultural practices, with the European wild pear being more frequently exposed to cultivated pear orchards in continental Croatia. This hybridization presents both risks and opportunities. While gene flow from cultivated pears may alter the genetic structure of wild populations, it also enhances genetic diversity and introduces beneficial traits for breeding programs. This dual impact underscores the importance of monitoring and managing hybridization to conserve wild gene pools while exploring their potential for fruit crop improvement. These findings highlight the need for targeted conservation strategies for wild pear populations, particularly in the context of ongoing habitat disturbances driven by climate change.

Keywords: cultivated-to-wild gene flow; genetic introgression; microsatellites; pomaceous species; sympatric hybrid zones

THE FLORA OF THE ISLAND OF IŽ (ZADAR ARCHIPELAGO, CROATIA)

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Iž is a small island of Zadar archipelago with an area of 16.51 km² and its highest point at 168 meters above sea level. Prior to recent studies, its flora remained largely unexplored. Our research was conducted between 2016 and 2025. We identified 470 wild plant species and approximately 120 plant species cultivated on the island. Among the introduced plants, around 50 species are adventive, with some plants showing potential invasiveness and 16 invasive plant species were recorded. The representation of plant families corresponds closely to that in the Croatian flora overall, with most taxa belonging to Fabaceae (55), Poaceae (50), and Asteraceae (50). We documented 11 species from the Orchidaceae (e.g., *Ophrys rhodostephane*), along with several rare (e.g. *Cytinus hypocistis* ssp. *clusii*) and endemic species (e.g., *Hypericum spruneri*), which are not recorded on neighbouring larger islands. These findings reflect the rich and diverse flora of Iž Island, which has persisted despite centuries of human influence. The presence of rare and endemic species highlights the ecological significance of islands within the Adriatic region.

Keywords: diversity, eastern Adriatic, invasive, Mediterranean, vascular plants

USMENA PRIOPĆENJA

Edukacija, promocija i profesionalne aktivnosti

ORAL PRESENTATIONS

Education, Promotion and Professional Activity

BRIOŠKOLA AND PTERIDOŠKOLA – EDUCATIONAL AND POPULARIZATION BOTANICAL PROJECTS

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Brioškola is a project aimed at introducing interested students to bryophytes and was held in October 2024 at the Botanical Division of the Biology Department of the Faculty of Science, University of Zagreb and Risnjak National Park. The lecturers on the project were eight bryologists from Croatia, Serbia and Slovenia. Also, as part of this project, a collection of 40 bryophyte samples of different species was created and a lecture and educational workshop were held for interested students and teachers within the Center of Excellence for Biology of Varaždin County. Pteridoškola is a project aimed at introducing interested students to ferns and was held in March 2025 at the Botanical Division of the Biology Department of the Faculty of Science, University of Zagreb, the Herbarium Croaticum herbarium collection and the Medvednica Nature Park. Six botanists have presented the world of ferns from different aspects. Around forty interested students participated in both projects, who revealed through feedback that they were delighted to participate in the projects and expressed enthusiasm for learning about the secrets of the plant kingdom.

Keywords: ferns, Medvednica, bryophyte, Risnjak, students

FLORA CROATICA DATABASE IN ITS PRIME – NEWS AND UPDATES

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Established in early 1990s with numerous upgrades since, *Flora Croatica Database* was gradually shaped into the widely nationally and internationally recognized botanical compendium, as well as relevant and highly cited source of verified botanical data on national and regional floras. It nowadays represents the life work and scientific passion of professor Toni Nikolić from the University of Zagreb who has, along with numerous contributors, created this interactive, multi user online database designed for collecting, storing, processing, assaying and mapping of diverse data on the Croatian flora. Nowadays the database is fully web-oriented and strongly supported by GIS tools in spatial data display and analysis. It consists of several modules to encompass the taxonomy, systematics, distribution, threat status and conservation, allochthonous status, economic usage of flora, photo gallery etc., while storing the data on plant occurrences from several herbaria, published literature and unpublished field observations. The database is maintained by professional botanists from different institutions to ensure professional quality, while its users are a wide range of individuals, public institutions, museums, educational system institutions, scientific institutions and private companies, with bilateral agreements based on fair participation in data acquisition and sharing. Although initially oriented exclusively toward vascular plants, in the last years the database attempted to host several new plant groups, starting with complete herbarium-and literature-processed bryophyte database. More recently, taxonomic backbone has been established for algae and lichens, leading to distribution data inclusion in the prospective. Most recently, in collaboration with the Ministry of Environmental Protection and Green Transition, a comprehensive revision with significant improvements and updates has been made in the modules Allochthonous plants and The Red book. The most current initiative toward linking *Flora Croatica Database* with the *Global Biodiversity Information Facility* (GBIF) and *Biodiversity Atlas of Croatia* (BioAtlas) in terms of reciprocal data contributions has come to its decisive phase.

Keywords: botanical compendium, FCD, GBIF, national flora, vascular plants

STUDENTS' VIEWS ON PLANTS AND SCHOOL BOTANY

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The aim of our survey was to examine students' attitudes towards plants and school botany. A total of 1,732 respondents participated in the survey (1,166 elementary school, 469 high school and 97 university students). Statistical analysis was performed by the *Jamovi* 2.3 program. The first part of the survey analyzed attitudes towards plants, content about plants in school, content of biology courses and attitudes towards biology teachers. The second analysis referred to the interest in certain biological disciplines and the content of botany, while in the third part respondents were asked to make suggestions for more interesting school botany. The most important results of the first part of the research showed that students are most aware of the importance of knowledge and content of botany and biology, and that elementary school students give the highest marks to their biology teachers, while high school students give their biology teachers the lowest marks.
From the second part of the survey, it is evident that high school students are most interested in human biology, and the least interested in botany, and that elementary school students are most interested in zoology, and the least interested in cell biology. When asked what they would exclude from school botany content, high school students and undergraduate and graduate university students would first exclude plant evolution, and elementary school students would first exclude the structure of plant organs. This clearly indicates that the approach to the school treatment of these important botanical topics needs to be changed. However, it is interesting that university students consider knowledge of plant determination to be an important content of botany. When asked about the improvement of teaching about plants, the majority of all students suggested including more field works and workshops in nature, which should be a guideline in the future botany curriculum.

Keywords: students' interest in botany, questionnaire, botanical concepts

150 YEARS OF DIVISION OF BOTANY, DEPARTMENT OF BIOLOGY, FACULTY OF SCIENCE AT UNIVERSITY OF ZAGREB

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The modern University of Zagreb was officially established on 19 October 1874, comprising three founding faculties, including the Faculty of Philosophy, which housed the Department of Mathematics and Natural Sciences. Within it, the Department of Botany and Physiology marked the beginning of institutional botanical education and research in Croatia. The first professor, Bohuslav Jiruš, played a key role in founding and equipping the department, delivering the first lectures in botany in the spring of 1876. This marked the start of a continuous 150-year tradition of botanical teaching, research, and public engagement, now continued by the Division of Botany within the Department of Biology at the Faculty of Science. Over the decades, many prominent Croatian botanists have contributed to the development and reputation of the Division. Among them was Professor Antun Heinz, who in 1889 established the Botanical Garden, which has remained an integral part of the Division's academic and public mission. This tradition was carried forward by distinguished scients such as Prof. Vale Vouk, Prof. Ivo Horvat, Prof. Stjepan Horvatić, and many others, whose contributions significantly influenced the botanical field both nationally and internationally. The lecture will provide an overview of the most important historical milestones, focusing on the succession of leading professors who helped shape the Division's scientific and educational path. It will explore the evolution of the Division's structure, scientific focus, and broader societal role. Special emphasis will be placed on the enduring connection between the Division and the Botanical Garden, which together represent a vital center for botanical research, biodiversity conservation, and science communication in Croatia. This historical reflection aims to celebrate 150 years of continuous progress and lasting impact.

Keywords: botany, higher education, history, teaching

LAUNCHING A LICHEN MODULE IN THE FLORA CROATICA DATABASE

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The Flora Croatica Database (FCD) is a vital tool for botanical research and biodiversity conservation in Croatia. Acknowledging the ecological significance of lichens, we are excited to introduce a new lichen module within the FCD. This expansion includes around 20,000 entries, providing comprehensive coverage of Croatia's lichen diversity and addressing the need for enhanced lichenological data for research and conservation. Almost all known literature references as well as preserved specimens from numerous herbaria are part of the dataset. Most of the data was sorted and georeferenced by Siniša Ozimec and Dragan Prlić during the *EU Natura 2000 integration project* (NIP) between 2012 and 2015, and also for the purpose of master thesis by Azra Mehmetović named *An inventory of the lichen diversity of Croatia* in 2019. Each entry in the module offers both the original name and the most recent taxonomy, together with distribution maps, conservation status, encompassing lichenized fungi (lichens s.str.), lichenicolous fungi, non-lichenized or doubtfully lichenized fungi, doubtful records and poorly known taxa. This approach supports academic researchers and conservation practitioners alike, promoting an integrated understanding of lichen diversity. By adding this module, the FCD proves as a leading resource in the region for botanical research and natural resource management. It aims to stimulate further lichenological studies and contribute to the preservation of Croatia's natural heritage through improved understanding of ecological dynamics. This initiative not only advances botanical knowledge but also emphasizes the importance of a comprehensive biological database for informed conservation and research efforts. We encourage the scientific community to engage with this valuable resource and participate in its continued development.

Keywords: lichenized fungi, lichenology, natural resource management, taxonomic information

USMENA PRIOPĆENJA

Konzervacijska biologija i urbana ekologija

ORAL PRESENTATIONS

Conservation biology and urban ecology

NEW RECORDS ON DISTRIBUTION OF TARGET HABITATS AND THREATENED PLANTS IN NATURA 2000 AREAS IN THE CROATIAN DANUBE REGION

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The ecological network Natura 2000 in Croatia covers 37% of the land territory, and includes 822 sites: 40 special protection areas (SPAs) under the Birds Directive and 782 sites significant for the conservation of wild species and natural habitats (SCIs/SACs) under the Habitats Directive. The Danube River in part of its middle course flows throughout Croatia, in length of 137.5 km. The Croatian Danube Region includes two easternmost counties, Osijek-Baranja and Vukovar-Srijem. Field activities in monitoring of target and priority habitat types and floristic inventory were carried out in period from March to September 2024, within four SCIs: HR2001309 Dunav S od Kopačkog rita; HR2000394 Kopački rit; HR2001308 Donji tok Drave; HR2000372 Dunav-Vukovar, HR2000573 Petrijevci; HR2001500 Stepska staništa kod Bapske, HR2001501 Stepska staništa kod Opatovca. Total of five Natura 2000 target habitat types had been surveyed: freshwater habitats (3130, 3150, 3270), and natural and semi-natural grasslands (6250, 6440). New localities were discovered for distribution of habitat types 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoëto-Nanojuncetea* in SACs HR2001309 Dunav S od Kopačkog rita and HR2000372 Dunav-Vukovar. During the floristic inventory, occurrence and new localities were recorded for many threatened and rare species in the flora of Croatia, particularly: *Agropyron cristatum* ssp. *pectinatum*, *Cyperus fuscus, Cyperus glomeratus, Cyperus michelianus, Digitalis lanata, Hippuris vulgaris, Kitaibela vitifolia, Lilium martagon, Limosella aquatica, Lindernia procumbens, Lythrum tribracteatum, Marrubium peregrinum, Marsilea quadrifolia, Polygonatum latifolium, Salvia nemorosa*, *Xeranthemum cylindraceum,* and *Xeranthemum annuum*. Broadened knowledge on distribution of Natura 2000 target habitat types, and threatened and rare plant species, contributes to planning of the conservation and restoration measures in the surveyed Natura 2000 sites in the Croatian Danube region.

Keywords: ecological network, freshwater habitats, dry grassland, red list species

RED LISTS OF BRYOPHYTES OF SERBIA

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The new red lists of hornworts and liverworts, and mosses of Serbia were published last year. This work was inspired by the red list of European bryophytes published in 2019 and based on a huge amount of data accumulated in the last decades in Serbia and in the neighbouring countries. As an example between 2000 and 2018 the Hungarian Natural History Museum in cooperation with the Botanical Institute and Botanical Garden of Belgrade organised fourteen field trips in Serbia, which resulted with 5300 specimens deposited in the Herbarium of HNHM, Budapest and 136 species (38 liverworts and 98 mosses) were added to the Serbian bryophyte flora based on these collections. The Serbian bryophyte red lists give a very good overview of the threat status of the species in the region. 134 hornwort and liverwort taxa and 640 mosses were assessed. The total number of liverwort taxa under threat (CR-critically endangered +EN-endangered +VU-vulnerable) is 53, which means 39.5% of the whole liverwort flora of the country. The total number of moss taxa under threat is 174, representing 27.18% of the Serbian moss flora. In spite the enormous increase of the quantity of recent data, there are still a high number of species in the DD – data deficient category, 11.2% of liverworts and 20.15% of mosses. These are mainly the species which have only historical data without any confirmed recent (after 1990) occurrence. The Serbian bryophyte red lists can promote similar projects in other Balkan countries and highlight the need for conservation efforts for this plant group, particularly in the light of rapid environmental and climate changes.

Keywords: extinction risk, hornworts, liverworts, mosses, threat

DEVELOPING SPECIES-SPECIFIC MONITORING FRAMEWORKS FOR CONSERVATION REPORTING IN CROATIA

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Within the framework of the Operational Programme Competitiveness and Cohesion (OPCC) project "Development of a Monitoring System for the Conservation Status of Species and Habitat Types", species-specific monitoring programmes were developed for plant species of conservation interest in Croatia. This paper focuses on six selected species: *Aquilegia kitaibelii*, *Cerastium dinaricum*, *Cypripedium calceolus*, *Eleocharis carniolica*, *Gentiana lutea*, and *Serratula lycopifolia*. The main objective was to design and implement monitoring protocols for evaluating the conservation status of these species, in line with the requirements of Article 17 of the EU Habitats Directive (92/43/EEC). The work provides an overview of the recent range, population, habitat for species and distribution of the selected species and outlines the monitoring methodology developed to assess key parameters. Monitoring protocols were developed and harmonised with national and EU-level guidelines as part of the project itself, which included the standardization of field data collection procedures. Field surveys were carried out using these newly developed standardized methods at specific locations, and georeferenced reference grid squares, based on the HTRS coordinate system. Special attention was given to the methodological challenges associated with estimating population size, particularly with regard to differing reporting requirements, whether as the number of individuals or spatial units (e.g., 1×1 km grid cells). These challenges informed the choice of sampling strategies and evaluation metrics in each protocol. In addition to biological and ecological assessments, the monitoring programmes systematically identified key anthropogenic pressures and threats relevant to each species. Based on these insights, targeted and evidence-based conservation measures were proposed to address species-specific vulnerabilities. The implementation of harmonised protocols and standardized field surveys has established a solid foundation for long-term trend analysis, enabling consistent evaluation of conservation status. By integrating recent field data, the monitoring significantly improves the understanding of the current status of the selected species.

Keywords: EU Habitats Directive, Natura 2000, plant species monitoring, population size

ORNAMENTAL PLANTS AS A SOURCE OF INVASIVENESS: FIRST-YEAR RESULTS OF THE LIFE ORNAMENTALIAS PROJECT IN CROATIA

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Aiming to prevent the spread of ornamental invasive alien plant species, the LIFE OrnamentalIAS project identifies key entry points and raises awareness among stakeholders to support early intervention. During the first year of implementation, two key activities were conducted: the inventory of ornamental plant taxa available on the market and the inventory of public and private green areas in Northwestern Croatia. The objective of these activities was to determine the range and presence of ornamental taxa with invasive potential. The inventory of 15 garden centres revealed that 74% of the total plant assortment offered in the surveyed garden centres/nurseries consists of alien taxa. The assessment of this part of the Croatian market showed that, in general, ornamental plants listed as invasive at the EU level are not commercially available. However, cultivars of certain invasive species claimed to have lost their invasive characteristics are present, which, due to cultivation practices and dispersal mechanisms, may warrant further discussion. The inventory of green areas includes data from 52 private gardens and 32 public green areas. It has confirmed the extensive use of alien ornamental plants, some of which display signs of spontaneous spread. In total, 1142 plant taxa were recorded: 545 in public areas and 1002 in private gardens. Regarding origin, 73% of the recorded taxa are alien taxa. These findings highlight the importance of promoting the use of native species, given their multiple benefits for biological and landscape diversity. Preliminary results indicate a strong link between the commercial availability and occurrence of alien taxa in cultivation, emphasizing the need for early intervention. Data collected provides a foundation for future monitoring, supports the development of risk assessment tools, and guides communication strategies targeting both the general public and professionals in the horticultural sector.

Keywords: garden centers, inventory of IAS, prevention, public and private areas.

FIRST NATIONAL IUCN ASSESSMENT OF SOME RARE AND ENDEMIC PLANTS FROM GALICHICA NP IN THE REPUBLIC OF NORTH MACEDONIA

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This study aimed to assess the national conservation status of several rare and endemic plant species from Galichica National Park, Republic of North Macedonia. The species investigated include *Dianthus galicicae* Micevski, *Centaurea galicicae* Micevski, *Centaurea soskae* Hayek, *Angelica palustris* Hoffm., *Rindera graeca* (DC.) Boiss. & Heldr., and *Helichrysum zivojinii* Černjavski & Soška. The threat status and assessment criteria were applied in accordance with the latest IUCN Red List methodology. Based on the applied criteria, *Dianthus galicicae* and *Angelica palustris* were assessed as Critically Endangered (CR), while *Centaurea galicicae, Centaurea soskae, Rindera graeca,* and *Helichrysum zivojinii* were categorized as Endangered (EN). The main threats identified include limited geographic distribution, habitat degradation, and human-induced disturbances. These findings emphasize the urgent need for immediate and sustained conservation actions, including habitat restoration and species protection measures. Furthermore, the study underscores the importance of this assessment as a critical step in establishing effective management strategies and informing policy decisions aimed at preserving the region's unique biodiversity.

USMENA PRIOPĆENJA

Ekologija, biogeografija, vegetacija i klimatske promjene

ORAL PRESENTATIONS

Ecology, Biogeography, Vegetation and Climate Change

SPATIAL DISTRIBUTION OF PRIMARY PRODUCTION DURING SUMMER AT LASTOVO ISLAND, SOUTH ADRIATIC

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Internal island-trapped waves (ITWs) are generated around Lastovo Island in the summer, causing vertical displacements of the thermocline up to 30 m, which can modify the stratification of the water column. ITWs could affect primary production by facilitating the transport of nutrients from deeper layers of the water column to the euphotic zone and bringing phytoplankton closer to the surface where they are exposed to higher light intensities. To estimate ITW impact on primary production, six *in situ* ^{14}C primary production experiments were conducted at Lastovo and Korčula Islands. During the incubation period, concurrent sampling of nutrients and chlorophyll *a* as well as temperature and light intensity measurements were performed. *In situ* data were supplemented by model and remote sensing data. Vertical profiles of daily net primary production at depth (P_T (z)) and daily depth-integrated water column primary production ($P_{Z,T}$) were determined from *in situ* data, while the spatial distribution was examined using model and remote sensing data. At Lastovo Island, $P_{Z,T}$ was significantly higher when compared to Korčula Island. Regarding ITWs, increased nutrient concentrations and P_T (z) were observed at thermocline depths. The spatial distribution of primary production at Lastovo Island was heterogeneous, with the highest production occurring in the southern part of the island. This suggests that observed spatial pattern is controlled by the phase relationship between ITWs and the light cycle. In conclusion, primary production at Lastovo Island exhibits heterogeneous distribution during summer stratification, with a significant response to ITWs in the thermocline layer particularly related to changes in nutrient concentrations and light availability.

Keywords: ^{14}C incubations, internal island trapped waves, models, remote sensing

IMPACT OF DESERT DUST DEPOSITION ON THE BIOLOGICAL PRODUCTION IN THE ADRIATIC

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Airborne dust originating from desert regions is one of the most prevalent types of aerosols, with significant impacts on the climate. Estimates of dust emission, transport, and deposition mostly rely upon satellite data and numerical simulations. MERRA-2 is a reanalysis aerosol data set based on the assimilation of satellite and ground-based aerosol optical depth measurements in the numerical model. For the first time, this reanalysis data was used to investigate the impact of dust on biological response in marine systems in the Adriatic Sea. First, a climatological analysis of deposition for the period 1989–2019 was conducted. Although such events are sporadic, the existence of an annual deposition cycle was shown, with a stronger peak in spring and a weaker one in autumn. The EOF method applied to the geopotential height at 850 hPa indicated two dominant synoptic situations associated with deposited dust mass. The deep Sharav cyclone, formed in the lee of the Atlas Mountains due to a thermal gradient, travels eastward along the African coast and typically brings dust in spring. The second situation involves an upper-level trough transporting Saharan dust in a southwesterly flow. The impact of dust deposition on primary production was observed through high oxygen saturation levels of up to 250% in the stratified middle water layer of the Rogoznica Lake marine system during intense wet deposition episodes. Dust sources relevant to the Adriatic can occasionally extend beyond the Sahara. The primary goal of further research is to examine the behaviour of the synoptic patterns related to the dust transport under climate change.

Keywords: EOF, MERRA-2, Oxygen Saturation, Rogoznica Lake

WHAT THE SEA TAKES, PEOPLE SHOULD GIVE BACK: EMBRYONIC DUNE RESTORATION ON MLJET ISLAND

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Embryonic coastal dunes are one of the rarest and most endangered habitats in the Mediterranean region of Croatia. These are the initial stages of dune formation, consisting of small sand accumulations or raised sandy areas in the upper part of the beach. Such habitats are home to specialized plant species that are adapted to very specific ecological conditions — mobile substrates, salty sands, dryness and nutrient-poor soils. Psammohalophytes — sand-dwelling halophytic plants — thrive in these extreme conditions, including several species that are strictly protected in Croatia, such as *Pancratium maritimum* (sea daffodil), *Calystegia soldanella* (beach morning glory) and *Elymus farctus* (russian wheatgrass). The Croatian coast is naturally poor in sandy beaches, and under the increasing pressure of urbanization, intensive tourism and climate change, which brings ever more destructive storms, the coastal dunes have little chance of spontaneous recovery. These sensitive ecosystems are under constant stress: trampling, sand deposition, construction and vegetation removal quickly destroy their structure, while extreme weather conditions further exacerbate the situation. The restoration of embryonic dunes is therefore becoming an increasingly important tool for the conservation of biodiversity and the protection of coastal ecosystems. This work presents the planned restoration measures for three beaches on the island of Mljet, which aim to restore the natural structure and function of coastal dunes. Key measures include the removal of damage caused by human activity, installation of protective fencing to prevent trampling, the removal of woody vegetation to maintain habitat mobility and the development of a monitoring plan to track the effectiveness of these measures. In addition, public education will play a crucial role in raising awareness of the importance of dune protection. Given the challenge of reconciling nature conservation and tourism use of coastal areas, such initiatives are an important model for the integration of nature conservation and sustainable coastal management.

Keywords: Coastal dunes, Psammohalophytes, Restoration, Monitoring, Coastal management

AQUATIC VEGETATION OF EASTERN SLAVONIAN WATERCOURSES: DIVERSITY AND ECOLOGY

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Eastern part of Slavonia (Croatia), situated between the rivers Sava and Drava and bordered by the Slavonian hills on the west, the Danube on the east, is part of the Pannonian ecoregion characterized mostly by small to moderately large lowland rivers and canals. Here we present a review of these watercourses regarding their macrophyte flora and physico-chemical parameters. The data was collected from 2016 to 2024 during the Water Framework Directive monitoring. In total, 65 sampling sites on 40 watercourses were visited (most of them multiple times) and 140 sets of vegetation surveys were performed and analyzed. Out of 76 recorded macrophyte species, the most frequent were *Lemna minor* (94% of sampling sites), *Spirodela polyrhiza* (75%), *Ceratophyllum demersum* (69%) and *Sparganium erectum* (69%). Species indicative of eutrophic conditions were dominant (frequency of 94.3%) in the survey. Most species were diagnostic for vegetation classes *Phragmito-Magnocaricetea* (44.8%), *Lemnetea* (30.7%) and *Potamogetonetea* (20.2%). Four endangered, three vulnerable, five strictly protected and three invasive alien species were recorded. When compared with the remaining sampling sites in the Pannonian ecoregion, there is a significant increase in the average annual values for multiple parameters indicating eutrophy (e.g. electrical conductivity and total phosphorus). Total phosphorus seems to be the main driver of eutrophication since no nitrogen compounds showed significant mean value difference between the two regions.

Keywords: Eastern Croatia, eutrophication, macrophytes, water bodies

COORDINATED POTENTIAL VEGETATION PREDICTION IN CONTINENTAL CROATIA AND HUNGARY

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Potential natural vegetation and potential replacement vegetation estimations (called PV jointly further on) provide both insight into the drivers of the distribution patterns of (semi)natural vegetation types and present a vital basis for sustainable planning of ecological restorations. PV effectively expresses the self-sustainability of a vegetation type given the abiotic conditions of a certain location. Model-based estimations are powerful means of providing PV estimates. We apply a machine learning method: gradient boosting models to estimate multiple potential vegetation (referred to as MPV together). MPV represents PV as a probability distribution making suitability maps of individual vegetation types comparable.

Joining the territory of Hungary and continental Croatia has been exploited in three ways: (1) MPV models trained on Hungarian data were applied to a study area including part of continental Croatia as a transferability test, (2) MPV in continental Croatia (and neighbouring areas) and Hungary was modelled together, (3) A new project has been launched to jointly model PV for the present and future along the broader Danube and Sava river corridor.

Existing results point to models of forest habitats being sufficiently transferable between the two country, thus additional training data has less influence. At the same time, estimations by models of herbaceous types were less successful and thus call for modelling based on extended training data including those from continental Croatia.

In conclusion, considering full range of distribution of vegetation types beyond borders benefits model transferability and provides basis for coherent restoration practices.

Keywords: ecological sustainability, habitat suitability, modelling, restoration planning, transferability

MAPPING OF NATURA 2000 HABITAT TYPE 6210 (DRY CONTINENTAL GRASSLANDS) USING UAS AND LiDAR

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Dry continental grasslands (Natura 2000 habitat type 6210) are ecologically significant habitats that contribute substantially to the biodiversity of Učka Nature Park. Of the nine grassland phytocoenoses identified within the Park, only *Gladiolo illyrici-Molinietum litoralis* aligns with habitat type 6210. This community is currently limited to two known localities: Sopaćica and Vela Sapca.
The objective of this study was to conduct a detailed spatial assessment of habitat 6210, with an emphasis on mapping extent, condition, and successional status using high-resolution remote sensing data. We employed an Unmanned Aerial System (UAS) to collect RGB imagery, enabling visual identification of grasslands based on their unique spectral characteristics. Polygon delineation was primarily driven by this spectral signature, and further refined through microrelief analysis derived from a photogrammetrically generated Digital Elevation Model (DEM), capturing microtopographic features indicative of habitat type 6210.
To assess successional processes, we integrated LiDAR-derived Canopy Height Models (CHM) to classify vegetation into three structural categories: grassland (<0.3 m), shrubland (0.3–5 m), and woodland (>4 m). This enabled the production of a high-resolution succession intensity map (10×10 m), providing insights into spatial patterns of habitat change.
Findings indicate a high degree of habitat fragmentation and degradation at the Sopaćica site, where 53% of grassland polygons were assessed as being in poor or very poor ecological condition. In contrast, the Vela Sapca site retains greater habitat integrity, with approximately 40% of polygons in good or excellent condition.
This study underscores the utility of integrating drone-based RGB imagery and elevation models for fine-scale habitat mapping and monitoring. The approach offers a robust toolset for conservation planning, particularly for habitats undergoing rapid change due to succession and land-use pressures.

Keywords: Habitat Condition Assessment, Succession, RGB imagery, Canopy Height Models, Grasslands.

A DECADE OF VEGETATION CHANGE: TRACKING BIODIVERSITY LOSS IN DRY GRASSLANDS OF PSUNJ MT.

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Dry and semi-dry grasslands of the *Festuco-Brometea* class represent one of the most endangered habitat types in continental Croatia, primarily due to the abandonment of traditional agriculture, which leads to overgrowth and succession into forest communities. These grasslands are important for their high biological diversity, including numerous rare and protected plant species, and they play a crucial role in ecosystem conservation. To deepen the understanding of floristic and ecological changes in dry grassland habitats over time, a study of vascular flora at various successional stages was conducted on the eastern slopes of Psunj. Fieldwork was carried out on the same plots that were surveyed ten years earlier, allowing for more accurate comparison and monitoring of vegetation cover changes over time. The research employed the standard Central European phytosociological method according to Braun-Blanquet, through which relevés were made and analyzed on a total of 12 plots distributed across different successional stages. A total of 170 plant taxa were recorded, with the most represented families being Fabaceae, Poaceae, Rosaceae, Asteraceae, and Lamiaceae. The highest diversity was observed in the first and second successional stages, represented by grassland and mosaic habitats. The comparison of old and new phytosociological relevés at the same locations showed a trend of successional processes toward forest communities, indicating that adequate management measures have not been implemented over the past ten years. The results point to the need for active management and the implementation of conservation measures for grassland habitats in order to prevent the loss of biological and landscape diversity.

Keywords: vegetation succession, habitat conservation, *Festuco-Brometa*, relevés

CROATIAN PEATLANDS ON THE VERGE OF DISAPPEARANCE? RESULTS OF AN EXTENSIVE CONSERVATION STATUS ASSESSMENT

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Peatlands rank among the most endangered ecosystems in Europe, with unsustainable land use and climate change considered to be the major drivers of their decline in recent times. Although they are priority habitats for conservation from the global standards (e.g., Ramsar convention) to more local policies (e.g., EU-based Natura 2000 network), there is still a general lack of comprehensive and comparable baseline data on their extent and current status in most European countries. Originating from the late glacial period, Western Balkans peatlands are relict habitats close to the southern edge of peatland distribution in Europe, where they cover small and highly fragmented areas. Croatia is listed among the European countries with the highest proportion of degraded peatland even though more than 75% of national peatlands are included in protected areas. To support effective conservation and management efforts for these vital habitats, we provided a detailed overview of habitat features, plant communities, and the main threats facing the 17 largest and most extensively researched peatlands in Croatia. We also evaluated the conservation status of each peatland and analyzed their similarities in habitat condition, threat levels, and current management practices. Our research reveals that nearly two-thirds of the examined peatlands are in a severely unfavorable state, with transition mires being particularly vulnerable to advanced vegetation succession and hydrological degradation, often driven by artificial drainage. In several Croatian peatlands, these issues have already led to the loss of characteristic plant species and communities. Based on our findings, we recommend general strategies for active peatland conservation, such as enhancing water retention, controlling vegetation succession, and reducing human impacts. However, targeted site-specific management initiatives will be crucial for ensuring the long-term survival of peatland habitats in Croatia.

Keywords: climate change, management practices, plant communities, protected areas, transition mires

USMENA PRIOPĆENJA

Biljke i društvo

ORAL PRESENTATIONS

Plants and society

NATURAL TEXTILE DYES EXTRACTED FROM MADDER (*Rubia tinctorum* L.)

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Modern life and industry require the development of environmentally friendly and sustainable processes in all areas of human activity, including the textile industry. In response to this demand, natural dyes, which had fallen into obscurity at the end of the 19th century, have gained popularity as an acceptable alternative to synthetic dyes. The applicability of natural dyes for dyeing textiles is increasingly being investigated, particularly due to their biodegradability, benefits to human health and current fashion trends. In addition, scientific research in the field of natural dyes is extremely important for archaeology and the conservation and restoration of textiles. This applies in particular to the natural dye obtained from roots of madder (*Rubia tinctorum* L.), which was of great historical importance for obtaining red colors. The dye obtained from *R. tinctorum* belongs to the group of mordant dyes, as the chemical structure of the main pigment is alizarin, which forms metal complexes of different colors with mordants (metal ions) with which the textile was previously treated. In this study, wool and silk fabrics were dyed at different pH values and with different mordants (without mordant, with aluminium, copper and iron). After dyeing, the color parameters of the dyed samples were determined spectrophotometrically. A washing and sunlight fastness test was carried out and the color difference was determined spectrophotometrically. By dyeing wool and silk with different process parameters, a wide range of red shades with h° values from 30° (red part of the spectrum) to 70° (yellow part of the spectrum) was obtained. By combining different brightness and chromaticity, wool and silk textiles in shades of orange, pink, red and burgundy were obtained with satisfactory fastness, ready for the challenges of the market.

Keywords: natural dyes, mordant, alizarin, textile, *Rubia tinctorum* L.

BOTANICAL ILLUSTRATION: WHEN ART MEETS SCIENCE

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Long ago, in the ancient world, stylized plants and flowers were not merely decorative motifs adorning the walls of temples and tombs—they represented accurate records of specific plant species, the early beginnings of what we now know as botanical illustration. Since then, botanical illustration has undergone a significant transformation: once monochromatic symbols have evolved into meticulously detailed drawings of scientific precision. Botanical illustration is, in fact, a discipline that unites art and science into an inseparable whole. As a complement to herbarium specimens, it provides a detailed depiction of a species, whether as a pen-and-ink drawing or an intensely colored watercolor, emphasizing and "revealing" hidden features in a format that is easily legible to the human eye. When combined with the herbarium, such illustrations breathe life into dried plant materials, granting them a sense of three-dimensionality and enabling observers to better visualize the living specimen. The illustrator, in essence, translates the botanist's description into a visual language. While digital photography has come to play an important role over time, it cannot present complex, intertwined structures in a visually comprehensible way, nor can it reconstruct a realistic depiction of a plant from a pressed herbarium specimen. Although illustrators now increasingly rely on digital research materials and use computers to create digital illustrations, the decision-making process behind every aspect of the illustration still resides in the mind of the illustrator. Whether working with pen and ink or a digital drawing, the tools move solely under the artists guidance. Illustrators adapt media, presentation, and drawing styles to reflect current trends in scientific writing and to facilitate the documentation of scientific literature. Attention to accuracy is essential, but excellence in style and technique is precisely what challenges modern technology and all of its "advantages."

Keywords: botanical illustration, fine art, modern technologies, traditional techniques

USMENA PRIOPĆENJA

Fiziologija stresa, anatomija i morfologija

ORAL PRESENTATIONS

Physiology of stress, anatomy and morphology

ASSESSMENT OF HEAVY-METALS CONTAMINATED MICROPLASTICS AND WEAR TYRE MIXTURE ON DUCKWEEDS

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Microplastics are complex pollutants that are ubiquitous in marine, freshwater, and terrestrial environments. Furthermore, they are influenced by various biotic and abiotic factors that can alter their properties and environmental toxicity. This study examined the influence of 1) pristine microplastics (a mixture of polyethylene, polystyrene, polypropylene) and rubber microparticles (MPs), and 2) MPs contaminated with heavy metals (Cu, Pb, Zn), on the growth rate, physiological (photosynthetic pigments) and biochemical (malondialdehyde, carbonyls, superoxide dismutase, ascorbate peroxidase, catalase, glutathione-S-transferase) stress indicators of *Lemna minor* L. Both treatments were applied in the concentration range 20-10,000 pcs MPs/L (0.15-74 mg/L) for seven days. The leaching of Cu and Pb from the pristine and contaminated MPs surface into the nutrient medium was demonstrated. However, only Cu accumulated significantly in duckweeds exposed to the highest concentration of both treatments compared to the control. Irrespective of the treatment, polypropylene MPs were adsorbed on duckweed leaves in the highest percentage compared to other MPs. Both pristine and contaminated MPs did not significantly affect the growth rate. Also, they did not cause any oxidative damage to lipids and proteins; however, pristine and contaminated MPs induced activities of the antioxidative enzymes and increased chlorophyll *a* content. Although duckweed growth remained unaffected in this experimental setup, the findings suggest that duckweeds have the potential to act as a vector for transferring MPs and MPs-induced contamination into the food chain.

Keywords: contaminants, leaching, *L. minor*, oxidative stress, polypropylene

USMENA PRIOPĆENJA

Genetika, genomika, metablomika i transkriptomika

ORAL PRESENTATIONS

Genetics, genomics, metabolomics and transcriptomics

CHANGES IN PIGMENT COMPOSITION DURING LEAF YELLOWING IN GINKGO (*Ginkgo biloba* L.)

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Ginkgo (*Ginkgo biloba* L.) is the sole living representative of the Ginkgoaceae family, easily recognized by its unique fan-shaped leaves and archaic botanical features. Widely planted as an ornamental tree, ginkgo is especially appreciated for its vibrant golden-yellow foliage in autumn. To better understand the biochemical basis of this striking coloration, we investigated the composition and dynamics of pigments in *Ginkgo* leaves during the autumn senescence period. Leaves were collected from early October to mid-November 2022, including freshly fallen yellow leaves. We analyzed major classes of compounds potentially involved in leaf coloration—polyphenols, flavonoids, chlorophylls, and carotenoids. Using HPLC-DAD, we quantified five biflavonoids: amentoflavone, bilobetin, ginkgetin, isoginkgetin, and sciadopitysin. Among these, sciadopitysin was the predominant compound, reaching concentrations of approximately 2.06–2.99 mg/g dry weight. Biflavonoid concentrations remained stable during the yellowing process compared to the previous period, with a noticeable increase in November and fallen leaves. Carotenoids were present in amounts of 0.06-0.15 mg/g dry weight and their levels were consistent. As expected, chlorophyll concentrations declined sharply during senescence, correlating with the shift from green to yellow hues. Our findings indicate that, alongside carotenoids, biflavonoids associated with yellow hues may contribute significantly to the vivid yellow coloration of autumn G*inkgo* leaves, highlighting their potential role as yellow pigments during leaf senescence.

Keywords: polyphenols, flavonoids, phenolic acids, biflavonoids, yellowing of leaves

POSTERSKA PRIOPĆENJA

Flora, sistematika, evolucija i filogenija

POSTER PRESENTATIONS

Flora, Systematics, Evolution and Phylogeny

TWO NEW *Romulea* TAXA (IRIDACEAE) IN THE FLORA OF CROATIA

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Research on the Croatian flora continues to reveal new insights into the presence of new and rare plant species. During recent botanical investigations, in late winter of 2021 in Istria (Rt Kamenjak) and 2025 in central Dalmatia (islands of Biševo and Vis), two new *Romulea* taxa (*R. columnae* Sebast. & Mauri and *R. linaresii* Parl. subsp. *graeca* Bég.) were recorded for the first time in Croatia. In fact, *R. columnae* has previously been erroneously identified by Zi. Pavletić in 1970 based on one incomplete herbarium specimen from the island of Korčula. Following detailed examination, this specimen has been reidentified as *R. bulbocodium* (L.) Sebast. & Mauri, a species widespread in the Adriatic part of Croatia. *Romulea columnae* is a small, early spring-flowering geophyte that grows in sandy places and dry grasslands within the whole Mediterranean area. The plants found on the island of Biševo exhibit morphological characteristics typical of this species, including narrow rigid leaves and flowers with white tepals with yellowish throat. The second taxon, *R. linaresii* subsp. *graeca*, is a rare and poorly known taxon with limited distribution mainly in the southern Balkans. This subspecies was recorded on the islands of Biševo and Vis, where it grows on typical Mediterranean grasslands represented by many annual species. Morphologically it is recognized by small narrow leaves and small purple flowers with a yellow throat. The discovery of these new taxa in Croatia significantly contributes to the understanding of the Croatian flora and raises important questions regarding their biogeography, ecology and conservation. Future research will focus on a more detailed study of their populations, habitat conditions and potential threats. These findings highlight the importance of continuous floristic research in Croatia, especially in winter and early spring period.

Keywords: Adriatic, geophytes, grasslands, spring-flowering species

Carex brevicollis and *Gymnadenia* × *suaveolens*, TWO NEW PLANT TAXA IN THE CROATIAN FLORA

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Research on the flora of the Dinaric Mountains continues to provide important discoveries that enhance our understanding of biodiversity in Croatia. In June 2024, during botanical investigations on Dinara Mt., two plant taxa were recorded for the first time in Croatia: *Carex brevicollis* DC. (Cyperaceae) and *Gymnadenia* × *suaveolens* (Vill.) Rchb.f. (Orchidaceae). *Carex brevicollis* is characteristic of mountain grasslands, where it grows in slightly deeper soils, open habitats in Central and Southern Europe. The population discovered on Dinara Mt. represents a significant contribution to the known range of this species, which was previously documented only on Troglav in neighboring Bosnia and Herzegovina. The second newly recorded taxon, *Gymnadenia* × *suaveolens*, is a natural hybrid between *G. conopsea* (L.) R.Br. and *G. rhellicani* (Teppner & E.Klein) Teppner & E.Klein. Its discovery on the subalpine grasslands of Dinara confirms the overlapping distribution of its parental species and suggests favorable ecological conditions for further hybridization in this region. On this occasion, this orchid hybrid was also recorded for the first time for Bosnia and Herzegovina. Occurrence of *G. rhellicani* on Dinara Mt. was also confirmed after more than 30 years in Croatia. The identification of these two taxa on Dinara Mt. is significant for understanding the Croatian flora and assessing the ecological factors that support their survival. These findings emphasize the need for further research, particularly in the context of climate change and conservation of mountain grasslands. Continuous monitoring and habitat protection are essential for preserving the rich floristic diversity of Croatia and the Dinaric Mountains.

Keywords: biodiversity, Dinara Mt., monocots, mountain flora

NOTES ON THE OCCURRENCE OF *Aconitum toxicum* RCHB. (RANUNCULACEAE) IN CROATIA

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Aconitum toxicum belongs to *Aconitum* subgen. *Aconitum* sect. *Cammarum* subsect. *Cammarum* ser. *Toxica* (in Europe including *A. degenii*, *A. lasiocarpum*, *A. pilipes*, *A. toxium*). *Aconitum toxicum* is endemic to southeastern Europe, with its center in the Southern and Eastern Carpathians and some disjunct areas on the Bihar mts. and on the Balkans. This species is divided into 3 subspecies: subsp. *bucegiense* (only in the eastern part of the Southern Carpathians), subsp. *crispulum* (in the Southern Carpathians) and subsp. *toxicum* (throughout the whole area). On the Balkans this species was also named *A. bosniacum* (synonym of subsp. *toxicum*, described by variable characteristics). The distribution of *A. toxicum* on the Balkans is proved by the evidence of herbarium material from Serbia (just one toponym), from Bosnia (mainly south of Sarajevo) and from Montenegro (just one toponym). In *Flora Croatica database* we can find two spots of this species for Croatia. One spot is situated W of Bihać on Bosnian territory. The second spot is NW of the town Ogulin, on the way from mt. Klek to mt. Kobeljak in about 900 m altitude. There exist no herbarium specimen from this region to be proved as *A. toxicum*. Additionally, I was very close to this toponym twice and the only blue flowering *Aconitum* growing there is *A. variegatum*. I recommend to exclude *Aconitum toxicum* from the checklist of the flora of Croatia.

Keywords: Hrvatska, flora of Croatia, ranunculaceae, *Aconitum toxicum*

ELEVEN NEW PLANT TAXA IN THE CROATIAN FLORA

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While Croatia is well explored botanically and with many species documented on its territory, there is still much more to be uncovered. During floristic investigations conducted in various parts of Croatia over the past five years, 11 plant taxa were identified as new for the country. Herbarium specimens of these taxa are deposited in ZAGR herbarium. Some taxa are localised, currently known from only a few sites, while the rest are widespread and occur in a larger area. The newly reordered taxa are *Acalypha australis* L., *Achillea filipendulina* Lam., *Allium polyanthum* Schult. & Schult.f., *Anthirrhinum tortuosum* Bosc ex Lam., *Cirsium* × *scopolii* Khek, *Cneorum tricoccon* L., *Corydalis* × *budensis* Vojda, *Helianthemum croceum* (Desf.) Pers. subsp. *croceum*, *Opuntia bergeriana* F.A.C.Weber ex A.Berger, *O. orbiculata* Salm-Dyck ex Pfeiff., and *Orobanche litorea* Guss. Among the mentioned taxa, four are allochthonous and pose a threat of being potentially invasive: *Acalypha australis*, *Achillea filipendulina*, *Opuntia bergeriana* and *O. orbiculata*. These discoveries not only broaden our knowledge of the national flora but also help us be aware of new, potentially invasive plant species.

Keywords: allochthonous, Southeastern Europe, invasive, introduced, new species

CHLOROPLAST HAPLOTYPE DIVERSITY OF THE HOLM OAK IN THE ADRIATIC

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The holm oak (*Quercus ilex*) is a widespread evergreen oak species native to the Mediterranean region. The species is distributed from Portugal and North Africa in the west to the Aegean Islands and western Turkey in the east, with a few records along the Black Sea coast. Its phylogeographic history largely reflects evolutionary processes shaped by past climatic fluctuations during the Quaternary glaciations. Previous genetic studies have revealed distinct genetic patterns across the Mediterranean. Five main haplotype groups have been identified, probably corresponding to major glacial refugia in the Iberian, Apennine, and Balkan peninsulas, as well as in North Africa. The main recolonization route of the species is suggested to be from the eastern to the western Mediterranean. In particular, it has been proposed that the species migrated across the Mediterranean from Greece to Italy and that there was an amphi-Adriatic connection between populations. Thus, we here aimed to assess the phylogeographic structure of holm oak populations in the amphi-Adriatic region based on three plastid regions (rbcL, trnK-matK and trnH-psbA). We hypothesized that there is a shared haplotype between the Balkan and Apennine peninsulas, supporting the amphi-Adriatic connection. For this purpose, we sampled 36 populations in this region and found a total of four haplotypes based on all three plastid regions (2 based on rbcL and 3 based on each trnK-matK and trnH-psbA region). As expected, the rbcL region had the lowest and trnH-psbA the highest variability measured as nucleotide diversity. Two haplotypes were found on both sides of the Adriatic Sea, confirming the amphi-Adriatic connection.

Keywords: amphi-Adriatic, chloroplast DNA, phylogeography, *Quercus ilex*

ENDEMIC *Festuca* SPECIES IN THE CENTRAL SANDY AREA OF THE CARPATHIAN BASIN

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Festuca vaginata is the dominant species in all geographical units in the open sandy area of the Carpathian Basin as far as the Romanian Plain. Moving towards the middle part of the basin, the number of species increases. On its northern edge, *Festuca javorkae* occurs as an endemic species. In the southern half of the basin and in the central part, also the endemic *Festuca wagnerii* can be found. *Festuca pseudovaginata* is another endemic in the middle part. The question is whether this is only due to anthropogenic influence or whether there is another, more calamitous connection? We also conducted comprehensive investigations of the forested steppe zone in the central area, including analyses of the species composition, and climatic data. After the anthropogenic impacts, we analyzed the vegetation and the occurring taxa. Festuca species were examined using leaf cross-sections, with 24 characteristics of the inflorescence and leaf anatomy taken into account. In addition, the micromorphological characteristics of the leaves were compared by stereomicroscopy, scanning electron microscopy, energy dispersive X-ray spectroscopy measurements and phytolith analysis method to establish the taxonomic application of epidermal micromorphological characters. We also discovered the presence of a new species, *Festuca tomanii*. After deforestation and scrubbing, the bare soil patches exposed to anthropogenic influences gave the opportunity for new vegetation to develop. In addition, the vegetation in the central part of the basin is under greater stress due to the more extreme climatic conditions and the extreme drought and heat, which requires a better adaptation to the environmental factors and at the same time leads to a greater richness of endemic species. The work was supported by grant K 147342 OTKA and MATE Research Excellence Project.

Keywords: steppe zone, leaf anatomy, phytolith, climatic adaptation

NEWLY DESCRIBED DIATOM SPECIES FROM A KARSTIC REGION IN CROATIA, DEPOSITED IN THE CROATIAN NATIONAL DIATOM COLLECTION

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Biological collections play a crucial role in preserving biodiversity by protecting specimens as scientific findings. While various types of collections exist, those focusing on microalgae have highlighted the significant role of algae, particularly emphasizing the importance of diatoms. Diatom collections are invaluable resources for modern taxonomy, phylogeny, and evolutionary studies. A notable example is the Croatian National Diatom Collection (HRNDC), established in 2018. Despite its recent establishment, HRNDC already contains 2,883 permanent specimens, including the valuable collection of Prof. Anto Jurilj. It also houses key data on diatom biodiversity in various waterbodies and includes holotypes, isotypes, and paratypes of newly described species. In this work, we aim to present the diatom species from karstic freshwater environments in Croatia that are deposited in the HRNDC. Throughout history, Croatian karstic areas, particularly freshwater environments, have been recognized as biodiversity hotspots, especially notable for their diversity of diatom taxa. Hustedt, one of the earliest and most renowned diatom researchers, described numerous species from the Plitvice Lakes and the Krka River, highlighting the importance of Croatian karstic areas as centres of diatom diversity and endemism. Today, the Croatian National Diatom Collection (HRNDC) houses four newly described diatom species: *Cymbopleura amicula* Gligora Udovič & Levkov, *Aneumastus visovicensis* Gligora Udovič & Levkov, and *Berkeleya* sp. nov. from the Krka River, and *Gomphosphaenia plenkoviciae* Gligora Udovič & Žutinić from the Crveno jezero (Red Lake). Additionally, the collection comprises freshwater species *Envekadea heidinii* (Hustedt) Van de Vijver, Gligora, Hinz, Kralj & Cocquyt, and the brackish species *Tetramphora croatica* Gligora Udovič, Caput Mihalić, Stanković & Levkov from the shallow Lake Vransko. These findings underscore the rich and still largely unexplored diversity of diatoms in Croatian karstic waters. The Croatian National Diatom Collection represents an invaluable contribution to the legacy of Croatian natural heritage, preserving scientific resources for future generations.

Keywords: biodiversity, biological collections, holotypes, freshwaters

NEW FLORISTIC DATA FOR THE VRLJIKA SPECIAL RESERVE

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The Vrljika River Special Reserve is part of the Biokovo - Imotski Lakes UNESCO Geopark. The wellspring and coastal zone of the Vrljika River, 100 m on each side of the wellspring, were protected in 1971 as a special ichthyologic reserve. The area of the special reserve is 50 ha, and 716 vascular plant species have been recorded in this part of the Imotski region so far. During 2022 and 2023, we conducted additional botanical field research in that area and recorded 37 new taxa of vascular plants. Among the newly recorded species, some are relatively common plants, such as *Carex pendula* Huds., *Chondrilla juncea* L., *Crepis vesicaria* L., *Hibiscus trionum* L. (which is in the NT endangered category), *Lathyrus pratensis* L., *Oenanthe pimpinelloides* L., while the finding of the relatively rare and dubious taxon *Ophrys aegirtica* P. Delforge should be highlighted. Unfortunately, we have also recorded alien species that have apparently spread into this natural reserve thanks to the negative anthropogenic impact, such as *Phyllostachys aurea* (André) Rivière & C.Rivière**,** *Tagetes patula* L. or a previously unrecorded taxon in the Flora Croatica Database - *Aesculus* x *carnea* Zeyh. In summary, including our findings, a total of 753 plant taxa have been recorded in this area to date, which, regardless of the presence of alien species, highlights the remarkable plant diversity of this part of the Imotski region. Given the area’s protected status, we expect that the spread of alien taxa will remain limited and that existing alien and invasive species will be continuously monitored.

Keywords: Biokovo - Imotski Lakes UNESCO Geopark, native plants, alien plants

FLORA OF LAKE LAPOVAC (CITY OF NAŠICE)

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Lapovac is an artificial lake located three km from the centre of the city of Našice (Osijek-Baranja County). It was created in 1993 to prevent the flooding of nearby settlements. Given that there is no floristic data for this part of Slavonia, the aim of our work was to conduct the first systematic floristic research for this area of Našice. Therefore, we performed research on six types of lakeside habitats (on an area of approximately six km^2), during the 2021 vegetation season. Plant taxa were photo documented and/or collected, the herbarium collection was deposited in the Herbarium Croaticum (ZA), and the nomenclature follows the *Flora Croatica Database*. Our floristic analysis showed that a total of 220 taxa of vascular plants have been recorded and classified into 58 families. The most common families were Poaceae (12.27%), Asteraceae s. str. (9.09%), Fabaceae (7.27%) and Lamiaceae (6.36%). The geoelements classify this area as Euro-Siberian-North American, and the dominant life form was hemicryptophytes (45.37%). The highest number of taxa were recorded on meadows (37.84%) and ruderal habitats (23.65%). Alien flora was represented by 58 taxa (41 archaeophytes and 17 neophytes), ten of which are invasive. Two taxa are threatened according to the IUCN categories (*Ruscus aculeatus* and *R. hypoglossum*), and two are strictly protected (*Dianthus barbatus* and *Iris pseudacorus*). The comparison of our results with available data for Continental Croatia showed that habitats around the Lapovac lake are less floristically diverse and have a higher share of alien flora, which is an indicator of strong anthropogenic influence. Systematic floristic research of the entire Našice area (in progress) will provide better insight into the anthropogenic impact on plant diversity.

Keywords: alien plants, continental Croatia, floristic analysis, native plants, Osijek-Baranja County

Knautia ehrendorferi (CAPRIFOLIACEAE), A NEW SPECIES FROM DINARIC MOUNTAINS

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The Balkan Peninsula represents one of the main centres of diversification of *Knautia* (Caprifoliaceae), particularly within the morphologically and genetically intricate *Knautia* sect. *Trichera*. Taxonomic resolution in this group is hampered by extensive polyploidy, frequent hybridization, and overlapping morphological traits, complicating species delimitation. Amid this complexity, we described as a new diploid species *Knautia ehrendorferi* endemic to the central Dinaric Mountains. The discovery of *K. ehrendorferi* emerged from comprehensive analyses involving relative genome size estimations and amplified fragment length polymorphisms (AFLP), which revealed clear genetic differentiation among diploid members of the Dinaric taxa. Detailed morphometric analyses using multivariate statistical methods confirmed that *K. ehrendorferi* forms a coherent and morphologically distinct cluster, separate from other closely related diploid taxa from the Balkan Peninsula. Morphologically, *K. ehrendorferi* is a perennial herb reaching up to 100 cm in height, with unbranched or usually branched stems bearing 2–5 well-developed stem leaf pairs and 1–4 flower heads per stem. It is clearly distinguished by its large, undivided, oblanceolate leaves, which are leathery, glabrous and somewhat shiny, therefore these populations were previously considered to belong to hexaploid *K. travnicensis*. *Knautia ehrendorferi* inhabits dry gravelly grasslands and it is currently known from Dinara, Grahovo Polje, and Svilaja, spanning Croatia and Bosnia and Herzegovina. It is named in honor of Friedrich Ehrendorfer for his foundational contributions to the systematics and evolutionary biology of *Knautia* and other plant groups. The new species not only adds to the floristic richness of the Balkan Peninsula but also enhances our understanding of speciation within this notoriously complex genus. Its recognition highlights the importance of integrative taxonomy in resolving cryptic diversity in biodiversity hotspots.

Keywords: Balkan Peninsula, *Knautia* sect. *Trichera*, new species, taxonomy

RECENT DISCOVERIES IN THE BRYOPHYTE FLORA OF CROATIA

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Croatian bryology has experienced a sustained revival, as demonstrated by the identification of 14 bryophyte taxa newly recorded at the national level over the last five years. Among these there are two epilithic liverworts – *Frullania riparia* Hampe, recorded in remnants of an old downy oak forest within the tectonic doline of Vitra above the Vinodol Valley (Liburnian Karst), and *Frullania cleistostoma* Schiffn. et W. Wollny, found on limestone rocks in Paklenica National Park. A survey of Croatian (semi)aquatic habitats revealed four new species, including *Philonotis marchica* (Hedw.) Brid. from submerged and exposed carbonate rocks in a fast-flowing karstic river in the mountainous Gorski Kotar region, two ephemeral colonists, *Bryum barnesii* J. B. Wood ex Schimp. and *Bryum klinggraeffi* Schimp., predominantly found along seasonal Mediterranean streams, as well as *Drepanocladus lycopodioides* (Brid.) Warnst. in the periodically flooded karstic field Blace on Dinara Mountain. Four Mediterranean terricolous ephemeral taxa were recorded while studying the flora of Rt Kamenjak in Istria – *Bryum gemmilucens* R. Wilczek & Demaret, *Tortula pallida* (Lindb.) R. H. Zander, *Microbryum muticum* (Venturi) Cl. Schneid., Th. Schneid. & Mahevas and *M. davallianum* var. *conicum* (Schleich. ex Schwägr.) R. H. Zander. The boreo-alpine moss *Herzogiella striatella* (Brid.) Z. Iwats. was found in the spruce forests of Mt Snježnik, marking the first record of this relict species in the Western Balkans. Another silvicolous species, *Tortula schimperi* M. J. Cano, O. Werner et J. Guerra was discovered in the sessile oak forest of Medvednica Nature Park. Finally, two new national records – boreo-montane *Hylocomiastrum umbratum* (Hedw.) M. Fleisch. and a Mediterranean *Timmiella barbuloides* (Brid.) Mönk. were found hidden within the historical bryophyte collection of the *Herbarium Croaticum*. At present, the Croatian bryoflora comprises a total of 808 taxa.

Keywords: liverworts, Mediterranean, moss, national records

FLORA OF ISLETS KRKNJAŠ VELI AND KRKNJAŠ MALI

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The flora of the islets Krknjaš Veli and Krknjaš Mali was explored during 2016, 2017 and 2025. The results revealed a great diversity, encompassing 105 taxa from 41 families. The most abundant families were Poaceae (18.10%), followed by Fabaceae (10.48%), Liliaceae (6.67%), Asteraceae, Caryophyliaceae, Chenopodiaceae (5.71%). The most abundant life-forms in the flora are therophytes (44.78%), hemicryptophytes (17.14%) and phanerophytes (14.28%). In the flora of the researched islets the most dominant element is the Mediterranean chorological element (62.80%). The research recorded four endemic taxa, and two endangered taxa noted in the Red Book of Vascular Flora of Croatia. Furthermore, a total of six protected taxa and 11 strictly protected taxa have been recorded in the flora of the islets Krknjaš Veli and Krknjaš Mali.

Keywords: flora, Krknjaš Veli, Krknjaš Mali, Croatia, Adriatic Sea, endems, endangered taxa, Mediterranean chorological element

NEW RECORD OF *Lunularia cruciata* (Marchantiophyta, Lunulariaceae) IN BOSNIA AND HERZEGOVINA

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Lunularia cruciata is a thalloid liverwort most easily recognized by its characteristic lunate gemma cups. It is naturally distributed across the Atlantic and Mediterranean regions of Europe, while outside of its native range it is considered rare or introduced. Its spread northward is believed to be facilitated by ongoing climate change. Although *L. cruciata* has been listed for Bosnia and Herzegovina in several general checklists of bryophytes, no specific localities have been documented in the available literature. During fieldwork conducted in the spring of 2025, *L. cruciata* was recorded near the mouth of the Una River into the Sava River, in the municipality of Kozarska Dubica. The species was found growing on moist, shaded soil along pathways. All observed individuals bore well-developed gemma cups, indicating active vegetative reproduction. This finding therefore represents the first confirmed locality for the species in Bosnia and Herzegovina. More comprehensive bryological surveys in Bosnia and Herzegovina are essential for a better understanding of the current distribution of *L. cruciata*.

Keywords: Balkans, bryoflora, distribution, liverworts

FIRST FINDING OF *Galanthus elwesii* Hook.f. (AMARYLLIDACEAE) IN MONTENEGRO

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The small genus *Galanthus* L. (Amaryllidaceae), widespread in Europe, the Middle East and Asia Minor, includes 23 species and a small number of subspecies, varieties and natural hybrids. In the territory of Montenegro, this genus is represented by two species, *G. nivalis* and *G. reginae-olgae* subsp. *vernalis*. During floristic research in the area of Berane and its surroundings (Donja Ržanica), the species *Galanthus elwesii* Hook.f. was registered, which is the first finding of this species for the vascular flora of Montenegro. Investigating this area, we registered the specimens in the city center of Berane (663 m asl.), in gardens as well as in meadows in their immediate vicinity (numerous populations), which led us to assume that these are cultivated species that started to spread spontaneously. We also registered smaller populations of this species in the area of Donja Ržanica (804 m asl), which is 8 kilometers away from the city in nature along the Kaludarska River and the edge of the forest, which confirmed the presence of *G. elwesii* in its typical natural habitat. This indicates that *G. elwesii* is not only spreading in the city center but is slowly conquering natural habitats as well. As it is a species that is rare in the European flora and is on the IUCN Red List, European Red List and Appendix 2 of CITES, research on *G. elwesii* in the territory of Montenegro in the future should be aimed at monitoring the growth and distribution of its populations.

Keywords: vascular flora, Donja Ržanica, flora

FLORISTIC DIVERSITY OF BIJELE I SAMARSKE STIJENE STRICT RESERVE (CROATIA)

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The Bijele i Samarske stijene Strict Reserve, established in 1985, is one of only two strict reserves (IUCN Category Ia) in Croatia. Today it also forms part of the Natura 2000 ecological network. Located in Gorski Kotar within the Velika Kapela massif, it covers over 1,100 hectares at elevations ranging from 900 to 1,335 meters above sea level. The area is characterized by pronounced karst features, leading to diverse microclimatic conditions. Although, in the Reserve, forest vegetation predominates, rock crevice vegetation (*Asplenietea trichomanis* (Br.-Bl. in Meier et Br.-Bl. 1934) Oberd. 1977) is especially interesting. The aim of this research was to create a comprehensive floristic inventory of the Reserve by combining data from literature, herbarium collections, observations and photographs from the Flora Croatica database, as well as our own field observations during 2024 vegetation season. Field research was conducted thoroughly at 48 locations across the entire Reserve, within different 1 × 1 km HTRS grid cells and considering various habitat types. Additional plant taxa were recorded between these locations. In total, the vascular flora of the Reserve numbers 347 taxa. During the field research 230 previously noted taxa were confirmed, while 47 new taxa were recorded. Out of all taxa, 30 are strictly protected, and 15 are endemic. There are 25 taxa on the Red List of Wild Species of Croatia, of which one is endangered (EN), four are vulnerable (VU), 11 are near threatened (NT), and three are data deficient (DD). Further six taxa were not assessed according to the new IUCN criteria and remained in the old threat categories (V – vulnerable and R – rare).
The results presented are derived from the project *Inventory of flora in the Bijele i Samarske stijene Strict Reserve.*

Keywords: biodiversity, Gorski Kotar, Natura 2000, protected area, vascular flora

WINTER PHYTOPLANKTON DIVERSITY IN HIGHLY PRODUCTIVE COASTAL AREA (BOKA KOTORSKA BAY)

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The Boka Kotorska Bay is a fjord-like deep embayment surrounded by two massifs of the Dinaric Alps located in southwestern Montenegro. Due to high precipitation and numerous submarine springs, the bay receives a substantial input of freshwater in late winter and spring, which contributes to increased nutrient concentrations and, consequently, higher phytoplankton growth. To gain insight into phytoplankton diversity, sampling was conducted at three stations in late winter (24.02., 25.02., and 28.02. 2025) before and after the heavy rain episode. Thermohaline properties were measured using a CTD probe, and samples were collected using Niskin samplers and phytoplankton nets. Before the heavy rain, samples were collected at the northernmost and deepest station Kotor-H (64m deep), middle station Kotor-IBM (20 m deep), and southernmost station Kotor-S (18m deep). After the heavy rain and adverse weather conditions, stations Kotor-IBM and Kotor-H were revisited. High precipitation significantly influenced the water column properties. At Kotor-H, the thermohaline boundary shifted from 5 m to 10 m depth, while at Kotor-IBM, its position remained stable; however, surface salinity notably decreased compared to earlier days. Chlorophyll *a* concentration was the highest at the surface layer, with maximal values at Kotor-H on 24.02. and Kotor-IBM on 25.02., reaching 4.95 mg/m³ and 3.37 mg/m³, respectively. Bulk phytoplankton diversity was assessed by light microscopy following the standard Utermöhl method, while live samples were used for cultivation of diatom species of interest. Several *Entomoneis* and *Chaetoceros* strains were established in monocultures, and pellets are currently being processed for DNA identification. The most abundant phytoplankton group were diatoms, of which the dominant ones were: *Skeletonema marinoi, Dactyliosolen fragilissimus, Chaetoceros curvisetus, Pseudo-nitzschia delicatissima, Chaetoceros vixvisibilis, Cerataulina pelagica, Leptocylindrus danicus, and Asterionellopsis glacialis.* Live net samples were inoculated into cultures to observe succession leading to various strains of cryptophytes, cyanobacteria, and lastly picoeukaryotes.

Keywords: phytoplankton, taxonomy, culturing, Boka Kotorska Bay

DISTRIBUTION OF THE SNOWDROPS (AMMARYLLIDACEAE) IN FLORA OF MONTENEGRO

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The aims of this study are the distribution, taxonomy and ecology of the native snowdrops which grow in Montenegro. Until recently, only two species from the genus *Galanthus* L. were known in the flora of Montenegro: *Galanthus reginae-olgae* ssp. *vernalis* and *Galanthus nivalis*. The newly discovered snowdrop species *Galanthus elwesii* has been observed in several localities (unpublished data - N. Bubanja & S. Vuksanović). Distribution of these two species is not clearly distinguished. Species G. *reginae-olgae* ssp. *vernalis* is distributed from the coast through the coastal Dinarides, karst fields and the Bjelopavlići plain to northern Montenegro. Species *Galanthus nivalis* is widespread in the north of the country, but the ranges of these two snowdrops overlap. *Galanthus elwesii* grows in the north. Further research is needed on the delimit the distribution of taxa occurring in Montenegro.

Keywords: Snowdrops, Galanthus, Montenegro, flora, native species, Balkan Peninsula

CATALOGUE OF VASCULAR PLANTS OF MONTENEGRO

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The Montenegrin Academy of Sciences and Arts launched the project "The Catalog of Vascular flora of Montenegro" in 2010. The first volume was published in 2013 and includes 41 families (Aizoaceae, Amaranthaceae, Aristolochiaceae, Berberidaceae, Betulaceae, Cactaceae, Cannabaceae, Caryophyllaceae, Ceratophyllaceae, Chenopodiaceae, Cupressaceae, Equisetaceae, Ephedraceae, Fagaceae, Fumariaceae, Juglandaceae, Lauraceae, Loranthaceae, Lycopodiaceae, Marsileaceae, Molluginaceae, Moraceae, Nyctaginaceae, Nymphaeaceaem Ophioglossaceae, Papaveraceae, Phytolaccaceae, Pinaceae, Platanaceae, Polygonaceae, Polypodiaceae, Portulacaceae, Rafflesiaceae, Ranunculaceae, Salicaceae, Santalaceae, Selaginellaceae, Taxaceae, Theligonaceae, Ulmaceae, Urticaceae), 137 genera, 564 species and subspecies and 9 hybrid taxa. The second volume was published in 2021, and 24 families were presented in it (Brassicaceae, Capparaceae, Resedaceae, Crassulaceae, Saxifragaceae, Rosaceae, Fabaceae, Oxalidaceae, Geraniaceae, Zygophyllaceae, Linaceae, Euphorbiaceae, Rutaceae, Polygalaceae, Anacardiaceae, Balsaminaceae, Aquifoliaceae, Rhamnaceae, Buxaceae, Tiliaceae, Malvaceae, Thymelaceae, Hypericaceae, Violaceae), 170 genera, 865 species and subspecies and 16 hybrid taxa. The third volume is in press and contains 24 families (Phyllanthaceae, Pyrolaceae, Ericaceae, Empetraceae, Primulaceae, Plumbaginaceae, Oleaceae, Gentianaceae, Menyanthaceae, Apocynaceae, Asclepiadaceae, Rubiaceae, Convolvulaceae, Boraginaceae, Callitrichaceae, Verbenaceae, Lamiaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Gesneriaceae, Orobanchaceae, Lentibulariaceae i Plantaginaceae), 150 genera and about 650 species, subspecies and hybrid taxa. The catalog is the result of the synthesis of scientific data published so far and our field research. A nomenclature revision was made, as well as a critical phytogeographical review. The publication of two more volumes of the Catalog is planned.

Keywords: The Montenegrin Academy of Sciences and Arts, vascular flora catalogue

POSTERSKA PRIOPĆENJA

Ekologija, biogeografija, vegetacija i klimatske promjene

POSTER PRESENTATIONS

Ecology, Biogeography, Vegetation and Climate Change

STUDY OF THE FLORISTIC DIVERSITY ALONG THE BJELOBRDSKA STARA DRAVA (NE CROATIA) UNDER THE "LIFE RESTORE FOR MDD" PROJECT

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The "LIFE RESTORE for MDD" project is an initiative for cooperation between 17 partners from Austria, Slovenia, Croatia, Hungary and Serbia, aimed at the preservation and restoration of wetlands and flooded forest habitats in the UNESCO's 5-countries Biosphere Reserve "Mura-Drava-Danube". The Bjelobrdska Stara Drava is a remnant of the former meander of the Drava River, cut-off by regulation works in 1805, and today it is a degraded oxbow lake. The Bjelobrdska Stara Drava is located within the Regional Park "Mura-Drava", in two Natura 2000 sites in Croatia: SPA HR1000016 Podunavlje i donje Podravlje, and SAC HR2000372 Dunav - Vukovar, and in the core zone of Transboundary Biosphere Reserve "Mura-Drava-Danube". The restoration measures aim to restore 65 ha of the water body and improve the hydrological condition and structure of the adjacent floodplain forests from Natura 2000 priority target habitat type 91E0* over 193 ha. Floristic survey, as part of the baseline biotic monitoring, was carried out during multiple field visits in the period from March to September 2024. Floodplain forest habitat type 91E0* is represented with two associations from the *Salicion albae* alliance: flood forest of white willow (*Salicetum albae*) and flood forest of willows and poplars (*Salici-Populetum nigrae rubetosum caesii*). The vascular flora consists of 108 species, classified into 84 genera and 50 families. The most species-rich families were Cyperaceae, Asteraceae and Poaceae. In the life-form spectrum, hemicryptophytes dominate (31%), followed by therophytes (23%) and hydrophytes (20%). Alien flora is represented by 20 species, of which 13 (12%) are invasive alien plant species, with dominance (62%) of species of North American origin. According to conservation status, two species are listed as endangered, and five as vulnerable in the Red List of Wild Species of Croatia, while 10 species are strictly protected in Croatia.

Keywords: floodplain, forest, nature restoration, river

CONTRIBUTION TO THE KNOWLEDGE OF THE RECENT DISTRIBUTION OF THE ADDER'S-TONGUE FERNS (OPHIOGLOSSACEAE) IN THE LIKA REGION (CROATIA)

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Plant species that are difficult to notice due to their small size and inconspicuous colour are often overlooked during research, which limits our understanding of their distribution. Among these, members of the adder's-tongue family (Ophioglossaceae) can be highlighted, with five species represented in the Croatian flora. The goal of the research conducted in the Lika region (Croatia) during 2021 and 2022 was to create a detailed floristic overview of 200 plots of grasslands, alkaline fens, and heaths, and to assess their conservation status. During the two-year study, two species from the Ophioglossaceae family were recorded: adder's-tongue *(Ophioglossum vulgatum* L.) and common moonwort (*Botrychium lunaria* (L.) Sw.). Adder's-tongue was found on 8 plots (4%). These were mostly individual specimens, but in areas with evident traces of bioturbation, they were sporadically very abundant. The species was recorded on alkaline fens (Ljubica-Velebit NP and Rudanovac-Plitvice Lakes NP), purple moor-grass meadows (Prijeboj-Plitvice Lakes NP, Gacko polje, Krbavica), false oat-grass meadows (Lipovo polje), and sub-Mediterranean dry grasslands (Ripište and Ljubica in Velebit NP). It was found both in habitats with a favourable level of conservation and in habitats under the influence of succession. Common moonwort was recorded at only one site (Karleušine plase-Plitvice Lakes NP) on the edge of a dry continental grassland under the strong influence of succession. All habitats where these species were recorded are rare and/or threatened habitats in Croatia and are target habitats of the Natura 2000 network. To achieve a favourable status for these species, especially Adder's-tongue, which is classified as Near Threatened (NT) on the Croatian Red List, it is necessary to promote regular mowing and extensive grazing of these habitats.

Keywords: bioturbation, *Botrychium lunaria*, conservation, *Ophioglossum vulgatum,* Red list species

PLANT COMMUNITIES ON THE SMALL ISLAND IN THE SOUTHERN CROATIA

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The results of a phytosociological study conducted in 2024 on the southeastern Adriatic islet of Proizd (surface area 0.63 km², Korčula Archipelago), based on a total of 48 phytosociological relevés, are presented. Altogether, six plant associations and one community, belonging to six alliances and classes, were identified. The benthic cormophyte community is represented by *Posidonietum oceanicae*, while the halophytic vegetation of the coastal low rocks belongs to *Plantagini holostei-Limonietum subanfracti*. Forest vegetation is composed of the *Pistacio lentisci-Pinetum halepensis* association, and the maquis is represented by *Pistacio lentisci-Juniperetum turbinatae*. In the garrigue, the *Erico-Rosmarinetum* association and the *Cistus monspeliensis* community were recorded. The thermophilous late-summer weed vegetation on sandy soils includes the *Portulacetum oleraceae* association. Despite the limited number of historical vegetation plots for the *Erico-Rosmarinetum*, recent data do not indicate biodiversity changes at the level of the local community or individual species.

Keywords: coastal plant communities, distribution, eastern Adriatic, NE Mediterranean, vegetation diversity

A NEW PLANT ASSOCIATION OF THE *Saturejion subspicatae* ALLIANCE IN SOUTHERN CROATIA (SOUTHEASTERN EUROPE)

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The coenological knowledge of calcareous rocky grasslands on shallow soils, situated in the transitional zone between the Mediterranean and Temperate regions – extending into the interior of southern Croatia – remains considerably incomplete. In particular, the phytosociological understanding of the Dalmatian hinterland has been largely neglected over the past four decades. This study presents and discusses new data, including 32 vegetation relevés collected between August 2020 and August 2021, accompanied by their ecological context and a phytosociological classification of grasslands inhabited by endemic species. We formally propose the new plant association *Saturejo subspicatae-Scabiosetum delminianae* Pandža, Jasprica et al. 2025, comprising three subassociations: *typicum*, *jurinetosum mollis* and *dalmatocytisetosum dalmatici*, within the *Saturejion subspicatae* Tomić-Stanković 1970 alliance. The results aim to enhance the understanding of Croatian syntaxonomic diversity, which is a valuable indicator of the region's overall ecological diversity.

Keywords: Dinaric karst, *Festuco-Brometea*, phytosociology, new syntaxa, syntaxonomy

NEW FINDINGS OF RARE AND UNDER – RECORDED DIATOM SPECIES FROM DINARIC AND PANNONIAN REGION IN CROATIA

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Croatia harbours great biodiversity, due to its unique geographic location and diverse ecosystems in two distinct ecoregions – the Dinaric and the Pannonian. Freshwater microalgae diversity is notable, especially diatoms. Diatoms play a crucial role as primary producers in benthic aquatic communities. They are very sensitive to environmental changes, which makes them good biological indicators for assessing the ecological status of freshwater ecosystems. In this study, recent findings on rare and under-recorded diatom species from freshwater ecosystems in both Croatian regions are presented. Rare species are characterised by low abundance and/or restricted distribution; potentially exhibit lower genetic diversity, narrower niches and higher vulnerability to environmental changes than common species. The karst-dominated Dinaric region has already been identified as a biodiversity hotspot. *Amphora aequalis* Krammer and *Planothidium fonticolanceolatum* (Lange-Bertalot & Schimanski) Lange-Bertalot were recorded from the Krka River. In the Korana River, *Simonsenia maolaniana* You & Kociolek and *Halamphora bullatoides* (M.H.Hohn and Hellerman) Levkov were found. Three species of the genus *Brachysira* were noted as rare: *Brachysira chiaruccii* Cantonati, Lange-Bertalot, E.Arnaud, M.Galbiati & É.Soróczki-Pintér and *Brachysira styriaca* (Grunow) R.Ross) from Lake Kuti (Dinaric region) and *Brachysira paraexilis* Van de Vijver & B.Kennedy from the artificial canal Plitvica (Pannonian region).

Keywords: biodiversity, biological indicators, distribution, diatoms, freshwater habitats

THE SPREAD OF INVASIVE SPECIES - A CASE STUDY FROM ĐURĐENOVAC MUNICIPALITY (EAST CROATIA)

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The spread of invasive plant species is considered to be one of the most important factors threatening biodiversity and having various unforeseen effects. The aim of this study was to identify invasive plants at two study sites in the eastern part of Croatia (Đurđenovac Municipality, Osijek-Baranja County). The first study site was a park in the settlement of Đurđenovac with an area of approximately 3.5 ha. The second study site was a large abandoned pasture located about 1.5 km from the Šaptinovci settlement. It is located near farmland, mainly arable land, and covers about 67.5 ha. During the field study, which was conducted from April to October 2024, a total of 19 invasive plants (park - 10; pasture - 15) from 12 families were found. In both areas, invasive species from the Asteraceae family were the most prevalent. According to the analysis of the life forms, therophytes (six species) dominated in the pasture, while hemicryptophytes (four species) predominated in the park. The analysis of ecological conditions revealed that most invasive plants at both sites are shade-tolerant and prefer moist and warm habitats. The results suggest that the abandonment of pastures and various anthropogenic activities at both sites influence the introduction and spread of invasive plants. To overcome the challenges posed by these species, it is crucial to implement regular monitoring and removal measures and educate the public about their potential negative impacts.

Keywords: invasive species, urban park, pasture, life form, Ellenberg indicator values

TEMPORAL VARIATION IN THE INCIDENCE OF DUTCH ELM DISEASE IN THE AREA OF KOPAČKI RIT

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Dutch elm disease (DED), caused by the invasive ascomycetous fungus *Ophiostoma novo-ulmi*, has a significant impact in elm-growing regions throughout Europe, including Croatia. DED pathogen exists in the form of two subspecies, *O. novo-ulmi* subsp. *novo-ulmi* and *O. novo-ulmi* subsp. *americana*, and their fertile hybrids. Its transmission depends on the breeding and feeding activities of the elm bark beetles, although it can also occur through root grafts. Interactions of the host, pathogen, and insect vectors involved in this complex pathosystem can be directly or indirectly mediated by abiotic factors. Ecological factors underlying the DED are expected to be affected by climate change, potentially leading to regional variations in disease dynamics. Therefore, continuous assessment of the disease incidence and impact over time is needed. This study was conducted in the area of Kopački rit, where two elm species, *Ulmus minor* Mill. and *U. laevis* Pall., are present to determine changes in the number of infected and killed trees between the two seasons. In the first year of the study, over one hundred trees were inspected for the presence of external and internal symptoms characteristic of DED, and each tree was marked. The pathogen isolated from the infected trees was characterised by sequencing the *col1* and *cu* genes, which are used for subspecies identification, and assigned to MAT-1 or MAT-2, which determines sexual compatibility and potential for sexual reproduction. In the second year, all field and laboratory studies were repeated. The results of this study provide insight into temporal changes in disease incidence and impact, as well as the structure of the pathogen population in this protected area, which contributes to the understanding of the current dynamics of DED.

Keywords: DED dynamics, DED impact, *Ophiostoma novo-ulmi*, *Ulmus*

HABITAT MAPPING OF NATURE PARK VRANSKO JEZERO – A NON-VEGETATION APPROACH

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The existing habitat map of Nature park Vransko jezero is more than 10 years old and outdated in many places. For effective management, the public institution needs a more precise and up-to-date map, which was the goal of this project. Habitat mapping was carried out using remote sensing techniques in QGIS and then validating the resulting polygons during 3 field visits (in the field we collected observational data about the type of habitat present in a specific polygon). At first, we created a map of 35 land cover classes using photo interpretation of orthophoto images. These polygons were visited during spring and autumn field visits and transformed into 53 habitat classes (national habitat classification). Identifying habitat classes was done using the extensive literature available for the area and fielddata. Along with field data, for separating similar and conflicting habitat types (e.g. eu- and submediterranean habitats), we used NDVI and NDMI obtained from Sentinel 2 satellite images. The final map is stored in the digital format in the scale 1:5000 and each polygon contains information on land cover, national habitat classification and Natura 2000 habitats. The methodology developed for this mapping project can be applied to any other protected area in Croatia and it is easy to use while giving precise results.

Keywords: Land cover, NDMI, NDVI, photo interpretation

GENETIC DIFFERENTIATION AND ECOLOGICAL NICHE MODELLING IN THE BALKAN ENDEMIC *Campanula hawkinsiana* (Campanulaceae)

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Campanula hawkinsiana is a species of bellflower that is endemic to the central Balkan Peninsula. Its distribution extends across southern Albania and northwestern Greece. It usually grows on ultramafic bedrock at elevations between 200 and 2,400 m a.s.l., though it can also grow on calcareous bedrock. This study presents the first comprehensive investigation of genetic diversity and the population-genetic structure of the studied species using ddRAD-seq data, along with environmental niche modelling. The population genetic analyses revealed significant differentiation and structuring, suggesting that the populations studied had been isolated over a long period of time. The observed genetic differentiation between populations was likely due to limited gene flow rather than specific environmental factors tested. The ecological niche models revealed that high-elevation areas within the species' known range offer favorable conditions, with projections for the Last Glacial Maximum (LGM) indicating even more suitable conditions throughout the region, including those at lower elevations. Based on the genetic data and environmental niche models, altitudinal migration rather than latitudinal shifts to climatically favorable regions is a more likely explanation for the observed diversity patterns.

Keywords: Balkan Peninsula, bedrock type, ddRAD-seq, ultramafic

CONTRIBUTION TO THE KNOWLEDGE OF DRY GRASSLANDS VEGETATION FROM THE ALLIANCE *Trifolion cherleri* Micevski 1970 IN THE REPUBLIC OF NORTH MACEDONIA

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The alliance *Trifolion cherleri* Micevski 1970 (order *Helianthemetalia guttati* Br.-Bl. in Br.-Bl. et al. 1940, class *Helianthemetea guttati* Rivas Goday et Rivas-Mart. 1963) in Republic of North Macedonia encompasses plant communities that develop on dry grasslands on a siliceous substrate at altitudes between 50 and 1200 m a.s.l. So far, five plant associations have been described within this alliance in North Macedonia (*Tunico-Trisetetum myrianthi* Micevski 1971, *Helianthemo-Euphorbietum thessalae* Micevski 1973, *Erysimo-Trifolietum* Micevski 1977, *Diantho-Cistetum incani* Micevski et Matevski 1984, and *Biserrulo-Scleranthetum dichotomae* Matevski et Kostadinovski 1998). Through fieldwork on the territory of the Monument of Nature "Markovi Kuli", southwestern North Macedonia, 27 vegetation relevés were made on the dry grasslands using the methodology of the Zurich-Montpellier school (Braun-Blanquet, 1964). Our main goal was to determine the syntaxonomic affiliation of these vegetation relevés. For this purpose, a database of 348 relevés and 550 taxa was compiled in the TURBOVEG software for vegetation data (Hennekens & Schaminée, 2001), of which 321 relevés belong to already described and registered plant communities of the *Trifolion cherleri* alliance from North Macedonia. Hierarchical agglomerative cluster analyses were conducted using the software package JUICE 7.1 (Tichý, 2002) in combination with PC-ORD program (McCune & Mefford, 2016). Additionally, ecological analyses were performed to determine the biological and chorological spectrum of the plant communities. By calculating the mean Ellenberg indicator values for each relevé and community, statistically significant mutual correlations and their influence on the vegetation were determined. The analyses indicated that the 27 relevés from the territory of the MN "Markovi Kuli" belong to the community *Helianthemo-Euphorbietum thessalae* subass. *campanuletosum* Micevski 1973. From the biological and chorological spectrum, it can be concluded that this community in the studied area exhibits a hemicryptophytic-therophytic life-form spectrum with a dominant presence of Eurasian and Euri-Mediterranean floral elements.

Keywords: chorological analysis, Ellenberg indicators, plant communities, siliceous substrate, syntaxonomy

DIVERSITY AND ECOLOGICAL PATTERNS OF EPIPHYTIC BRYOPHYTES IN MAKSIMIR FOREST PARK, ZAGREB

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The epiphytic bryophyte flora of Maksimir Forest Park was studied to assess its diversity, ecological preferences, as well as patterns of association with selected phorophyte species. Bryophytes were sampled from five individuals of each of the selected tree species: sessile oak, hornbeam, beech, black locust, and spruce. A total of 35 bryophyte taxa were recorded, including 31 moss species and four liverwort species. Beech supported the highest bryophyte diversity, while the most common and abundant bryophyte was *Hypnum cupressiforme*. On the other hand, black locust and spruce trees had the lowest bryophyte diversity. During the study, the NATURA 2000 target species *Dicranum viride* was found on beech and oak. The predominant life form overall in the study was the smooth mat, as it provides more surface area for photosynthesis, while the most common life strategy was stress-tolerant perennial, suggesting that the sampled environment is relatively stable with minor stressors. Biogeographically, most of the recorded species were temperate elements with a circumpolar distribution. The DCA analysis was performed to explore the bryophyte community composition on different tree species, while average Ellenberg indicator values of bryophytes for light, moisture, nitrogen, and pH, as well as measured or estimated environmental parameters (circumference at breast height, total coverage of bryophytes, the coverage of dominant species and bark roughness) were projected as vectors over the ordination to assess potential environmental gradients. Beech trees were characterised by species with higher indicator values for moisture. Along with hornbeam, they harboured higher diversity and were characterized by smoother bark and a higher proportion of bryophytes with higher indicator values for nitrogen and pH when compared to black locust trees. ANOSIM test revealed that bryophyte assemblages on different tree species differed significantly, however with considerable overlap, with those on black locusts being most distinct.

Keywords: epiphytes, bryophytes, phorophyte, life forms, biogeographical elements, Ellenberg indicator values

ASSESSMENT OF GRASSLAND STATUS IN RISNJAK NATIONAL PARK AND VELEBIT NATURE PARK: BASIS FOR PLANNING CONSERVATION ACTIONS

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The disappearance of traditional grassland management, such as mowing and grazing activities, leads to the succession of semi-natural grasslands. This work focuses on secondary grasslands protected under the Habitats Directive and present in Risnjak National Park and Velebit Nature Park, with the aim to assess their condition and identify potential restoration areas. Field surveys were conducted across all semi-natural grasslands in Risnjak NP (Natura 2000 codes 6210, 6520, 6230, 4030), all 6410 and 4030 grasslands and a subset of 6210, 62A0 and 6230 grasslands in Velebit NP. As the latter three cover larger areas in Velebit NP, remote sensing using Sentinel satellite images (2017-2023) was applied to obtain spatiotemporal representation indicating vegetation succession across their entire distribution in the park. Grassland areas were classified into three succession stages: 1. well-maintained grassland with no or little succession, 2. late-succession grasslands requiring restoration, and 3. final-succession which suggests leaving the area to the already formed young forest. Although most *Festuco-Brometalia* (6210) and sub-Mediterranean dry grasslands (62A0) were recorded in good condition, some areas show a clear trajectory towards shrub and tree dominance due to depopulation and lack of livestock. In species-rich *Nardus* grasslands (6230) where succession was recorded, *Nardus stricta* was absent, indicating the vulnerability of this grassland to succession. Heaths (4030), *Molinia* meadows (6410) and mountain hay meadows (6520) are at risk of disappearing due to their small extent in the parks, vegetation succession or land use changes. Heaths are increasingly affected by *Pteridium aquilinum*, whereas *Molinia* meadows are impacted by soil fertilization for increasing grassland productivity. These assessments provide a reference for design and implementation of conservation measures and as a knowledge base for better understanding management of grassland in both protected areas.

Keywords: ecological network, spatial analysis, traditional management, vegetation succession

PERIPHYTIC ALGAE AS BIOLOGICAL TRACES: MONITORING THE COLONIZATION OF PERIPHYTIC COMMUNITIES ON SYNTHETIC AND NATURAL SUBSTRATES

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Periphytic algae are essential components of aquatic ecosystems and have gained growing interest in forensic science due to their potential as biological tracers in investigations. This study explores the colonization dynamics of periphytic algae on various synthetic and natural substrates over a 56-day period in a natural freshwater environment. Substrates including cotton, nylon, leather, metal, plastic, glass, and wood were submerged to assess differences in algal succession and biofilm formation. Sampling occurred at regular intervals (1, 7, 14, 21, 28, 35, 42, 49, and 56 days) to examine algal composition and biofilm development. Environmental factors such as water temperature, pH, turbidity, light intensity and depth were also monitored to evaluate their impact on colonization rates. The goal of this study is to understand the colonization patterns and succession dynamics of periphytic algae on materials commonly encountered in forensic investigations. By analyzing algal accumulation and community composition over time, the research aims to enhance our understanding of how algae interact with submerged objects and contribute to determining the duration of submersion in forensic contexts. The findings indicate that periphytic algae can offer valuable insights into the exposure time of various materials in aquatic environments, making them useful indicators in forensic casework. This study emphasizes the potential of algae as biological evidence for determining the postmortem submersion interval (PMSI) of objects or bodies recovered from water. A deeper understanding of algal succession on different surfaces could improve forensic methods by refining postmortem interval (PMI) estimations, aiding in the identification of submersion time, and supporting evidence collection in aquatic crime scenes. Additionally, incorporating algal data could assist in distinguishing between accidental drownings and homicides, enhancing the accuracy of forensic investigations. Future research should examine colonization patterns under varying hydrological and seasonal conditions, further bridging the gap between forensic science and phycology.

Keywords: biofilm, drownings, biological tracers, postmortem submersion interval

DNA-BASED COMPARATIVE ANALYSIS OF FUNGAL COMMUNITIES IN HORSE AND CATTLE GRAZED GRASSLANDS

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In this study, soil samples were collected from grazed and ungrazed grasslands in two distinct regions. At Kunpeszér (Dél Alföld), cattle-grazed sites were studied, while in Szilvásvárad (Bükk Mountains), horse-grazed grasslands were examined. A total of 64 sampling points were designated across four equally sized sites. The soil samples were pooled, and DNA extraction was performed from 16 composite samples. Through the DADA2 bioinformatics pipeline, 1681 unique amplicon sequence variants (ASVs) were identified.The primary aim of the research was to assess how different grazing regimes – cattle grazing, horse grazing, and control (ungrazed) – influence the structure of fungal communities, based on three alpha diversity indices: Chao1 (species richness), Shannon index (diversity and evenness), and Simpson index (dominance-sensitive diversity).Results showed that the control sites in Kunpeszér had the highest species richness (~250), suggesting the presence of many rare species. In contrast, both cattle- and horse-grazed sites displayed lower species richness. Interestingly, the horse-grazed site in Szilvásvárad exhibited the most balanced species distribution, despite its lower richness, indicating a stable community with no dominant taxa. Cattle-grazed sites showed reduced alpha diversity, suggesting the presence of a few dominant species.These findings indicate that cattle grazing significantly disturbs fungal communities by reducing species richness and increasing dominance. In contrast, horse grazing has a more moderate impact, allowing for the persistence of more stable and evenly structured fungal communities. Control areas showed high richness with variable balance. From an ecological perspective, horse grazing appears to be a more sustainable land-use practice for preserving fungal diversity, while cattle grazing leads to notable structural shifts in community composition.

Keywords: Beta diversity, Fungal ecology, Metabarcoding, Soil microbiom

FLORA AND VEGETATION OF MACROALGAE ON THE TUFA-FORMING WATERFALLS OF THE KRKA RIVER (CROATIA)

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The waterfalls of the Krka River (Croatia) represent dynamic freshwater ecosystems where tufa formation processes are closely associated with specific macroscopic algal conglomerates. During the spring and autumn of 2024, a comprehensive survey of macroalgal flora and vegetation was conducted across seven waterfalls: Bilušića buk, Brljan, Manojlovac, Rošnjak, Miljacka, Roški slap and Skradinski buk. Fieldwork included *in situ* documentation and sampling of macroscopic algal and cyanobacterial communities with laboratory identification of taxa. Samples were identified to species level or the lowest possible taxonomic level. Environmental parameters such as water flow, light availability, substrate type, and carbonate precipitation intensity were recorded at each location. A total of 81 macroalgal taxa were identified. Cyanobacteria dominated the flora with 37 taxa (45% of the total documented taxa), followed by Chlorophyta with 28 taxa (35%), Rhodophyta with eight taxa (10%), Xanthophyta with five taxa (7%), Chrysophyta with two taxa (2%) and one Phaeophyta (*Heribaudiella fluviatilis*) (1%). Macroalgal communities were classified into 14 distinct types, including dominant filamentous algae (*Cladophora glomerata, Vaucheria* spp., Zygnemataceae assemblages), tufa-forming calcareous algae (e.g., *Gongrosira* spp., *Oocardium incrustatum*), cyanobacterial mats (e.g., *Nostoc* spp., Oscillatoriales), filamentous red algae (e.g., *Batrachospermum* spp., *Lemanea* spp., *Bangia atropurpurea*), a crustose freshwater red and brown algal assemblage (*Hildenbrandia–Heribaudiella*), coldwater algae (*Hydrurus foetidus*), terrestrial algae (*Trentepohlia aurea*), brackish-water forms (*Polysiphonia subtilissima*) and stoneworts (*Chara* spp.). The macroscopic flora and cyanobacterial mats were strongly influenced by hydrological and microhabitat conditions, with clear zonation related to water flow dynamics and light exposure. A historical comparison confirmed 15 species recorded by Hansgirg in 1890 and 24 species documented by Golubić in 1957, indicating both the long-term stability of key macroalgal communities and an increase in recorded diversity. The results highlight the importance of macroalgae and cyanobacterial mats in the biological and geomorphological processes of tufa formation.

Keywords: community structure, biodiversity, freshwater ecosystems, microhabitats, periphyton

BIOINDICATOR VALUES OF ORCHIDS IN THE WIDER AREA OF PLJEŠEVICA MT. IN BOSNIA AND HERZEGOVINA

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Botanical research on the wider area of Plješevica Mt. is scarce. Data on the ecological status of primeval forest ecosystems can be found in the work of Višnjić et al. (2012), while information on the diversity of specific species, particularly orchids, is provided by Nadarević et al. (2025). Although the area of Plješevica Mt. is well preserved, as evidenced by the presence of intact beech and fir communities as well as numerous orchid species, certain anthropogenic pressures have been observed, significantly disrupting the structure and dynamics of primary climatogenic ecosystems and natural habitat types. Preliminary research on the wider area of Plješevica Mt., has confirmed a high diversity of plant species belonging to the Orchidaceae family (Nadarević et al., 2025), with a total of 21 taxa recorded, some of which are rare and endangered. While representatives of this vascular plant group are widely distributed and form part of open ecosystems in the submontane and montane belts, their habitats are currently under threat due to various anthropogenic influences.The aim of this study is to present the taxa of the Orchidaceae family in the wider area of Plješevica Mt., and analyze their indicator values (Landolt et al., 2010). The obtained data on their ecology may contribute to assessing the current status of primary ecosystems in the studied area and in the future, aid in the improved conservation of the broader Plješevica mountain region.

Keywords: primary ecosystems, anthropogenic pressures, ecosystem conservation, mountain ecology.

CONTRIBUTION TO THE KNOWLEDGE ON ALLIANCE *Trifolion resupinati* MICEVSKI 1957 IN THE REPUBLIC OF NORTH MACEDONIA

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This study presents a syntaxonomic analysis of wet meadows belonging to the alliance *Trifolion resupinati* Micevski 1957 (class *Molinio-Arrhenatheretea*) in the subarid continental regions of the southern Balkan Peninsula. It includes eight original relevés from the Glajsho locality on Galichica Mountain (North Macedonia) and 422 relevés from literature and unpublished sources from North Macedonia, Serbia, Kosovo, and Greece, totalling 430 relevés. Hierarchical cluster analysis revealed that the vegetation belongs to the association *Cynosuro-Caricetum hirtae*, and that the newly sampled relevés form a distinct cluster. This justified the description of a new subassociation – *Cynosuro-Caricetum hirtae galietosum macedoniceae* subass. nova – representing a transitional vegetation type between meadows and pastures. The new subassociation is characterized by a unique floristic composition, dominated by hemicryptophytes, with a significant presence of *Trifolium* species and diagnostic taxa such as *Galium macedonicum*, *Trifolium scabrum*, and *Phleum pratense*. Ordination analysis (DCA) confirmed the ecological distinctiveness of this association, which is adapted to drier and more continental conditions. This contribution enriches the understanding of the variability of meadow vegetation in North Macedonia and the Southern Balkans and highlights the ecological importance of non-intensively grazed meadow habitats in mountainous areas.

Keywords: *Cynosuro-Caricetum hirtae*, Galichica, grassland communities, phytosociology, subassociation

POSTERSKA PRIOPĆENJA

Konzervacijska biologija i urbana ekologija

POSTER PRESENTATIONS

Conservation biology and urban ecology

FLORISTIC COMPOSITION AND COMPARATIVE ANALYSIS OF *Rhododendron luteum* HABITATS: INSIGHTS FROM A SLOVENIAN POPULATIONS AND TWO RELICT SITES IN EUROPE

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Rhododendron luteum Sweet, a rare relic of the Tertiary, has the main area of distribution in the Pontic area with numerous small disjunct locations in Poland, Belarus, Ukraine, Austria, Greece, and Slovenia. While it was introduced in several regions where it sometimes naturalized, it is threatened and protected in its natural habitats. It faces conservation challenges due to habitat loss, overcollection, and climate change. Conservation efforts focus on habitat protection, regulated collection, and ex-situ cultivation in botanical gardens to preserve genetic diversity and prevent extinction. In Slovenia the species was first documented in 1954 in the Gorjanci region. Additional known sites are located in the Sevnica municipality: Boštanj and Vrhk above Tržišče. All Slovenian sites are part of the Natura 2000. There, the species thrives in acidic soils, typically under tree canopies that protect it from excessive sunlight. It grows mainly in associations with *Fagus sylvatica* and *Castanea sativa*, forming small populations indicative of its relict status. In this study I assessed the current population status of *R. luteum* in Boštanj, conducted a floristic inventory, and compared species composition with literature data from similar sites in Austria and Poland. Considering geographic differences and local flora characteristics, the comparative study showed that common tree species across all sites include *F. sylvatica*, *Quercus petraea*, and *Sorbus aucuparia*, while the herbaceous layer features *Vaccinium myrtillus*, *Frangula alnus*, *Calluna vulgaris*, and *Pteridium aquilinum*. The data presented will help the local conservation measures, which include forest rejuvenation logging followed by selective removal of the thicket.

Keywords: conservation, rare plant, Tertiary relic, yellow azalea

INSIGHT INTO LAWN MAINTENANCE PRACTICES IN SLOVENIAN PRIVATE LAWNS

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Private lawns, ubiquitous in suburban and urban areas, pose both ecological challenges and opportunities. While lawns can support local biodiversity depending on maintenance practices, they often require high water consumption, chemical fertilizers, pesticides, low-diversity seed mixtures, and frequent mowing. We aimed to evaluate the efforts and willingness of Slovenian lawn owners to maintain their lawns. We conducted a public, anonymous survey. Here, we present preliminary results from over 230 respondents. More than half of the respondents spent between €100 and €300 annually, driven by aesthetic preferences. Socially, lawns symbolize status and community conformity. During peak season, 40% of respondents mow weekly, spending an average of 1 to 3 hours per week on lawn care for various tasks. Slovenian lawns are often multifunctional green spaces, with many incorporating other plant species, such as trees, demonstrating potential to enhance biodiversity and support local pollinators. In conclusion, balancing ecological benefits with social acceptance is key to leveraging private lawns for sustainable urban ecosystems.

Keywords: biodiversity, green infrastructure, mowing, urban habitat

ROLLING ON THE MURA RIVER… A STUDY OF NON-NATIVE PLANT DISTRIBUTION IN NORTHERN CROATIA

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Freshwater ecosystems are among the most degraded and threatened globally, particularly vulnerable to alien species. Rivers serve as primary pathways for the spread of these aliens, facilitated by downstream currents and, more significantly, by river infrastructure that disrupts both longitudinal and lateral connectivity, leading to degradation and fragmentation of vital riparian habitats. The riparian zones experience considerable pressure from exotic plant species due to disturbances in native vegetation caused by both natural events, like floods and erosion, and human-induced changes, such as alterations in hydrology and hydromorphology. To assess the invasion rates of non-native plant species in the riparian zone, an extensive field study was conducted along the Mura River in Northern Croatia during the summer of 2024. The Mura River, the northernmost river in Croatia, is part of the protected area Mura-Drava Regional Park. The study encompassed the final 79-kilometer long stretch of the river, from its entry point into Croatia to the confluence with the Drava River. Surveys were conducted from the boat, sailing downstream and estimating the abundance of non-native plant species for each kilometer of the riverbank. Every section of the river was invaded by at least one non-native plant species. A total of 18 invasive species were identified, with an average of five species per kilometer. The most common species included *Solidago canadensis*, *Acer negundo*, *Impatiens glandulifera*, *Populus* × *canadensis*, *Reynoutria* × *bohemica, Echinocystis lobata*, *Fraxinus pennsylvanica* and *Robinia pseudoaccaia*. While most species exhibited low average coverage (less than 20%), *Reynoutria* × *bohemica* and *Populus* × *canadensis* had notably higher coverages of 25.7% and 22.4%, respectively. In summary, non-native invasive plant species pose a significant threat to the riparian vegetation and flora along the Mura River, with no straightforward solutions in sight.

Keywords: alien species, habitat degradation, invasion rate, Mura-Drava Regional Park, riparian habitats

DISTRIBUTION AND THREAT STATUS OF THE ORANGE LILY *Lilium bulbiferum* L. IN THE PLITVICE LAKES NATIONAL PARK

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Orange lily *Lilium bulbiferum* L., is a strictly protected and vulnerable (VU) plant species of Croatia and the Plitvice Lakes National Park (PLNP). The PLNP Management Plan (2019) requires a detailed mapping and research of strictly protected and endangered floral taxa. The aim of this research was to obtain more detailed data on the distribution, population density and status of the orange lily within the PLNP. The research covered the habitats where it grows; mountain grasslands, target habitat type 6210* Semi-natural dry calcareous grasslands and their scrub stages (Festuco-Brometalia) (*important orchid sites) and forest edges. Multi-year research was conducted during the flowering period (late June, early July) when the species is easily visible. The species was recorded in the marginal, less explored parts of the PLNP at the locations Kuselj, Špejarovi Lugovi and Sječivica. The main threat to the orange lily habitats in the PLNP area is vegetation succession. In the area of Kuselj, an additional threat was observed - the usage of area for farming purposes (cultivated plants). The measured differences in the plant densities indicate that the area of Kuselj is the most suitable for this species, which is why more attention should be paid to it in terms of conservation. The results of the research will be used for improvement of monitoring, taking management measures and amending the management zoning of the PLNP (Natura 2000 habitat zones).

Keywords: strictly protected and vulnerable plant species, distibution, The Plitvice lakes Menagment Plan

EARLY-RESPONSE OF BRYOPHYTE COMPOSITION TO EXPERIMENTAL INTERVENTIONS IN OAK-DOMINATED FORESTS: CASE STUDY FROM CENTRAL SLOVAKIA

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Biodiversity loss in temperate oak forests is driven by land-use changes, nitrogen deposition, climate change, and plant invasions, resulting in altered forest structure and species composition. Traditional management practices, such as canopy thinning and litter raking, historically kept forests more open, allowing more light and exposing bare soil, which supported diverse understorey plant communities. Their abandonment has led to canopy closure, shifts toward more mesophilous, shade-tolerant, and nutrient-demanding vegetation, and an overall decline in biodiversity. Given their sensitivity to microclimatic changes, nutrient dynamics, and substrate availability, bryophytes represent valuable indicators of ecosystem responses to forest interventions. However, experimental studies specifically analyzing bryophyte communities in response to management practices, particularly in temperate oak forests, remain scarce. In this study, we analyzed a three-year response of bryophyte taxonomic and functional composition to canopy reduction, litter raking, and fertilization treatments within a restoration-oriented field experiment in oak-dominated forests of Central Slovakia (the Western Carpathians). By applying these treatments individually and in combination in 10×10 m plots, we aimed to disentangle their effects and assess how historical practices, and modern environmental pressures jointly shape bryophyte community dynamics. Results of a partial PCA analysis revealed that raked plots had a significantly different species composition compared to unraked ones. In particular, raked plots with reduced canopy showed a marked increase in small, light-demanding, terrestrial acrocarpous mosses. Raked plots where the canopy remained intact changed the most over three years, with a notable rise in the cover of Brachytheciastrum velutinum. In contrast, all unraked plots maintained a similar species composition and showed little change over the same period, suggesting a relatively weak individual and combined effect of thinning and fertilization. Restoring traditional practices can thus enhance bryophyte diversity in temperate oak forests. This work was supported by the Interreg VI-A Hungary-Slovakia Programme (HUSK/2302/1.2/168).

Keywords: functional traits, historical management, liverworts, mosses, Quercus

POSTERSKA PRIOPĆENJA

Edukacija, promocija i profesionalne aktivnosti

POSTER PRESENTATIONS

Education, Promotion and Professional Activity

HOW MUCH DO CHILDREN IN PRIMARY EDUCATION KNOW ABOUT PLANTS?

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The aim of our study was to detect the knowledge of primary school students about the fundamentals of botany and the recognition of the most common plant species in their immediate environment. The research was conducted on 78 upper-grade students from elementary schools in Samobor. Participation was voluntary via questionnaire, attended by seventh-graders. The students were divided into two groups: Group A (52 students) completed a questionnaire assessing botanical knowledge and plant species recognition, while Group B (26 students) completed the questionnaire one week after using the exercise book "Known - unknown about plants" (in Croatian). The results showed that fewer students in Group A recognized the concept of herbaceous vs. woody plants (31% vs. 60%) and the roles of roots and leaves (51% vs. 72%) compared to Group B. Both groups mostly answered correctly (72% vs. 76%) that tubers, bulbs and rhizomes are parts of the stem, and 61% of Group A versus 80% of Group B identified rose hips as the fruit of the wild rose. Students in Group A generally failed to recognize common regional species, whereas Group B performed better: beech (*Fagus sylvatica* L.; 27% vs. 42%), hornbeam (*Carpinus betulus* L.; 30% vs. 58%), maple (*Acer platanoides* L.;39% vs. 67%), and spruce, pine, and fir (*Picea abies* (L.) H. Karst*., Pinus sylvestris* L*., Abies alba* Mill.;27% vs. 52%). In an open-ended question about the term for decorating a Christmas tree, students indicated with varying accuracy (25% vs. 58%) that fir or spruce is primarily used. Participants in both groups (48% vs. 68%) partly recognized poisonous plants, though 15% of Group A mistakenly classified yew (*Taxus baccata* L.) as non-poisonous. We can conclude that the use of additional practical materials in teaching has noticeably improved knowledge, and students' self-assessments have shown an increased interest in plants.

Keywords: botany, education, primary school students, questionnaire

CENTENNIAL CELEBRATION OF THE JOURNAL *ACTA BOTANICA CROATICA*

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The journal *Acta Botanica Croatica* has a long history dating back to 1925, when it was founded under the name *Acta Botanica instituti botanici regalis universitatis Zagrebensis* by Croatian botanists from the Department of Botany at the Faculty of Humanities and Social Sciences (then Faculty of Philosophy) of the University of Zagreb. Throughout its history, the journal has undergone various phases, including interruptions in publication due to political and economic conditions, especially during the Second World War. In the early years, the journal mainly published articles by local authors in Croatian. In 1969, an international peer-review process was introduced. Since 1998, the journal has been published regularly with English-language articles. The journal publishes scientific articles on terrestrial and aquatic botany, plant ecology with a special emphasis on karst areas in southern Europe and the Mediterranean, and experimental botany (including plant viruses, bacteria, archaea, algae, and fungi). In the 21st century, the journal has gained visibility in the scientific community and has been indexed in citation databases such as Scopus, CABI, and Web of Science. It also became part of the Hrčak portal, which provides open access to scientific articles. Over the years, the journal has modernized its appearance and editorial processes, resulting in improved quality and visibility, as well as a higher impact factor. The journal *Acta Botanica Croatica* continues to work on improving its visibility and quality in order to gain even more prominence in the international scientific community.

Keywords: Acta Botanica Croatica, botany, international peer review, open access, scientific journal

"NOBODY LEAVES WITHOUT LEARNING SOMETHING!" PROMINENT SPECIES IN THE COLLECTIONS OF ZAGREB FACULTY OF SCIENCE BOTANICAL GARDEN INTENDED TO GENERAL EDUCATION

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University of Zagreb Faculty of Science Botanical Garden cultivates ca 6,500 plant taxa in 15 main collections managed by four curators, a head-gardener and 14 gardeners. Total area of the Garden remained the same since its foundation in 1889: most of its 4.5 ha is an arboretum planted with trees and shrubs. Croatian flora is grown in the phytogeographical groups (rockeries), while some more sensitive indigenous species are overwintering indoors. Systematic fields are planted with herbs, annuals and bulbous species according to their affiliations, primarily intended for the university botany lessons, but also open to the public. Among other, there are the assortments of useful, medicinal and culinary plants, as well as the Children's vegetable garden, *Salvia* and *Narcissus* collections, native and old *Iris* hybrids collection, etc. The largest single family depicted in the Garden are Iridaceae, with more than 600 taxa. Marsh and water plants are grown both outdoors and indoors: in the water basins at the systematic fields, in the ponds and greenhouses. With exception of the "Victoria house", containing assorted tropical epiphytes and water plants, the glasshouses are closed to the public. Nevertheless, they are housing extensive collections of dendrological, herbaceous and bulbous plants of various tropics around the world, among which some of the most prominent are palms, ferns, succulents, bromeliads and carnivorous species. During the summertime, majority of the large greenhouse potted plants are brought in the open, where they could be appreciated by more than 100,000 visitors per season. Our mission is "nobody leaves the Garden without learning something", hence our plant collections are first and foremost educational. Yet, to attract broader public, various ornamentals are planted in flowerbeds through the Garden. Many rare, endemic, very old or otherwise outstanding single plants and collections are accompanied by information boards in Croatian and in English.

Keywords: arboretum, botanical collections, glasshouse, learning, popular botany

COMPARISON OF THE EFFECTIVENESS OF DIFFERENT METHODS OF TEACHING PLANT SYSTEMATICS USING AI

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Plant systematics is one of the fundamental branches of botany, and learning plant classification and identification can be challenging for students. The aim of the research is to compare the effectiveness of three approaches (traditional, digital, combined) in teaching plant systematics when dealing with the topic *Diversity of living things and methods of their classification*. The traditional approach included working with a physical herbarium and traditional keys for determination; the digital approach included creation of a digital herbarium using AI for plant identification, and the third approach was a combination of the first two. The sample consisted of 120 eighth grade students from three elementary schools. The adoption of the outcomes was checked using multiple-choice and short-answer questions after processing. The students' attitude towards the mentioned learning approaches was checked using questionnaires, and a *Likert scale*. Statistical analysis was performed using the *Jamovi 2.3 program*. ANOVA and *t-test* were used for statistical analyses. The results showed that the combined approach was the most effective in acquiring knowledge about plant systematics, and the traditional approach was the least effective. The results of the survey show that students rate the digital and combined approach better than the traditional one. The results additionally indicate that digital and combined approaches enable greater interactivity, easier access to information, and greater student motivation for learning compared to traditional methods. These results suggest the importance of adapting teaching methods to new generations of students and the need to integrate digital tools into biology teaching in order to achieve better educational outcomes.

Keywords: artificial intelligence, botany, attitudes, herbarium, determination

STUDENTS' MISCONCEPTIONS ARISING FROM THE ADOPTION OF BOTANY CONCEPTS

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The aim of our research was to determine misconceptions related to botanical content that appear from the 8th grade of elementary school to the 3rd grade of high school. Testing in elementary schools was conducted face-to-face in 2019 (N=52), and online in 2023 (N=108), and in high schools in 2023, face-to-face (N=155) and online (N=81). From eight questions used for testing reproductive knowledge and conceptual understanding, misconceptions were identified, separated and associated with macroconepts listed in the Croatian curriculum. Identified concepts were part of the macroconcepts *Organization of the living world*, *Processes and interactions in the living world*, and in elementary school of the macroconcept *Energy in the living world*. Statistical analysis was performed with the *Jamovi 2.3 program*. To analyze the variance between concepts and causes of misconceptions, the *Kruskal-Wallis* rank test was used, and *Post-Hoc DSCF* analysis was used to compare groups within the sample. Our results showed that high school students had the highest frequency of misconceptions in the concepts of reproduction of plants (16.7%) and photosynthesis (13.9%), and among elementary school students in the concepts of growth and development (11.1%) and photosynthesis (8.4%). The *Kruskal-Wallis rank test* showed a statistically significant difference between the concepts and the classes in which they were recorded, as well as between the concept and the cause of the misconception. Misconceptions related to the concepts of plant organs and growth and development appear among 8th grade students, while they are not recorded in the same concepts among high school students. The analysis of the frequency of the causes of misconceptions showed that the most common cause of misconceptions in both groups of respondents was misunderstanding of terms and adoption of facts without understanding. High school students more often do not understand concepts (38.9%), and elementary school students more often acquire content without understanding (19.4%).

Keywords: elementary and high students, macroconcepts, concepts of reproduction of plants, concepts of photosynthesis

LOOKING FOR PLANTS IN THE SCHOOL READING ASSIGNMENTS

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At the Silvije Strahimir Kranjčević Elementary School, with the aim of encouraging an interdisciplinary approach to teaching, we launched a project that combines literature and natural sciences. Students from 5th to 8th grade were tasked with paying attention to the plants mentioned in the books they were reading and writing them down in their reading journals. Twenty books, five from each grade, which students read during the second semester, were analyzed. A list of 147 recorded plant species was compiled, and the 13 most frequent ones were selected, one for each of the 13 classes, to become the subject of their further research. Those plants are: *Rosa* sp. (13/20 books), *Solanum tuberosum* L. and *Malus domestica* Borkh. (9/20 books), *Prunus domestica* L. and *Juglans regia* L. (8/20 books), *Brassica oleracea* L., *Corylus avellana* L., *Solanum lycopersicum* L., *Musa* sp., *Citrus aurantium* L. (7/20 books), *Vitis vinifera* L., *Pinus sylvestris* L. and *Tilia* sp. (6/20 books). The next step was the creation of educational posters, in which the students presented the botanical characteristics of the selected plants, as well as their role and context in the literary works. The poster exhibition was set up in the Zagreb City Libraries, starting with the Medveščak Library during June 2025. The aim of the project was to encourage students to research and learn outside the usual frameworks, showing them how different areas of knowledge can complement and enrich each other. Through this project, students developed research, analysis, presentation, and teamwork skills, while also having fun and learning something new about the world around them.

Keywords: books, exhibition, interdisciplinary, library, students

COLLECTION OF SEEDS AND FRUITS OF THE NATURAL HISTORY DEPARTMENT OF THE MUSEUM OF SLAVONIA

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A valuable donation of seeds and fruits of wild and cultivated plant species to the Museum of Slavonia Collection by prof. dr. sc. Mira Knežević founded a new museum collection of the Natural History Department called the Collection of Seeds and Fruits. The aim of the exhibition is to present the aforementioned collection, which contains native plant species and biodiversity records in the area of northeastern Croatia. From wild-growing taxon of angiosperms of weedy, ruderal and grassland flora, to food, fodder plant properties and properties for industrial processing collected as part of numerous botanical research. A smaller number of seed samples refer to Mediterranean properties that were collected in field experiments in Istria. The donated collection is entered into the museum holdings according to the systematic affiliation of properties in two classes. The catalog record of seed and fruit samples contains the scientific and native name, the indication of the threat and the inventory mark. The collection is published in the edition Catalogues of the Museum of Slavonia Seeds and Fruits, 2024.

Keywords: collection catalogue, donation, native plant species, museum collection

COMMON MISCONCEPTIONS IN BOTANY IN BIOLOGY TEACHING

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Student perceptions that are not in accordance with scientific knowledge, and that arise after learning or have not changed during learning, are called misconceptions, and they should direct us to search for methods for their early detection and suppression. The aim of the research is to determine the frequency of such perceptions in the field of botany among students in the first and third grades of the grammar school program before and after the processing of teaching content in the field of botany. It is expected that the frequency of misconceptions among students will decrease from the first to the third grade of grammar school. The initial research was conducted using 36 closed-ended questions in the Forms tool on a sample of 559 students in the first and 390 students in the third grade of grammar schools from the Split-Dalmatia and Zadar counties. The research results were also processed in the Forms tool. After processing the results, it was established that the frequency of misconceptions is lower among third grade students, although some misconceptions are still present. The results of this research should encourage teachers to change teaching methods when processing content in botany in order to reduce the aforementioned frequent misconceptions. The earlier the identification of misconceptions, along with proven educational materials and the most effective methods of active and investigative learning, the less likely they are to be present among students.

Keywords: student perceptions, scientific knowledge, grammar school

POSTERSKA PRIOPĆENJA

Biljke i društvo

POSTER PRESENTATIONS

Plants and society

BANANA (GENUS *Musa* L.) PSEUDOSTEM SAP AS NATURAL DYE AND UV PROTECTION FOR COTTON FABRIC

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The banana plant (*Musa* L.) is one of the oldest cultivated species, belongs to the *Musaceae* family and is widely recognized as an important part of human nutrition. However, the pseudostem of the banana plant that remains after annual pruning often poses a challenge to the environment. In most cases, it is disposed of through unsustainable methods such as burning or dumping in nature, contributing to the accumulation of bio-waste. To mitigate this problem, the implementation of a circular economy model that utilizes all parts of the plant is essential. The banana pseudostem is particularly rich in fibers and sap, which can be used in textile technology, thus reducing bio-waste.
Banana pseudostem from genus *Musa* L. was used and cut into smaller pieces to extract the sap from the pseudostem, which is needed for dyeing cotton fabrics. The extraction was carried out in a machine to separate the banana pseudostem sap from the other solid parts of the banana pseudostem. The extracted sap was evaporated to obtain a dry extract.
Chemically bleached cotton fabric (CB) was dyed with a dry extract of banana pseudostem sap (BPS) at a concentration of 100% (based on the mass of the material), without (CB_BPS) and with the addition of 5% metal salts (mordants) - aluminum (CB_BPS_Al), copper (CB_BPS_Cu) and iron (CB_BPS_Fe).
The spectral characteristics were measured using a remission spectrophotometer and the UV protection with a UV/VIS transmission spectrophotometer.
Chemically bleached cotton fabric dyed with BPS produces brown hues that depend on the type and addition of a mordant. When examining the UV protection, it can be seen that the treatment with BPS increases the UPF value to excellent compared to the CB and the samples treated only with mordants that do not have UV protection. The exception is the sample treated only with ferroum mordant, because ferroum itself has the ability to absorb UV radiation.

Keywords: bio-waste, brown hues, circular economy, textile technology, UPF value

”CITIZEN SCIENCE” IN FLORISTIC FIELD WORK: PITFALLS AND BENEFITS

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Citizen science (=CS) concept is very popular recently. Its main idea is involvement of the general public in scientific research to connect science, policy makers, and society. 10 principles of CS developed and applied by ECSA will be analyzed. Our point of view is applicable in the ex-Yu region with extremely high plant diversity, comparably low financial and technical resources and quite low general public interest in floristics.
“Involvement of CS research produces new knowledge, with citizen contributors, collaborators, or project leaders (1)”: problematic due to low level of knowledge, lack of self-criticism and lack of experience. “CS projects should have genuine science outcome (2)”: achievable with highly adapted and elaborated methodology not by CS brainstorming. “Professionals and citizens should benefit from participating (3)”: discussion on responsibility share and knowledge input, different expectations of benefits. “CS may participate in multiple stages of the scientific process (4)”: problematic idea causing communication noise. “Feedback from project address also CS participants (5)”: sounds fair. “CS is considered a research approach like any other, with limitations … to be considered and controlled for (6)”: how to compensate for the biases and extract the reliable information from information noise. “CS project data are publicly available and published (7)”: problem of data quality and responsibility for quality control. “CS is acknowledged in results and publications (8)”, sounds fair. “CS programs evaluated for scientific output, data quality, participant experience ... (9)”: problem of low quality recognition. “Leaders of CS projects consider legal/ethical issues (10)”: but who can know all that?

Key-words: General public, policy makers, flora

SIGNIFICANT MEDICINAL PLANTS ON VRŠANI NEAR TUZLA (NORTHEASTERN BOSNIA AND HERZEGOVINA)

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This paper is based on research into significant medicinal plants found in the Vršani area near Tuzla, located in the northeastern Bosnia and Herzegovina. The Vršani site is a natural recreational area, situated approximately 2 km southeast of the urban zone, at an altitude of 412 m. The location is enriched with a diversity of plants, owing to favorable ecological factors. The dominant vegetation consists of forest ecosystem species, particularly *Carpinus betulus* L. *Quercus petraea* Lieb., *Fagus sylvatica* L. The study focused on specific medicinal plants found at these locations, Šiljci, Lake, Hukići, covering an area of 2 km², from September 2024 to March 2025. The aim of the research is to identify plant species that are important to visitors of the recreational area for their medicinal value and are also accessible for collection and use in healing purposes. These species were determined in the laboratory using identification keys and were photographed. A total of 12 species are: *Pulmonaria officinalis* L., *Symphytum officinale* L., *Allium ursinum* L., *Taraxacum officinale* Weber., *Urtica dioica* L., *Crataegus azarolus* L., *Rubus fruticosus* L., *Rosa canina* L., *Cornus mas* L., *Malus sylvestris* Mill., *Prunus avium* L., and *Prunus domestica* L. In terms of taxonomy, these species belong to the following families: *Rosaceae* (6), *Boraginaceae* (2), *Urticaceae* (1), *Asteraceae* (1), *Amaryllidaceae* (1), and *Cornaceae* (1). The majority of the studied species belong to the *Rosaceae*. A diversity in vertical stratification was also observed, including herbaceous (5), shrub (4), and woody (3) species. All of the listed plant species are important as sources of medicinal substances and are suitable for use in maintaining human health. Further, more research is necessary in the future to develop a complete phytocoenological profile of the medicinal flora found at the Vršani site and the surrounding area of the city of Tuzla.

Keywords: Bosnia and Herzegovina, Vršani, medicinal plants, forest.

TRENDS AND FORGOTTEN PRACTICES IN WILD PLANT USE IN HRVATSKO ZAGORJE REGION (NW CROATIA)

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Ethnobotanical field research across the geographical and historical region of Hrvatsko zagorje has been conducted since 2015, with the aim of collecting and recording data on the traditional use of wild plants among local inhabitants, along with gathering diverse local dialectal nomenclature. The field work study used semi-structured interviews and free listing. It included 160 informants of average age of 70 from rural surroundings of four cities throughout the region. Voucher specimens of the taxa mentioned were collected whenever available. The result is the plant species list including wild plant taxa with belonging vernacular names and different ways of usage: human and domestic animals nutrition, medicinal use, ornamental and religious use, everyday useful items construction - e.g. basketry, building tools, musical instruments, toys and use as construction material and firewood. The most commonly mentioned plants are those being used as food and medicine, belonging to families Asteraceae, Lamiaceae, Rosaceae and Fabaceae. Due to the common climate and similar vegetation, many species used in Hrvatsko zagorje region overlap with previously recorded taxa from surrounding countries (Slovenia, Hungary, Bosnia and Herzegovina). There is a certain assumption of the disappearance of traditional knowledge from everyday life as some traditions and practices have still been utilized or remembered only by the small number of aged inhabitants. At the same time, several of recorded plant species and their use have no traditional roots, but they are mentioned as a result of literature use and influence of modern media. In addition, as in many other rural areas in Croatia, the abandonment of traditional agriculture and negative population trends have been noticed also in Hrvatsko zagorje, contributing to further loss of traditional knowledge.

Keywords: ethnobotanical study, Hrvatsko zagorje, NW Croatia, traditional knowledge

POSTERSKA PRIOPĆENJA

Genetika, genomika, metablomika i transkriptomika

POSTER PRESENTATIONS

Genetics, genomics, metabolomics and transcriptomics

ANTIBACTERIAL AND ANTI-BIOFILM EFFECTS OF *Solidago gigantea* OIL

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Solidago gigantea Aiton is a rhizomatous perennial herb native to North America and invasive to Europe and Asia. Its aerial part contains flavonoids which may be responsible for its diuretic, anti-inflammatory, and antispasmodic effects. However, data on the effects of its essential oil are limited. This study aimed to evaluate the antibacterial and biofilm-inhibitory activities of *Solidago gigantea* essential oil against urinary tract pathogens, including *Escherichia coli* ATCC 25922, methicillin-resistant *Staphylococcus aureus* (MRSA) ATCC 25923, and *Pseudomonas aeruginosa* ATCC 27853. The essential oil was extracted via steam distillation from the aerial parts of *S. gigantea* that were collected from three locations in Hungary (Hévíz, Homokmégy, and Vejti). Antibacterial activity was assessed using broth microdilution, biofilm inhibition, and membrane damage assays. Scanning electron microscopy was utilized to examine structural changes in bacterial cells. Minimum inhibitory concentration (MIC) analysis revealed species-specific differences in susceptibility: *Escherichia coli* was the most sensitive (MIC: 0.31-0.62 mg/mL), followed by methicillin-resistant *Staphylococcus aureus* (MRSA) (MIC: 0.62-1.25 mg/mL), while *Pseudomonas aeruginosa* was the most resistant (MIC: 1.25-2.50 mg/mL). Consistently, *E. coli* biofilms were the most effectively inhibited, with degradation rates reaching up to 95.7%. MRSA biofilms showed inhibition rates exceeding 90%, whereas *P. aeruginosa*, despite its higher resistance, still exhibited a notable 87.3% reduction. The effectiveness of the essential oil varied with the sampling location of the plant material. The sample from Vejti exhibited the highest antimicrobial activity across all assays, including the most substantial biofilm inhibition and over 80% membrane disruption in each bacterial species after 60 minutes of incubation. In conclusion, our findings demonstrate that *Solidago gigantea* essential oil exhibits antibacterial and biofilm inhibitory activities against urinary tract pathogens. The antimicrobial efficacy of the essential oil is influenced by the origin of the source plant.

Keywords: giant goldenrod, steam distillation, urinary tract pathogens

WILD CABBAGE (*Brassica incana*) RESPONSE TO ABIOTIC STRESS: METABLOMIC APPROACH

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Climate change has a significant impact on biodiversity and agricultural production worldwide, as it has a negative effect on the growth and development of plants and thus on yields and crop quality. Drought, high temperatures and increased soil salinity have become important abiotic stress factors for many crops, including brassicas, especially in the Mediterranean region. Wild representatives of brassicas growing in nature under extreme environmental conditions can serve as an excellent model for deciphering mechanisms of tolerance to single and combined abiotic stress factors. In this project, seeds from different populations of wild cabbage (*Brassica incana*) occurring on the Adriatic islands were collected and used for stress response experiments. Special attention was paid to the changes in the metabolome under stress. Seeds were germinated under laboratory conditions and seedlings were exposed to drought, high temperatures, elevated salinity and combined stress factors. Oxidative stress markers such as proline and lipid peroxidation were determined spectrophotometrically, and metabolites (primary and specialised) were analysed using a UPLC-ESI-QqQ instrument. The metabolomic response to a particular abiotic stress is population specific. Salinity and osmotic stress caused more drastic changes compared to temperature stress. Under combined stress conditions, high temperature can mitigate the detrimental effects of salinity and drought. The more tolerant populations accumulated more polyphenols and glucosinolates under stress conditions, which is consistent with their antioxidant activity.

Keywords: abiotic stress, Brassicaceae, metabolites, tolerance, wild cabbage

POSTERSKA PRIOPĆENJA

Fiziologija stresa, anatomija i morfologija

POSTER PRESENTATIONS

Physiology of stress, anatomy and morphology

IMPROVING THE BIOACTIVITY AND PHYTOCHEMICAL PROFILE OF COMMON ONION (*Allium cepa* L.) BY METABOLITE TRANSFER FROM AN AQUEOUS EXTRACT OF CHAMOMILE (*Chamomilla recutita* (L.) Rauschert)

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The common onion (*Allium cepa* L.) is a biennial plant from the Amaryllidaceae family. In the first year of development, it forms an underground bulb with fleshy inner leaves and protective dry, papery scales. This plant is known to contain many bioactive substances with beneficial effects on human health. Polyphenols present in common onion varieties with purple scales are: gallic acid, 3,4-dihydroxybenzoic acid, catechin, caffeic acid, rutin trihydrate, *p*-coumaric acid, *trans*-ferulic acid, apigenin-7-glucoside, quercetin, resveratrol, kaempferol etc. For this research, bulbs of the "Red Karmen" onion variety were used. The research aimed to prove metabolite transfer between onion bulbs and donor aqueous chamomile (*Chamomilla recutita* (L.) Rauschert) extract. It is assumed that this increases the proportion of polyphenols in onion bulbs that are abundant in chamomile extract. The bulbs were germinated in an aqueous extract of chamomile, and plain water as control, for 24 h. The plant material (roots, bulbs and scales) was then dried in a drying oven at 90 degrees. The dried plant parts were separately ground in a mortar and 70% ethanol extracts were prepared. Ethanol extracts were used to determine total phenols, total hydroxycinnamic acids, total flavonols, and antioxidant activity by the FRAP method. The difference in the amount of total phenols measured is statistically significant for roots and bulbs. The difference in the amount of total hydroxycinnamic acids is statistically significant for all onion parts. The total amounts of flavonols are statistically significantly higher in the scales and fleshy inner leaves. Antioxidant activity using the FRAP method showed a statistically significant difference in activity between all onion parts. The results presented prove that the germination of onion bulbs in aqueous chamomile extract increases the proportion of polyphenols and antioxidant activity.

Keywords: bioactive substances, polyphenols, onion bulbs, germination

AGE-RELATED MORPHO-ANATOMICAL AND PHYSIOLOGICAL ALTERATIONS OF *Spirodela polyrhiza* DURING SULFUR DEFICIENCY

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Sulfur (S) is an essential macronutrient, and its limitation affects the growth and development of fast-growing aquatic macrophytes. Daily and seasonal variations of sulfur concentrations characterize aquatic environments. This research aimed to test whether Sulfur deficit triggers age-dependent morphological and metabolic adjustments within *Spirodela polyrhiza* four-frond colonies. The plants were cultivated for seven days in Steinberg nutrient solution under control in a growth chamber (16/8 h photoperiod, 120 µmol $m^{-2} s^{-1}$, 25 ± 1 ^{0}C). To investigate intracolonial variations, fronds were carefully separated from a four-frond colony and marked as mother fronds (MF), daughter fronds (DF1 and DF2), and granddaughter fronds (GDF). Sulfur deficiency did not alter frond proliferation compared to the control conditions, but a 25 % decrease in frond area was recorded. Root number and length increased under optimal conditions with frond age. Under S-deficient conditions, root elongation and an increase in the root number depending on frond age were observed. The root number increased the most in GDF (3.2-fold), while root length increased by 1.1 to 1.8-fold across all fronds. The chlorophyll content was significantly reduced in all fronds, while anthocyanins accumulated progressively towards the youngest granddaughter frond (4.8-fold increase). IKI-staining of frond cross-sections showed increased starch content in daughter and granddaughter fronds. Microscopic analysis showed different anthocyanin localizations in the frond cross-sections, depending on the frond age. Since sulfur deficiency affects fronds in *S. polyrhiza* colony differently, diverting carbon towards starch and anthocyanin accumulation in younger fronds without significantly reducing the duckweed's growth rate, short-term sulfur limitation can be used as a practical approach to enhance duckweed starch yields for bioenergy production.

Keywords: anthocyanins, chlorophyll content, frond structure, great duckweed, starch grains

INSIGHT INTO GERMINATION ENERGY AND CAPACITY OF SEEDS OF CHOSEN GRASSLAND SPECIES FROM THE ASTERACEAE AND CICHORIACEAE FAMILIES

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Grasslands habitats are known for their high conservational and agronomical value, providing numerous ecosystem services through their taxonomical and functional diversity. Recently, they have become endangered due to changes in management regimes and are consequently targets of restoration activities. This often includes the introduction of the target species, which requires good knowledge of their biology, particularly when grown from seeds. Only properly stored seeds, germinated in adequate conditions, prove to be useful in restoration actions. Seed viability is generally maintained by storage at low humidity and low temperatures, although this is species-specific. Within the project LIFE for SEEDS (LIFE20 NAT/SI/000253), effect of storage and exposure to low temperatures on germination of 6 grassland species from related plant families *Asteraceae* (*Buphtalmum salicifolium* L., *Centaurea jacea* L., *Centaurea scabiosa* L., *Leucanthemum ircutianum* Turcz. (DC.)) and *Cichoriaceae* (*Leontodon hispidus* L. and *Tragopogon orientalis* L.) were tested. Germination energy and germination capacity of 4 x 50 seeds in controlled conditions (20°C, 8/16h) were monitored for 21 days, following one of two treatments: without pre-chill (seeds stored at the room temperature) and with the pre-chill treatment (simulated in cold cabinet at 4-7°C). All species had statistically significantly (ANOVA, $p<0,05$) higher germination energy with the pre-chill treatment (8 % higher on average). Germination capacity was higher with pre-chill treatment for *B. salicifolium* and *T. orientalis* and lower for *C. scabiosa* and *L. hispidus*. *L. ircutianum* was shown as the most successful species, undemanding regarding germination requirements, whereas *C. jacea* was the least successful. Exposure to lower temperatures prior to sowing or introducing seedlings of *B. salicifolium* and *T. orientalis* has proved useful, whereas additional germination tests of *Centaurea* spp. and *L. hispidus* might be needed. Absence of taxonomical determinacy in germination biology of chosen species was confirmed in this study.

Keywords: sprouting, seed stratification, grassland restoration, long-term seed storage

PLANT INVERTASES IN PLANT-PATHOGEN INTERACTIONS

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Invertases are plant enzymes that catalyse hydrolytic cleavage of sucrose into glucose and fructose, altering apoplastic sugar levels. During plant-pathogen interactions, host plant metabolism undergoes significant modifications, leading to elevated energy demands and carbon-rich compounds such as sucrose, glucose, and fructose accumulation. In addition to being the primary transport form of carbohydrates in plants, these sugars function as signalling molecules involved in the activation of defence-related signalling pathways. This study aims to determine the role of the sucrolytic pathway in the interaction between winter wheat (*Triticum aestivum*) and phytopathogenic fungi of the genus *Fusarium*, the causal agents of *Fusarium* head blight (FHB). This disease affects commercial crops worldwide and represents a global economic and agricultural problem. The research was conducted on flag leaves of six winter wheat genotypes inoculated with *Fusarium culmorum* and *Fusarium graminearum*. Impact on the sucrolytic pathway was estimated by measuring activities of sucrose synthase, cytosolic, vacuolar and cell wall invertases using semi high-throughput spectrophotometric methods. FHB-resistant genotypes, such as Vulkan and Galoper, exhibited increased activity of sucrose synthase, as well as cytoplasmic and vacuolar invertases. In contrast, the susceptible genotype Golubica showed reduced activity of these enzymes. The elevated activity of sucrolytic pathway enzymes in FHB-resistant cultivars suggests enhanced carbohydrate-mediated signalling, contributing to a more robust defence response against *Fusarium* infection.

Keywords: biotic stress, phytopathogenic fungi, *Fusarium*, sucrolytic pathway, wheat

THE IMPACT OF BISPHENOL S (BPS) ON THE ROOT LENGTH AND FREQUENCY OF CHROMOSOME ABERRATIONS IN ONION ROOT CELLS (*Allium cepa* L.)

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Bisphenol S (BPS) is an analog of bisphenol A (BPA). The industrial use of BPS has increased following the recognition of BPA as an endocrine disruptor and persistent organic pollutant that readily leaches from plastic materials, particularly under elevated temperatures. BPS was introduced as a supposedly safer alternative due to its lower acute toxicity and greater stability against thermal and photodegradation. This study aimed to investigate the impact of BPS on morphometric characteristics (root morphology and length) and the frequency of chromosome aberrations in *Allium cepa* meristematic cells. Chromosome aberrations (C-mitosis, lagging chromosomes, multipolar spindles, chromosome breaks, anaphase bridges, and chromosome adherence) can be described as changes in chromosome number or structure and serve as reliable indicators of genotoxicity. Onion roots were exposed to BPS solutions at concentrations ranging from 0 to 50 mg/L for three days. After 72 hours, root length was measured as the average of the two longest roots per bulb. Three roots per onion bulb were fixed using Carnoy's solution. Subsequently, the meristematic root tips were dissected, stained with aceto-orcein, and macerated using a glass rod. Samples were prepared using the squash technique and examined under a light microscope. Significant differences between treatments were assessed using one-way ANOVA followed by Duncan's multiple range test. BPS exposure induced morphological changes in the roots, which became curly, brown, and lost hardness. A significant reduction in root length was observed only at the highest concentration (50 mg/L). The frequency of chromosome aberrations was significantly increased at 5 – 50 mg/L compared to control samples. BPS exhibits both aneugenic effects (lagging chromosomes, sticky chromosomes, C-mitosis, and multipolarity) and clastogenic effects (chromosome breaks and anaphase bridges). Given the observed toxicity of BPS, further biochemical studies are warranted to elucidate its mechanisms of toxicity on *A. cepa* cells.

Keywords: Aberrations, bisphenol S, chromosome, common onion, root length, genotoxicity, aneugenic effects, clastogenic effects

THE POTENTIAL OF INTERSPECIFIC METABOLITES TRANSFER FOR BIOFORTIFICATION IN RADISH MICROGREENS

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Biofortification is emerging as a sustainable strategy for enriching plant foods with nutrients offering an effective solution to the global problem of malnutrition associated with the lack of essential micronutrients in the diet. Recently, the InterSpecific Metabolite Transfer method (ISMT) has been investigated as a promising method of biofortification. ISMT is an innovative approach that enables the transfer of bioactive compounds between a donor plant and an acceptor plant. Microgreens, young plants with high nutritional value and intensive metabolism, represent an ideal system for the application of various biofortification methods, especially due to their short development cycle and the possibility of controlling growing conditions. The aim of this study was to examine the possibility of transferring bioactive metabolites from olive leaf tea (*Olea europaea* L.) to radish microgreens (*Raphanus sativus* L.) at different developmental stages: seeds and seedlings aged three and seven days, respectively. Two radish varieties: Red Vulcano and Daikon were grown hydroponically in a growth chamber under controlled conditions (violet LED light with peaks at 448 and 645 nm, intensity 320 µmol $m^{-2}s^{-1}$, 16/8 photoperiod, temperature 21±1°C). Seven-day-old plants were measured for antioxidant status by measuring antioxidant activity, content of total soluble polyphenols and ascorbic acid. It was shown that up to four hours of treatment with olive leaf tea was optimal for radish microgreens. Preliminary results show that the two varieties respond differently to tea treatment, with variations also observed depending on the developmental stage at which the treatment was applied. These findings suggest the potential of the ISMT approach for enhancing the nutritional value of microgreens and highlight opportunities for further research into interspecific metabolite transfer.

Keywords: antioxidant activity, ISMT, metabolites, *Olea europaea* L., *Raphanus sativus* L.

EXPERIMENTAL GERMINATION OF TWO SAND GRASSLAND FESCUE SPECIES (*Festuca wagneri* AND *Festuca tomanii*) UNDER GREENHOUSE CONDITIONS

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During the study of dry sand steppe grasslands along the Danube, the idea emerged that the drought-tolerant individuals of dominant grass species found in these habitats might be suitable for urban planting. This is particularly relevant since native grass species are rarely used for such purposes. However, non-native plants, when introduced into urban environments, may escape cultivation and become invasive species. Therefore, we sought aesthetically suitable native grass species. To achieve this goal, we analyzed the dominant grass species of two sample sites. Based on preliminary research, we selected *Festuca wagneri* and *Festuca tomanii* for further investigation. These taxa were subjected to additional studies in the greenhouse of the ELTE Botanical Garden. To establish an effective cultivation protocol, we examined the height and germination percentage of seedlings grown in different substrates. For this purpose, we sowed seeds in six different growing media: a sand-peat mixture, pure sand, coconut fiber, peat, a coconut fiber-sand mixture, and native habitat sand soil. Our results revealed that, contrary to our initial expectations, the native habitat sand soil yielded the lowest germination percentage and the shortest seedlings. In contrast, peat proved to be the most favorable substrate. From an agronomic perspective, we consider peat soil the most suitable for cultivation, despite the fact that these species are naturally adapted to extreme conditions in open sand steppe grasslands. The successful germination of *Festuca* taxa requires an adequate water supply, which, in their native sandy habitat, is ensured by the moss-covered surface that retains moisture and provides a humid microenvironment.

Keywords: habitat, peat, species, steppe, urban

HEAT AND DROUGHT CO-STRESS DURING MICROGAMETOGENESIS ALTERS PHENOLOGY, PHYSIOLOGY AND STRUCTURE IN SIX-ROWED WINTER BARLEY (*Hordeum vulgare* L.)

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Barley, covering 46.2 million hectares with an average yield of 3.1 tons per hectare and a total production of 146 million tons in 2023, is the fourth most produced cereal globally, used as food, fodder, and malting grain. Rising global temperatures and extreme climate events are projected to further reduce cereal production by the end of the 21st century, with drought-related cereal production losses expected to intensify by more than 3% per year. To meet increasing food demands, along with increasing yield stability under unfavorable environmental conditions, is one of the primary goals of breeders. Despite the prevalence of combined heat and drought periods in field-grown plants during reproductive development, most studies have focused on the effects of heat or drought as single stressors. Pollen abortion induced by meiotic anomalies and tapetum dysfunction is a significant contributor to grain loss in cereals. Thus, extensive research has been conducted on microsporogenesis. In contrast, while functional vegetative and generative cells form through the first pollen mitosis, and sperm cells through the second, very few attempts have been made to reveal the environmental stress sensitivity of microgametogenesis. Our study aimed to investigate the effects of combined high temperature and water withdrawal during pollen development on both vegetative and generative processes. The responses of two six-rowed barley varieties with different stress tolerance were analyzed. The plants were grown under optimal environmental conditions until the mid-uninucleate stage of microspore development, after which they were subjected to total water withholding at a temperature 10 °C above the optimum until anthesis. Genotypic variation was noted in response to co-stress, which was attributed to differences in phenology, anatomy, and physiological and biochemical processes. The work was financed by a grant from the Hungarian Academy of Sciences (SZ-10/2024) and OTKA K - 147342.

Keywords: Climate change, pollen viability, ultrastructure

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TWELVE YEARS OF THE JOURNAL OF THE CROATIAN BOTANICAL SOCIETY

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The Journal of the Croatian Botanical Society is an open-access scientific and professional journal, published regularly since its release in 2013. It serves as a platform for sharing research notes on plant biology in either Croatian or English, catering to both the national and international botanical communities. The journal primarily focuses on Croatia and its neighboring regions. The initiative to establish this journal arose from the increasing difficulty in publishing professional and scientific manuscripts concerning the flora of Croatia in international journals, thus leaving significant knowledge about the national flora, especially contributions from botanists outside the realm of academia, largely unpublished and inaccessible to the public. Topics covered in the journal include vascular plants, bryophytes, lichens, algae, fungi, vegetation, habitats, taxonomy, systematics, nomenclature, ecology, and applied botany. To date, 25 volumes have been published, featuring original scientific articles, short communications, professional papers, review articles, contributions to the bibliography of Croatia's flora and vegetation, book reviews, and updates related to the activities of the Croatian Botanical Society, written by more than 130 authors. While the number of volumes fluctuated between two and four in the early years, a consistent pattern of releasing two volumes per year has recently been established. The journal has had three editors-in-chief and three technical editors to date. It is indexed in HRČAK (Portal of Croatian scientific and professional journals), the Directory of Open Access Journals (DOAJ) and CAB Abstracts, with plans to seek inclusion in Scopus in 2025. With this in mind, a smaller bibliometric analysis of the journal has been conducted, as a potential indicator of interest for indexing in Scopus.

Keywords: articles, bibliography, national flora, open-access journal, Scopus

CENTENNIAL CELEBRATION OF THE JOURNAL *ACTA BOTANICA CROATICA*

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The journal *Acta Botanica Croatica* has a long history dating back to 1925, when it was founded under the name *Acta Botanica instituti botanici regalis universitatis Zagrebensis* by Croatian botanists from the Department of Botany at the Faculty of Humanities and Social Sciences (then Faculty of Philosophy) of the University of Zagreb. Throughout its history, the journal has undergone various phases, including interruptions in publication due to political and economic conditions, especially during the Second World War. In the early years, the journal mainly published articles by local authors in Croatian. In 1969, an international peer-review process was introduced. Since 1998, the journal has been published regularly with English-language articles. The journal publishes scientific articles on terrestrial and aquatic botany, plant ecology with a special emphasis on karst areas in southern Europe and the Mediterranean, and experimental botany (including plant viruses, bacteria, archaea, algae, and fungi). In the 21st century, the journal has gained visibility in the scientific community and has been indexed in citation databases such as Scopus, CABI, and Web of Science. It also became part of the Hrčak portal, which provides open access to scientific articles. Over the years, the journal has modernized its appearance and editorial processes, resulting in improved quality and visibility, as well as a higher impact factor. The journal *Acta Botanica Croatica* continues to work on improving its visibility and quality in order to gain even more prominence in the international scientific community.

Keywords: Acta Botanica Croatica, botany, international peer review, open access, scientific journal

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PLANTS FROM A SOCIAL PERSPECTIVE

Marković, S.

"*We are dependent on the natural world for every breath of air we take and every mouthful of food we eat. But it's even more than that. We are also dependent on it for our sanity and sense of proportion.*"— Sir David Attenborough

From the dawn of human history, plants have fascinated us. In the hair of Neanderthals and in the pollen between their teeth, we find traces of plant-derived compounds—our first apothecary and chemical library. Long before synthetic chemistry, they sustained our health, fed us, and shaped our cultures. That same fascination still drives botanists today, from the scientists of Botany Bay to the present. But admiration comes with a price. The popular meme "Nothing natural can harm you" can be sunk in seconds by the toxic torpedo of the genus Aristolochia. Such superficial naïveté spreads more powerfully on social networks than the voices of pharmacognosy and botany experts. While it is statistically unlikely that all medicines can be found in nature, the belief reflects something more profound: our persistent anthropocentrism. We see plants mainly for their use—medicinal, nutritional, or aesthetic—yet they are far more than that. And in today's "War of Influencers," plants are often misused in clickbait promises, false cures, and commercial illusions. The real challenge is to cross the mountain pass beyond selfish utility, toward a vast meadow of respect and preservation. Plants are not just resources; they are fellow players in the great network of life, already suffering enormously under human civilisation. In this lecture, I will explore the good, the bad, and the ugly of plants: from their gifts to their dangers, from their scientific truth to their social misuse. Ultimately, our survival depends on teaching future generations not only to use plants, but to honour them as our essential partners in life.

DRUŠTVENA PERCEPCIJA BILJAKA

„Ovisni smo o prirodnom svijetu o svakom udahu zraka i svakom zalogaju hrane koji unesemo. Ali to je i više od toga. Ovisni smo o njemu i za vlastiti razum i osjećaj za mjeru." — Sir David Attenborough

Još od početaka ljudske povijesti biljke nas očaravaju. U kosi neandertalaca i u peludi među njihovim zubima pronalazimo tragove biljnih spojeva — naše prve ljekarne i kemijske knjižnice. Davno prije nego što smo razvili sintetsku kemiju, one su nas hranile, liječile i oblikovale naše kulture. Ta ista fascinacija pokretala je i botaničare od Botany Baya do današnjih dana. No divljenje ima svoju cijenu. Popularna tvrdnja *„Ništa prirodno ne može štetiti"* može se potopiti u sekundi otrovnim torpedom roda Aristolochia. Takva površna naivnost širi se društvenim mrežama snažnije nego glasovi stručnjaka iz farmakognozije i botanike. Iako je statistički malo vjerojatno da *svi* lijekovi postoje u prirodi, to vjerovanje otkriva nešto dublje: našu upornu antropocentričnost. Biljke uglavnom promatramo kroz njihovu korisnost — ljekovitu, prehrambenu ili estetsku — no one su mnogo više od toga. A u današnjem „Ratu influencera" biljke se često zloupotrebljavaju u mamcima za klikove, lažnim lijekovima i komercijalnim iluzijama.Pravi izazov je prijeći planinski prijevoj izvan sebične koristi i zakoračiti u prostranu livadu poštovanja i očuvanja. Biljke nisu samo resurs; one su suigrači u velikoj mreži života — već sada teško pogođene ljudskom civilizacijom. U ovom predavanju istražit ću dobro, loše i ružno u svijetu biljaka: od njihovih darova do njihovih opasnosti, od znanstvene istine do društvenih zabluda. Naša će budućnost ovisiti o tome hoćemo li buduće generacije naučiti ne samo koristiti biljke, nego ih i poštovati kao naše bitne životne partnere.

EDUKACIJA ZA NASTAVNIKE

TEACHERS EDUCATION

BOTANIČKI SADRŽAJI KROZ ISHODE KURIKULUMA BIOLOGIJE

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Kurikulum predmeta Biologija za osnovne škole i gimnazije oblikovan je s ciljem usmjeravanja nastave prema usvajanju temeljnih koncepata i razvoju kompetencija potrebnih za svakodnevni život i nastavak obrazovanja, a ne pukom usvajanju činjenica. Struktura kurikuluma usklađena je sa suvremenim obrazovnim trendovima u Europi i svijetu, a ishodi učenja nastavnicima pružaju određenu razinu autonomije u odabiru sadržaja. Takva fleksibilnost omogućuje prilagodbu nastave vlastitim interesima i stručnim sklonostima, no istovremeno može izazvati nesigurnost u tumačenju ishoda i izboru sadržaja. Botanički sadržaji osobito su primjenjivi u ostvarivanju ishoda vezanih uz proučavanje građe organizma, najčešće u drugom razredu gimnazije, ali i u okviru tema ekologije i evolucije. Njihova uporaba omogućuje usporedno sagledavanje građe, razvoja i utjecaja različitih skupina organizama. Time se nastavnicima otvara mogućnost da, kroz vlastite sklonosti prema botanici, oblikuju nastavu na način koji potiče entuzijazam i pozitivan odnos učenika prema prirodi i životu.

Ključne riječi: biologija, kurikulum, ishodi učenja, botanika, obrazovni sadržaji

PRAKTIČNE VJEŽBE IZ BOTANIKE ZA USPJEŠNO OSTVARIVANJE KURIKULARNIH ISHODA

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Glavni cilj nastave prirodoslovnih predmeta je jačanje intelektualnih kompetencija učenika poput samostalnog učenja, rješavanje problema, donošenje odluka i kritičko promišljanje. Kako bi ostvarili ovaj cilj moramo posegnuti prema poučavanju kroz aktivnosti kao što su praktično orijentirane laboratorijske vježbe. U nastavi biologije ovakav pristup omogućuje premošćivanje između nižih razina i viših razina ishoda učenja što je veliki izazov za ostvariti u redovnoj nastavi. Interes učenika za botaničke teme kao i opredjeljenje u struke botaničkog smjera je mali u usporedbi s drugih biološkim disciplinama. Jedan od mogućih načina za povećanje interesa učenika za botaniku je fokus prema praktičnim vježbama. Vježbe koje se mogu odraditi koristeći biološke modele biljaka i algi uglavnom je lakše za pripremiti, nabaviti materijal i vremenski zahtijevaju manje vremena nego upotreba heterotrofnih modela. Generalni je zaključak velikog broja studija da praktične vježbe u nastavi biologije uvelike pomažu učenicima prilikom bolje usvajanja bioloških koncepata kao i razvijanju svijesti o svijetu oko sebe i važnosti očuvanja istog. Prema novom Kurikulumu nastave biologije u osnovnim i srednjim školama dio ishoda teško je ostvariti bez aktivacije praktičnih vještina učenika što predstavlja nove izazove za nastavnike. Priprema biološkog materijala, izrada uputa i radnih listića, organizacija i priprema učenika za izvođenje vježbe i vrednovanje samo su neki od zahtjeva koje nastavnici moraju savladati prilikom provođenja ovakve nastave. Kroz ovo predavanje nastavnici će dobiti pregled nekih praktičnih vježbi kojima mogu ostvariti ishode iz Kurikuluma biologije za učenike osnovnih i srednjih škola, načine kako pripremiti i sakupiti biljni materijal, prilagodbe vježbi ovisno o željenom tipu nastave i informacije oko prikupljanja literature za izradu materijala za učenike i primjer radnih listova tijekom, za i nakon izvođenja vježbi.

METODOLOGIJA ISTRAŽIVAČKOG RADA U BOTANICI: LIŠAJEVI KAO MODELNI ORGANIZMI

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Istraživačka nastaava jedan je od najučinkovitijih oblika poučavanja prirodoslovnih predmeta jer potiče učenike na aktivno sudjelovanje u procesu istraživanja i otkrivanja, učenici koji opažaju promjene u prirodi, opisuju ih, postavljaju pitanja, razmjenjuju ideje, provode istraživanje koristeći adekvatne metode, kritički interpretiraju rezultate vlastitih istraživanja te dolaze do rješenja problema. Složenije razine istraživačke nastave kao što je otvoreno istraživanje osobito su pogodne za darovite učenike u kasnijim obrazovnim ciklusima (predmetna nastava u osnovnoj školi i srednja škola). Teme iz stvarnog svijeta i povezanost sa životnim iskustvima i interesima te istraživanje koje se provodi i izvan učionice, u prirodi potiče interes i motivaciju svih učenika, a osobito darovitih u prirodoslovnom području. U sklopu istraživačke nastave često se izrađuju istraživački radovi, s kojim učenici mogu sudjelovati na natjecanju iz biologije u kategorijama: samostalni istraživački radovi i prirodoslovni pristup. Metodologija izrade istraživačkih radova u botanici biti će predstavljena pomoću istraživačkih radova: Lišajevi otoka Visa i Lihenoflora na sakralnim objektima otoka Visa koje su učenici izradili u sklopu dodatne nastave iz biologije u svrhu edukacije o lihenoflori otoka Visa, posebnom pažnjom posvećenom ugroženim i zaštićenim vrstama lišajeva te važnosti lišajeva kao bioindikatora čistog zraka. Učenici su s radovima sudjelovali na državnim natjecanjima iz biologije. Modelni organizmi u oba istraživanju su lišajevi. Lišajevi su iznimno zanimljivi organizmi koji se rijetki koriste kao modelni organizmi u istraživanjima unotoč svojoj jedinstvenoj biološkoj strukturi i ekološkoj ulozi. Zahvaljujući svojim karakteristikama kao što su simbiotski organizmi, bioindikatori, ekstremofili omogućavaju istraživanja u različitim područjima znanosti: botanika, ekologija, genetika, farmakologija, evolucijska biologija i astrobiologija. Razumijevanje istraživačke nastave i znanstvene metodologije ključno je za razvoj budućih generacija istraživača. Ovim pristupima omogućuje se učenicima da ne samo steknu znanje, već i razviju sposobnosti.

KAKO PRIBLIŽITI FOTOSINTEZU UČENICIMA? DOKAZIVANJE ŠKROBA U BILJKAMA

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Zbog smanjenog broja nastavnih jedinica posvećenih fiziologiji bilja unutar ukupnog kurikuluma biologije, ovo područje često se svodi na prezentaciju velikog broja apstraktnih i nepovezanih činjenica. Takav pristup smanjuje nastavnu kvalitetu i otežava učenicima razumijevanje temeljnih koncepata, poput fotosinteze, čime se dodatno umanjuje njihov interes za fiziologiju bilja. Jedan od učinkovitih načina za poticanje interesa učenika za fiziologiju bilja jest usmjeravanje nastave prema razumijevanju općeg značaja biljaka za život na Zemlji, uz isticanje njihove prisutnosti i uloge u svakodnevnom životu. Dodatno, uključivanje većeg broja praktičnih aktivnosti u botanički dio nastave može značajno pridonijeti motivaciji učenika. U tom kontekstu, planirane su vježbe za dokazivanje prisutnosti škroba kao produkta fotosinteze, koje će se provoditi korištenjem bioloških modela biljaka. Sinteza škroba u biljkama odvija se u dva tipa plastida: kloroplastima i amiloplastima. Iako se u oba slučaja proizvodi isti kemijski spoj – škrob – razlikuju se način njegove sinteze, funkcija te morfologija škrobnih granula. U kloroplastima, tijekom dana, nastaje asimilacijski (primarni) škrob koji služi kao privremeno skladište energije u listovima. Njegove granule su brojne i sitne te se noću razgrađuju kako bi se osigurala energija za cijelu biljku. Nasuprot tome, u amiloplastima se tijekom duljeg perioda akumulacije stvara skladišni (sekundarni) škrob, koji služi za dugoročnu pohranu energije potrebne u fazama intenzivnog rasta, poput klijanja. Granule skladišnog škroba su veće i gusto upakirane. Asimilacijski i skladišni škrob dokazivat ćemo pomoću bojenja Lugolovom otopinom, čime se učenicima omogućuje vizualizacija razlika i bolje razumijevanje uloge škroba.

DIJATOMEJE U NASTAVI PRIRODE I BIOLOGIJE

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Dijatomeje su fotosintetski eukariotski jednostanični organizmi koji žive u morima i slatkim vodama. Značajne za ekosustav, kao primarni proizvođači, pogodni su modelni organizmi u nastavi Prirode i Biologije. Dijatomeje su relativno slabo zastupljene u nastavi, a njihova upotreba je široka i raznolika. Tijekom predavanja prikazat ćemo nastavne alate kao pomoć nastavnicima i učenicima prilikom korištenja dijatomeja u nastavi. Zbirka trajnih preparata dijatomeja koja je pripremljena za posudbu školama u 3 primjerka s po 10 uzoraka bit će predstavljena kroz predavanje kao i terenski, lako uporabljivi, mikroskopi, izrađeni modeli stanica različitih vrsta dijatomeja te nacrt buduće aplikacije za korištenje navedenih materijala. Prikazani će biti i ishodi iz Nacionalnog kurikuluma za Prirodu i Biologiju te izdvojene i pridružene teme od fotosinteze, evolucije do bioraznolikosti i zaštite prirode, pogodne za poučavanje korištenjem školske zbirke dijatomeja.

DRVOKOD –PRIMJER POSTAVLJANJA, KOORDIRANJA I REALIZACIJE PROJEKATA IZ BOTANIKE

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Velike projekte poput Drvokoda koji se izvodi samostalno ili u suradnji s drugim institucijama, treba pomno planirati i izvesti u nekoliko faza kao bi postavljeni ishodi bili uspješno ostvareni. Drvokod je izvrstan primjer projektne nastave koja se svrstava u osnovni oblik nastave, a u kojem se posebno ističe timski rad nastavnika i učenika u rješavanju problema. Višegodišnji je projekt koji se provodi u većem broju škola bez obzira na njihovu udaljenost. Drvokod je realiziran kao izvannastavna aktivnost, a nastao je kao rezultat interakcije nastavnih predmeta biologije i informatike, odnosno uključuje imenovanje vrsta grmlja i drveća u školskom dvorištu uz postavljanje pločica sa QR-kodovima. Projekt je započeo u jednoj školi, te je zbog svoje zanimljivosti postao županijski, a nakon dvije godine državni i međunarodni. Za njegovu kvalitetnu provedbu trebalo je planirati svaki korak, uključujući podjelu posla na autore projekta, mentore, izvoditelje projekta, edukatore i korisnike rezultata projekta. Pridruživanjem drugih škola, održane su edukacije i radionice kako bi se dale jednake upute za rad mentorima i učenicima. Objave provedbe projekta svih uključenih škola su objedinjene i postavljene na web portal (https://drvokod.eu/) čime je olakšan pregled i međusobna suradnja. Na portalu se trenutno nalazi svih 28 škola koje su uključene u projekt. Na njihovim web adresama nalazi se popis vrsta grmlja i drveća koje rastu u školskim dvorištima. Ukupno je izbrojano 110 biljaka, te je nakon determinacije istih zaključeno da u školskim dvorištima rastu 52 različite svojte. Projekt poput Drvokoda uvelike pridonosi edukaciji, motivaciji i aktivnosti učenika. Glavni je cilj projekta da učenici uoče kako su ključevi za determinaciju koncipirani, od čega se sastoje i kako se čitaju, da prepoznaju i usvoje imena vrsta, principe klasifikacije živih bića, primjenu informatičkih rješenja, budu motivirani za stjecanje novih saznanja o živom svijetu oko njih, te razvijaju brigu prema prirodi, njenoj zaštiti i očuvanju. Naime, znanje učenika stečeno aktivnim radom na projektu, ostaje trajno u njihovom dugoročnom pamćenju. Cijeli projekt Drvokoda u svim školama koje su sudjelovale, realiziran je kroz projektnu nastavu te istraživačko i iskustveno učenje. Upravo takve aktivnosti potiču učenike na razvoj prirodoslovnih kompetencija koje podrazumijevaju analitički pristup temeljen na znanstvenim principima, odnosno razvoj vještina i sposobnosti kritičkog mišljenja, planiranja, promatranja, eksperimentiranja, tumačenja rezultata, donošenja zaključaka i prezentaciju usvojenih saznanja.

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