Department of Biology and Ecology,
Faculty of Sciences and Mathematics, University of Niš
Institute for Nature Conservation of Serbia
Science Technology Park Niš

15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Niš, 23th to 25th May, 2025

Abstracts

15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Niš, 23th to 25th May 2025

Book of Abstracts

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PROGRAMME

Friday, May 23th, 2025

08.00-10.00 Registration

10.00-11.30 Opening Ceremony

11.30-12.00 Coffee break

12.00-13.15 *In memoriam*

13.15-14.00 Lunch break

14.00-16.00 Session 1

Hall 1

Taxonomy and Systematics

Hall 2

Agriculture, Forestry and Landscape Architecture

16.15-18.30 Session 2

Hall 1

Phytogeography, Floristics and Phytoecology

Poster Session 1

18.30-20.00

Taxonomy and Systematics

Phytogeography, Floristics and Phytoecology

Genetics, Selection and Biotechnology

Agriculture, Forestry and Landscape Architecture

Saturday, May 24th, 2025

08.00-10.00 Registration

10.00-11.30 Session 3

Hall 1

Phytochemistry and Phytotherapy

Hall 2

Ecology and Environmental Protection

12.00-14.15 Session 4

Hall 1

Nature Protection

14.15-15.30 Lunch break

Poster Session 2

15.30-17.00

Ecology and Environmental Protection

Nature Protection

Phytochemistry and Phytotherapy

20.00 Conference dinner

Sunday, May 25th, 2025

Hall 2

10.00-11.00 Presentation of COST Action CA22105-BeSafeBeeHoney

Danijela A. Kostić*, Biljana B. Arsić
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12.00-18.00 Excursion

Detailed Programme

Hall 1

Friday, May 23th, 2025.

10.00-11.30

Opening ceremony

11.30-12.00 Coffee break

In memoriam

12.00-12.15
Nikolić, D., Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Niš, Serbia
Professor Dr. Vladimir Ranđelović – In memoriam (1965-2023)

12.15-12.30
Mihajilov-Krstev, D., Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Niš, Serbia
Professor Dr. Novica Ranđelović – In memoriam (1937–2023)

12.30-12.45
Lakušić, D., Tomović, G., Vukojičić, S., Faculty of Biology, University of Belgrade, Belgrade, Serbia
Professor Dr. Vladimir Stevanović (1947-2024) – In memoriam

12.45-13.00
Anačkov, G., Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Novi Sad, Serbia
I could live here for the rest of my life - Prof. Dr. Biljana Božin: a researcher from the heart of the Pannonian Plain on the mountain peaks of Serbia and the Balkans

13.00-13.15
Lakušić, B., Stojanović, D., Faculty of Pharmacy, University of Belgrade, Belgrade, Serbia
Professor Dr. Violeta Slavkovska (1958-2025) – In memoriam

13.15-14.00 Lunch break

Taxonomy and Systematics, Hall 1

Friday, May 23th, 2025.

Chairs of the section: Anačkov, G., Buzurović, U.

Introductory Lecture

14.00-14.15
Rat, M., Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Novi Sad, Serbia

The development of botanical studies among Serbs during the European Revolutionary Era (late 18th – early 19th century)

Oral Presentations

14.15-14.25
Çiftçi, A., Mollmann, R., Kaleli, B., Şık, L., Erol, O.
Erol, O., Botany Division, Department of Biology, Faculty of Science, Istanbul University, Istanbul, Türkiye
Rewriting the story of Crocus chrysanthus Herb.

14.25-14.35
Çiftçi, A., Özel, B., Gülçelik, C., Erol, O.
Gülçelik, C., Department of Biology, Faculty of Science, Istanbul University, Fatih, Istanbul, Türkiye
Exploring scape anatomy in Crocus L.: Its role in distinguishing series and species

14.35-14.45
Ranimirović, M., Đurović, S., Tomović, G., Niketić, M.
Ranimirović, M., Faculty of Pharmacy, University of Belgrade, Belgrade, Serbia
Morphological variability of selected taxa in the Stachys recta group (Lamiaceae) in the Central and Southern Balkans

14.45-14.55
Hroneš, M., Department of Botany, Faculty of Science, Palacký University, Czech Republic
Putting together the pieces of Gagea bohemica (Liliaceae) biosystematic puzzle

14.55-15.05
Milivojević, L., Tomović, G., Đurović, S., Bogdanović, S., Niketić, M., Buzurović, U.
Milivojević, L., Faculty of Biology, University of Belgrade, Belgrade, Serbia
Morphological delimitation of neglected species Armeria dalmatica Beck from Armeria canescens (Host) Boiss.

15.05-15.15
Peškanov, J., Radak, B., Bogdanović, S., Vlku, A.Z., Anačkov, G.
Peškanov, J., Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Novi Sad, Serbia
Preliminary morphometric analysis of the Ophrys sphegodes complex from Croatia

15.15-15.25
Zbiljić, M., Kuzmanović, N., Novaković, J., Mladenović, Ž., Lakušić, D.
Zbiljić, M., Department of Botany, Faculty of Pharmacy, University of Belgrade, Belgrade, Serbia
Teucrium montanum subsp. skadarensis (Lamiaceae) – a new subspecies from northern Albania

15.25-15.35
Milićević, A., Popović, S., Jakovljević, O.
Milićević, A., Institute of Botany and Botanical Garden "Jevremovac", Faculty of Biology, University of Belgrade, Belgrade, Serbia
A new Navicula species (Bacillariophyceae) from Serbia's thermomineral springs

Agriculture, Forestry and Landscape Architecture, Hall 2
Friday, May 23th, 2025.

Chairs of the section: Đurović, S., Crnković, M.

Introductory Lecture

14.00-14.15
Ocokoljić, M., Petrov, Đ., Galečić, N., Skočajić, D., Čukanović, J., Kolarov, R., Đorđević, S.
Petrov, Đ., Department of Landscape Architecture and Horticulture, Faculty of Forestry, University of Belgrade, Belgrade, Serbia
Potential of the climbing rose 'Casino' in urban environments: Towards to climate change

Oral Presentations

14.15-14.25
Ocokoljić, M., Petrov, Đ., Galečić, N., Skočajić, D., Čukanović, J., Vujičić, D., Simović, I.
Petrov, Đ., Department of Landscape Architecture and Horticulture, Faculty of Forestry, University of Belgrade, Belgrade, Serbia
Trachelospermum jasminoides (Lindl.) Lem. in pergola design: An experimental study in Belgrade

14.25-14.35
Bobinac, M., Andrašev, S., Šušić, N.
Bobinac, M., Faculty of Forestry, University of Belgrade, Belgrade, Serbia
The phases of degradation in oak forests of the western part of the National park 'Fruška Gora' - a challenge for sustainable forest management

14.35-14.45
Ocokoljić, M., Petrov, Đ., Galečić, N., Skočajić, D., Čukanović, J., Vujičić, D., Simović, I.
Petrov, Đ., Department of Landscape Architecture and Horticulture, Faculty of Forestry, University of Belgrade, Belgrade, Serbia
Indigofera heterantha Wall. ex Brandis – a new exotic species in Serbia

Phytogeography, Floristics and Phytoecology, Hall 1

Friday, May 23th, 2025.

Chairs of the section: Radak, B., Papp, B.

Introductory Lectures

16.15-16.30
Ćuk, M., Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Novi Sad, Serbia
Diversity and dynamics of sand dune habitats in Serbia

16.30-16.45
Papp, B., Lőkös, L., Dragićević, S.
Papp, B., Botanical Department, Hungarian Natural History Museum, Budapest, Hungary
Montenegrin coastal bryophyte vegetation – 100 years later in the footsteps of the earlier bryologists

Oral Presentations

16.45-16.55
Đurović, S., Ranimirović, M., Obradov, D., Rat, M., Perić, R., Jovanović, M.D., Zlatković, B., Vukojičić, S., Niketić, M.
Đurović, S., Faculty of Agriculture, University of Niš, Kosančićeva 4, 37000 Kruševac, Serbia
Contribution to the knowledge of endangered and vulnerable species of the genus Euphorbia L. in the flora of the Republic of Serbia

16.55-17.05
Šoškić, M., Stešević, D., Popović, A., Rat, M.
Šoškić, M., Department of Biology, Faculty of Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro
The genus Ornithogalum sensu stricto in the flora of Montenegro

17.05-17.15
Vassilev, K., Velev, N., Nazarov, M., Genova, B.
Vassilev, K., Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria
What do we know about vegetation diversity of Bulgaria?

17.15-17.25
Đurović, S., Stevanoski, I., Đorđević, V., Kuzmanović, N., Vukojičić, S.
Đurović, S., Faculty of Agriculture, University of Niš, Kosančićeva 4, 37000 Kruševac, Serbia
The BEOU herbarium as a source of information on protected plant species in Serbia, focusing on plant taxa protected by the Habitats Directive and the Bern Convention

17.25-17.35
Genova, B., Velev, N., Gecheva, G., Georgiev, S., Grigorov, B., Mardari, C., Nazarov, M., Vassilev, K.
Genova, B., Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria
Syntaxonomical diversity of the Phragmito-Magnocaricetea class in Bulgaria – an overview

17.35-17.45
Popović, A., Šoškić, M., Stešević, D.
Popović, A., Natural History Museum of Montenegro, Podgorica, Montenegro; Department of Biology, Faculty of Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro
Vascular flora and floristic peculiarities of the Čakor Pass area and surroundings

17.45-17.55
Vlku, A.Z., Radak, B., Peškanov, J., Anačkov, G.
Vlku, A.Z., Department of Biology and Ecology, Faculty of Science, University of Novi Sad, Novi Sad, Serbia
New orchid records from Tupižnica Mt. (Eastern Serbia)

17.55-18.05
Prpa, B., Rat, M., Bokić, B., Kladar, N., Bijelić, K., Anačkov, G.
Prpa, B., Department of Pharmacy, Faculty of Medicine, University of Novi Sad, Novi Sad, Serbia; Center for Medical and Pharmaceutical Investigations and Quality Control, Faculty of Medicine, University of Novi Sad, Novi Sad, Serbia

Diversity and distribution of Allium sect. Scorodon Koch 1837. in the flora of Serbia

Poster Session 1:

Taxonomy and Systematics
Phytogeography, Floristics and Phytoecology
Genetics, Selection and Biotechnology
Agriculture, Forestry and Landscape Architecture

18.30-20.00
Friday, May 23th, 2025.

1

Bakić, V., Trakić, S., Muratović, E., Đug, S.

Botanical characterization of black locust honey samples from Bosnia and Herzegovina

2

Xhulaj, S.

Lichenized and lichenicolous fungi from the southernmost areas of Albania

3

Nadarević, V., Mašić, E., Matić, I., Halilović, A.

Orchids of Mount Plješevica in Bosnia and Herzegovina – preliminary research

4

Mašić, E., Matić, I., Halilović, A., Nadarević, V.

Diversity of cyanobacteria and algae in selected water habitats in the wide area of Mount Plješevica (Bosnia and Herzegovina) – preliminary research

5

Mladenović, Ž., Kuzmanović, N., Lakušić, D., Stojanović, D.

Variability of leaf anatomical traits of Gentiana sect. Ciminalis (Gentianaceae) on the Balkan Peninsula

6

Çelik, M.

SEM-EDX Analysis of calcium oxalate crystals in the fruit of Scaligeria napiformis (Apiaceae: Apioideae)

7

Çetin, Ö., Çelik, M.

Microscopic examination of Pimpinella tripartita Kalen fruits: Anatomy, micromorphology and crystal composition

8

Doğan, N., Çetin, Ö., Çelik, M.

A microscopic perspective on Chaerophyllum crinitum Boiss. fruits: Anatomy, surface morphology, and crystal analysis

9

Stojković, J., Mitić, Z., Zlatković, B., Jevtović, S., Stojanović, G.

Pigment content in sunflower and maize treated with sodium cholate, elicitor substance from manure

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Maksimović, J., Buzurović, U., Buntić, A., Đikanović, N., Pavlović, J., Milinković, M., Knežević, M.

Improvement of carrot seed germination by Bacillus spp. isolates

60

Filipović, S., Vučenović, I., Đurović, S., Mitić, S., Radović, A.

Assessment and management of soil fertility for vineyard establishment (Vitis vinifera L.)

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Filipović, S., Vučenović, I., Đurović, S., Mitić, S., Vasić, A., Radović, A.

Agrochemical soil analysis for the establishment of strawberry (Fragaria x ananassa Duch) plantations in the Trstenik region

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Pekeč, S., Milović, M., Drekić, M., Vasić, V., Orlović, S.

Phenological phases of leafing and leaf fall in stands of sessile oak (Quercus petraea Matt. Liebl.) and pedunculate oak (Quercus robur L.) during 2024.

Phytochemistry and Phytotherapy, Hall 1

Saturday, May 24th, 2025.

Chairs of the section: Matejić, J., Mladenović, M.

Oral Presentations

10.00-10.10

Simonović, N., Stojanović-Krasić, M., Milenković, L., Ilić, Z., Stanojević, Lj., Cvetković, D., Stanojević, J.

Simonović, N., Faculty of Technology, University of Niš, Leskovac, Serbia

Optimization of maceration conditions for stems and leaves of Tagetes patula L.

10.10-10.20

Acar, A.G., Şahin, T., Çamlı, M.C., Severoğlu, Z., Kılıç, Ö., Aşkın, S.

Severoğlu, Z., Department of Biology, Faculty of Science, Marmara University, Türkiye

The essential oil property of Origanum vulgare subsp. gracile and the biological activities and usage areas of some taxa belonging to the genus Origanum L.

10.20-10.30

Badalamenti, N., Pavela, R., Maggi, F., Spinozzi, E., Bruno, M.

Badalamenti, N., Department of Biological, Chemical and Pharmaceutical Sciences and Technologies (STEBICEF), University of Palermo, Palermo, Italy; NBFC-National Biodiversity Future Center, Palermo, Italy

Spectroscopical analyses, cytotoxic and insecticidal effects of Artemisia campestris subsp. variabilis (Ten.) Greuter essential oil and its main components

10.30-10.40

Stanojević, Lj., Milenković, A., Nikolić, G., Zvezdanović, J., Stanojević, J.

Milenković, A., Faculty of Technology, University of Niš, Leskovac, Serbia
Chemical composition and antioxidant activity of Geranium robertianum L. leaves hydrolate

10.40-10.50
Porrello, A., Castagliuolo, G., Vaglica, A., Moscedano, M., Antonini, D., Varcamonti, M., Ilardi, V., Bruno, M., Zanfardino, A.
Porrello, A., Department of Biological, Chemical and Pharmaceutical Sciences and Technologies (STEBICEF), University of Palermo, Palermo, Italy
Antioxidant and antimicrobial activities of essential oils from the Sicilian (Italy) accession of Pimpinella peregrina L.

10.50-11.00
Acar, A.G., Şahin, T., Çamlı, M.C., Severoğlu, Z., Kılıç, Ö., Aşkın, S.
Aşkın, S., Department of Biology, Institute of Science, Marmara University, Türkiye
Essential oil characteristics of Mentha longifolia subsp. typhoides var. calliantha and the biological activities and usage areas of some taxa belonging to the genus Mentha L.

11.00-11.10
Milenković, A., Stanojević, J., Cvetković, D., Nikolić, V., Stanojević, Lj.
Milenković, A., Faculty of Technology, University of Niš, Leskovac, Serbia
The reducing power of black pepper (Piper nigrum L.) essential oil and hydrolate

Ecology and Environmental Protection, Hall 2

Saturday, May 24th, 2025.

Chairs of the section: Andrejić, G., Stamenković, S.

Oral Presentations

10.00-10.10
Brzozowski, M., Pełechaty, M.
Brzozowski, M., Department of Ecology and Environmental Protection, Poznań University of Life Sciences, Poznań, Poland
Expansion of Lychnothamnus barbatus in response to climate change

10.10-10.20
Stamenković, S., Nešović, S.
Stamenković, S., Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Niš, Serbia
Air quality in the urban and surrounding area of a mining center in eastern Serbia using lichens as an biological indicators

10.20-10.30
Ćirković, G., Rakonjac, A., Ajtić, R.
Ćirković, G., Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Kragujevac, Serbia
From algae to zooplankton: What Pelophylax kl. esculentus tadpoles eat in the Morava River Basin (Republic of Serbia)

10.30-10.40
Stanković, N., Meißner, S., Fastner, J., Monaghan, M., Hilt, S.
Stanković, N., Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany; Depadtment of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Serbia
Ecological and molecular assessment of toxic cyanobacteria in macrophyte-associated biofilms

10.40-10.50
Savić Zdravković, D., Ilić, M.P., Jovanović, M.D., Stojanović, J., Nikolić, M.
Savić Zdravković, D., Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Niš, Serbia; Biological Society "Dr. Sava Petrović", Niš, Serbia
From fire history to conservation strategy: An integrated biodiversity and risk assessment in Lalinačka slatina

10.50-11.00
Stanković, N., Kostić Kokić, I., Fideršek Dudić, M., Begović, M., Petronijević, T.
Stanković, N., Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany; Depadtment of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Serbia
Allelopathic potential of microcystin-RR at environmentally relevant concentrations: Species-specific growth responses of cyanobacteria and green microalgae

Nature Protection, Hall 1

Saturday, May 24th, 2025.

Chairs of the section: Ćušterevska, R., Jelić, I.

Introductory Lectures

12.00-12.15
Jelić, I., Stojanović, V., Tabašević, M.
Jelić, I., Institute for Nature Conservation of Serbia, Belgrade, Serbia
Protection of the Banat peony (Paeonia officinalis subsp. banatica (Rochel) Soó) within the outstanding natural landscape Rudnik Mountain

Oral Presentations

12.15-12.25
Stojanović, V., Sokolović, D., Niketić, M., Matić, B., Petrović, M.
Stojanović, V., Natural History Museum, Belgrade, Serbia
Contribution to knowledge of the flora of the Gornjačka gorge

12.25-12.35
Stanković, M., Pokret gorana Sremska Mitrovica, Sremska Mitrovica, Serbia
New species in the flora of SNR Zasavica

12.35-12.45
Joksimović, A., Marković, O., Pešić, A., Ćetković, I.
Joksimović, A., Institute of Marine Biology-University of Montenegro, Kotor, Montenegro
New dangerous invasive species of lionfish (Pterois miles) on the Montenegrin coast, Adriatic Sea, how to react?

12.45-12.55
Stojiljković, B., Nedeljković, D., Jotić, B., Zlatković, B.
Stojiljković, B., Institute for Nature Conservation of Serbia, Unit in Niš, Niš, Serbia
Rediscovery and conservation of the population of Hypecoum pseudograndiflorum (Papaveraceae) at the Niš Fortress

12.55-13.05
Đurđević, A., Lepojević, I., Stojanović, V.
Đurđević, A., Institute for Nature Conservation of Serbia, Office in Niš, Niš, Serbia
Protecting habitat of Cordulegaster heros Theischinger, 1979 (Insecta: Odonata) as a strategy for conservation of plant species and their communities

13.05-13.15
Stojanović, J., Jenačković Gocić, D., Jotić, B., Jovanović, M.D., Nikolić, J., Stojković, J., Pavlović, M.M., Raca, I., Nikolić, D., Jušković, M., Mitić, Z., Zlatković, B.
Stojanović, J., Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Niš, Serbia
Chasmophytic vegetation of the high-mountain belt of Suva Planina Mt.: A call for conservation efforts

13.15-13.25
Stojković, M., Institute for Nature Conservation of Serbia, Office in Niš, Niš, Serbia
Contribution of Professor Siniša Stanković in research and proposals for the protection of the Ohrid Lake between the two World Wars

13.25-13.35
Stanković, M., Pokret gorana Sremska Mitrovica, Sremska Mitrovica, Serbia
Overwiev of the ferns (Pteridophyta) of the Zasavica Special Nature Reserve

13.35-13.45
Jovanović, M.D., Stojanović, J., Jotić, B., Nikolić, J., Stojković, J., Pavlović, M.M., Raca, I., Jenačković Gocić, D., Nikolić, D., Jušković, M., Mitić, Z., Zlatković, B.
Jotić, B., Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš, Niš, Serbia
Endangered and protected plant species in the high mountain belt of Suva Planina Mt.: Current state and perspectives

13.45-13.55
Stojiljković, B., Zlatković, B., Jovanović, M.D., Đorđević, M., Mitić, Z., Tošić, S., Jušković, M.
Stojiljković, B., Institute for Nature Conservation of Serbia, Unit in Niš, Niš, Serbia
Priority species, floristic hotspots and their networking: An approach to the long-term conservation of Lalinac Salt Marsh

13.55-14.05
Damjanović, J., Stanković, M.
Damjanović, J., Pokretu za zaštitu i negovanje reke Bosut, Batrovci, Srbija
Floristic values of Mali Bosut Nature Park

14.05-14.15
Stanković, M., Pekić, A., Simikić, S.
Pekić, A., Udruženje građana "Čuvari Majevice", Lopare, Bosnia and Herzegovina
Results of floristic research of Majevac in the territory of the Municipality of Lopare, Bosnia and Herzegovina

Poster Session 2:

Ecology and Environmental Protection
Nature Protection
Phytochemistry and Phytotherapy

15.30-17.00
Saturday, May 24th, 2025.

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Nahirnić-Beshkova, A., Shamshev, I., Barták, M., Đorđević, V.
The first records of the pollinators of Gymnadenia frivaldii (Orchidaceae) on the Balkan Peninsula

2
Jušković, M., Jenić, J., Stojanović, J., Nikolić, D., Jenačković Gocić, D.
Bioindicator potential of Pinus nigra J.F. Arnold needles in polluted areas: Morphological and anatomical insights

3
Pećić, M., Jerinkić, D., Jakovljević, O.
Water quality assessment of the Ćelije reservoir based on periphytic diatoms inhabiting artificial substrate

4
Popović, S., Jakovljević, O., Savković, Ž., Stupar, M.
Life under lighting system in Stopić Cave: phototrophs and fungi on artificial substrates

5
Vukotić, D., Andrejić, G., Kuzmanović, N., Stojanović, J., Jenačković Gocić, D.
Environmental gradients in wetlands: Soil pH variability and its role in structuring wetland vegetation

6
Paušič, I., Granda, T.
Protecting orchid biodiversity in the age of "green energy": First report of the large-scale terrestrial orchid Neotinea tridentata Scop. (Orchidaceae) conservation translocation in Slovenia. How to measure it's success?

7
Tijanić, A., Lazarević, M., Cvetković, V., Mitić, Z., Nikolić, B.2, Nikolić, J., Žikić, V.
Effects of Thuja plicata essential oil on wing morphology in Drosophila melanogaster

8
Nastić, M., Jenačković Gocić, D., Nikolić, D., Raca, I., Petronijević, T., Kostić Kokić, I., Andjelković, T., Stanković, N.
Could cyanobacterial metabolites be responsible for the decline of Pistia stratiotes L.?

9
Stamenković, O., Kostić Kokić, I., Stojković, O., Petrović, M., Anđelković, T., Raca, I.
The influence of phosphorus enrichment on the growth of Ceratophyllum demersum L. in ponds: a mesocosm approach

10
Nikolić, M., Ilić, M.P., Samardžić, A., Medenica, I., Savić Zdravković, D.

IN MEMORIAM

Professor Dr. Vladimir Ranđelović – *In memoriam* (1965-2023)

Nikolić, D.

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This work is dedicated to the memory of Professor Dr. Vladimir Ranđelović (1965–2023), an extraordinary botanist, plant ecologist, and educator whose contributions to science and academia continue to resonate throughout Serbia and the Balkans. As a full professor at the Faculty of Sciences and Mathematics, University of Niš, he held numerous distinguished roles during his career: professor, mentor, head of the Department of Biology and Ecology, vice-dean, dean, editor-in-chief of *Biologica Nyssana*, and founder and president of the Biological Society "Dr. Sava Petrović". He was also the founder and president of the Scientific and Organizing Committee of the Symposium on the Flora of Southeastern Serbia and Neighboring Regions (SFSES). His research significantly enriched the understanding of regional flora, and his scientific legacy includes the discovery of new species as well as the publication of numerous important monographs and scientific papers. Yet beyond all titles and achievements, Professor Ranđelović was a man of rare generosity, humility, and strength. He was deeply devoted to his students, always ready to offer guidance, encouragement, and sincere advice. Even while battling a serious illness, he remained committed to his work, teaching, and inspiring others with unwavering determination. To those of us who had the privilege of knowing him, he was not only a brilliant scientist but also a deeply compassionate human being. Of all the roles he held, perhaps the one he cherished most was that of a grandfather – his family meant everything to him. I honor his memory with profound respect, gratitude, and sorrow, carrying forward the values he lived by.

IN MEMORIAM

Professor Dr. Novica Ranđelović – *In memoriam* (1937–2023)

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"I never wanted to leave my small village, because to me, that place is the center of the world," our dear professor, colleague, and friend Dr. Novica Ranđelović would often say with a warm smile. Born on September 15, 1937, in Kočane (Municipality of Doljevac), he grew up there, took his first steps, and learned his first letters. Though his passion for knowledge took him far, he remained devoted to his village throughout his 86 fruitful years. There he built a family, raised two children, applied his biological expertise to protect natural heritage, and served his community as municipal president. It was there, to the great sorrow of all, that he cast his final gaze on January 27, 2023 - leaving it to forever watch over his beloved Kočane, to which he dedicated the unique book entitled *Genealogica Kočaneiana*. Professor Novica will be remembered for his extensive floristic and vegetation research, especially within the genus *Crocus* L., where he co-described three species new to science. He published over 70 scientific papers, several monographs, textbooks, and manuals on medicinal plants. He assembled an impressive plant collection, *Herbarium Moesiacum Doljevac*, and founded a herbal pharmacy, *Herba Moesiaca*. He laid the foundations of the Southern Serbian Botanical School, the Symposium on the Flora of Southeastern Serbia and Neighboring Regions, and fulfilled his greatest dream by establishing the Department of Biology and Ecology at the Faculty of Sciences and Mathematics, University of Niš. Generations of students had the privilege of learning from him. Professor Novica will be remembered not only for his professional legacy but also for his kind heart, optimism, and unrelenting spirit.

IN MEMORIAM

Professor Dr. Vladimir Stevanović (1947-2024) – *In memoriam*

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Vladimir Stevanović (Belgrade, December 4, 1947 – Belgrade, March 19, 2024) was a Serbian biologist, university professor and academician. Until the end of his life, Stevanović was a retired professor at the Faculty of Biology at the University of Belgrade and a full member of the Serbian Academy of Sciences and Arts. Formally, Professor Stevanović was a biologist, ecologist, and biogeographer, but essentially, he was a botanist and naturalist who viewed the living world and its environment as an inseparable whole. His scientific work was very wide-ranging. He was primarily concerned with fundamental aspects of ecology, geography and plant systematics, but also with the application of basic knowledge in various areas of nature conservation and biodiversity. Professor Stevanović was not only a man of immense knowledge, he was also a man who knew how to impart this knowledge and - which is a real rarity these days - a man who passed it on selflessly. A detailed overview of Professor Stevanović's work is provided by Marjan Niketić in his work "Professor Dr. Vladimir Stevanovic, full member of SASA (Serbian Academy of Sciences and Arts) – On the occasion of his 70th birthday" (BOTANICA SERBICA 41(2): 109-121, 2017).

IN MEMORIAM

I could live here for the rest of my life - Prof. Dr. Biljana Božin: a researcher from the heart of the Pannonian Plain on the mountain peaks of Serbia and the Balkans

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Professor of Pharmacognosy and Phytotherapy at the Department of Pharmacy, Faculty of Medicine, University of Novi Sad, Dr. Biljana Božin, passed away on July 18, 2022, at the age of 51. A rapid and devastating illness took one of the leading figures in emphasizing the importance of biological and biochemical research in Pharmacy and Medicine from the scientific community of Serbia. Her work includes numerous published papers and monographs, exceptional citations in international journals, and memberships in many scientific associations. The scientific community of Serbia was privileged to have such a dedicated researcher and educator within its framework. Dr. Božin was an exceptional project manager, research coordinator, and scientist who successfully led research in all phases. With a background in Biology, she stressed the importance of understanding her research objects, their ecology and biology. From the start of her career, Prof. Božin was an active participant in the Symposium on the Flora of Southeastern Serbia and Neighboring Countries, and from the 11th Symposium onward, she was a member of the Scientific Committee, and almost by default, the Head of Phytochemistry and chemotaxonomy section. Her constructive criticism and guidelines were invaluable to many young researchers, supporting their work and professional growth.

IN MEMORIAM

Professor Dr. Violeta Slavkovska (1958-2025) – *In memoriam*

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Violeta Slavkovska (Radožda, Macedonia, November 17, 1958 – Belgrade, April 22, 2025) was a Serbian biologist and professor of botany at the Faculty of Pharmacy, University of Belgrade. Although she was interested in various fields of botany, her scientific work was primarily dedicated to the study of variability of essential oils at intrapopulation, interpopulation and interspecies levels in medicinal, aromatic and potential medicinal plants. Her major contributions focus on the investigation of the influence of abiotic environmental factors on the variability of essential oils in plants from both natural and cultivated populations. In addition to her notable scientific results, documented in more than 80 publications, Professor Slavkovska has made an outstanding contribution to the education and training of young pharmacists and biologists. As a mentor, co-mentor or committee member, she was involved in the supervision of more than 200 students' theses and research projects and actively collaborated with the Center for Scientific Research of Students at the Faculty of Pharmacy. Her teaching was highly valued by students, consistently earning top marks in surveys. Professor Slavkovska will be remembered by students and colleagues as a discreet, friendly and warm-hearted person who was always ready to offer her help selflessly.

15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Niš 23th-25th May, 2025

Taxonomy and Systematics

INTRODUCTORY LECTURE

The development of botanical studies among Serbs during the European Revolutionary Era (late 18th – early 19th century)

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With almost 4,000 taxa of vascular plants, the Republic of Serbia is known for its high floristic diversity. Until the late 18th century, however, knowledge of the flora remained largely unknown. The revolutionary era in Europe, which spanned the late 18th and early 19th centuries, brought unexpected advances in education and science as well as significant social and geopolitical changes to the Serbs. In just over a century, a previously unexplored region became an important destination for botanical researchers, a status that keeps to this day. The literature and herbarium collections from this period provide a valuable overview of these pioneering studies and illustrate their lasting impact. Early botanical studies led to the discovery of new genera and plant species as well as the recording of some now regionally extinct species, which were recorded at the time and are still preserved in the collections as the only evidence of their presence in the past. With them, the first urban floristic inventory was published, and some of the most important cultural heritage form the basis of today's knowledge of Serbian ethnobotany. In the end, the seemingly illogical sequence of botanical activities laid the foundation for the development of Serbian modern botany.

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ORAL PRESENTATIONS

Rewriting the story of *Crocus chrysanthus* Herb.

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In recent years, the systematics of the genus *Crocus* L. in Türkiye has experienced significant upheaval, driven by the publication of numerous new species. This disruption largely stems from the exploitation of loopholes in the ICBN regulations, which has led to species descriptions lacking rigorous comparative analysis with closely related taxa. Many of the descriptions published after the 1990s are based on vague or inaccurate type localities, cultivated plants that fail to represent natural populations, or superficial morphological traits. These questionable practices have hindered the accurate diagnosis of taxa, especially when inconsistent characters are prioritized. The type specimen of the *Crocus chrysanthus* (holo.: K 000099741!) was originally described from the Rumeli region. However, due to the inadequacy of the type specimen, nearly all taxa later published as distinct from *C. chrysanthus* remain problematic in their diagnoses. This study addresses these challenges by thoroughly defining the range of variation within *C. chrysanthus* and reassessing the validity of the taxa described in the last 12 years. Through an integrated approach encompassing cytological, genetic, morphological and anatomical data, the study provides clarity and resolves taxonomic ambiguities within this group.

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Exploring scape anatomy in *Crocus* L.: Its role in distinguishing series and species

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The genus *Crocus* L. (Iridaceae) is represented by 235 taxa distributed primarily in the Balkans and Türkiye. The complexity of the genus' systematics and the impossibility of studying all taxa simultaneously has been highlighted by numerous researchers. This study presents, for the first time, an in-depth examination of the scape anatomy of taxa from several series, including Series *Biflori* (*C. chrysanthus* Herb., *C. gembosii* Ruksans, *C. harpkeae* Ruksans, *C. muglaensis* Ruksans, *C. pestalozzae* subsp. *violaceus* Yüzb. & Özhatay, *C. tuna-ekimii* Yüzb., *C. uschakensis* Ruksans), Series *Flavi* (*C. antalyensis* B.Mathew, *C. flavus* Weston), Series *Crocus* (*C. asumaniae* B. Mathew & T.Baytop, *C. dispathaceus* Bowles, *C. mathewii* Kernd. & Pasche, *C. pallasii* Goldb., *C. rifatozdemirii* Erol, *C. turcicus* Ruksans), Series *Kotschyani* (*C. kotschyanus* K.Koch), Series *Reticulati* (*C. cancellatus* Herb., *C. gargaricus* Herb.) and Series *Speciosi* (*C. speciosus* M.Bieb). Scapes from mature capsules were embedded in paraffin, sectioned via manual microtome and stained with Safranin-Alcian Blue. Principal Coordinates Analysis (PCoA) revealed five groups, some of which correspond to Series within genus *Crocus*, though scape features were not effective in separating all Series. The results indicate that these scape characters are more useful for distinguishing crocuses at the species level.

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Morphological variability of selected taxa in the *Stachys recta* group (Lamiaceae) in the Central and Southern Balkans

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The polymorphic *Stachys recta* group includes 14 accepted species. One of them, *S. zepcensis* Formánek (*S. chrysophaea* Pančić, nom. inval.), is known for the ultramafic massifs of Serbia and Bosnia and Herzegovina. Judging by the morphology and previous classifications, endemics of the Central and Southern Balkans adjacent to the group could also be added to this species: *S. r.* subsp. *baldaccii* and *S. r.* subsp. *doerfleri*. For the last two taxa a similar calyx and leaf shape and colour of corolla are observed. Furthermore, morphological similarities are mentioned for populations of different taxa inhabiting ultramafic areas. In total, morphometric analyses of 41 characters were performed on 112 individuals from 15 populations (six representing *S. r.* subsp. *baldaccii*, four *S. r.* subsp. *doerfleri* and five *S. zepcensis* s.l.). Principal component analysis (PCA) and canonical discriminant analysis (CDA) were performed, showing a clear seclusion of an isolated population of *S. zepcensis* from Jerma Gorge in Eastern Serbia from the other measured populations. The main morphological characters used to distinguish this population from the others are: calyx length, calyx width, upper calyx tooth length and lower calyx tooth width, as well as ratio of lower bract length and width.

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Putting together the pieces of *Gagea bohemica* (Liliaceae) biosystematic puzzle

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Gagea bohemica is an early flowering monocot geophyte inhabiting relict, dry and rocky places. It occurs in large parts of southern, south-eastern and central

Europe, but its range is highly disjunctive. Various ploidy levels have been reported from different parts of the species' range, but it is unclear how these ploidy levels are linked to morphology and cytogeography. The taxonomy of the species is still unsettled with taxonomic concepts ranging from the recognition of several narrowly delimited taxa to a single highly variable species. Despite the attention given to populations in the Apennines and Western Europe, other parts of the range remain relatively neglected. We aimed to examine the cytological diversity within populations in less explored areas of *G. bohemica* occurrence, quantify the extent of morphological variation, reveal evolutionary patterns and population clustering. We employed a wide range of biosystematic methods, including morphometric analysis, flow cytometry, chromosome counting, pollen viability analysis, cpDNA sequencing, and genotyping-by-sequencing. By doing so, we have uncovered fine population structure that partially corresponds to the ploidy levels of the populations and some taxonomic concepts. Our study demonstrates the necessity of multi-method biosystematic approaches for the resolution of intricate polyploid complexes.

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Morphological delimitation of neglected species *Armeria dalmatica* Beck from *Armeria canescens* (Host) Boiss.

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Beck described *Armeria dalmatica* in 1898 based on the specimens collected in Croatia (islands of Pag and Brač) and Bosnia and Herzegovina (Velež Mountain). Later, Novák changed the status of this taxon to the rank of a variety within *A. canescens*, while Trinajstić introduced the new combination *A. canescens* subsp. *dalmatica*. There is no consensus on the taxonomic treatment of this taxon; it is treated as a separate species, sometimes as a subspecies and more often as a synonym of *A. canescens*. Therefore, a morphometric study was conducted on the two populations of *A. dalmatica* and four populations of the closely related *A. canescens*. Based on 19 quantitative characters, canonical discriminant analysis (CDA) clearly shows the separation of the two groups, one belonging to *A. canescens* and the other to *A. dalmatica*. Characters such as the length of the outer leaf length, the width of the spikelet bract and the ratio of the length of the calyx tube to the length of the calyx limb contribute most to the separation of these taxa along the first CDA axis. It was also concluded that *A. dalmatica* is a halophyte occurring in several localities in Dalmatia.

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Preliminary morphometric analysis of the *Ophrys sphegodes* complex from Croatia

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Morphometric analysis was performed on seven taxa belonging to the *Ophrys sphegodes* complex from Croatia, five of which are stenoendemics. Our analysis included taxa from three groups of this complex *O. exaltata*, *O. incubacea* and *O. sphegodes*. For this purpose, we obtained 25 linear measurements from flowers on total of 264 individuals from 21 populations. Univariate and multivariate analyses, Canonical Discriminant Analysis (CDA) and Principal Component Analysis (PCA), were performed at taxon and population levels. The CDA and cluster analyses

clearly showed the separation of *O. archipelagi* and O. *incubacea* from the other analysed taxa. *Ophrys tommasinii* occupies the central parts of the coordinate morphospace of CDA. Relative to these, populations of *O. sphegodes* are situated on the positive side of the first discriminant axis. Populations of *O. illyrica*, *O. incantata*, and *O. liburnica* formed a single group located on the negative side. *Ophrys tommasinii* is distinguished from *O. sphegodes* by its smaller labellum and stigmatic cavity dimensions and the greater length of the bulges. Within the group consisting of *O. illyrica*, *O. incantata* and *O. liburnica*, it was possible to observe a similar pattern of character variation, indicating that the group may represent a single taxon.

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Teucrium montanum subsp. *skadarensis* (Lamiaceae) – a new subspecies from northern Albania

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Teucrium montanum is a semi-woody dwarf shrub that is widespread in Europe, North Africa and Asia Minor. It exhibits a high degree of morphological variability and has a broad ecological valence. Due to its high morphological variability, many taxa have already been described. However, only two are currently accepted - *T. montanum* subsp. *montanum* and subsp. *helianthemoides*, while others are considered synonyms of *Teucrium montanum*. In the Balkans, this species is represented by seven distinct morphological groups whose morphological specificity is quite well documented. Previous studies have shown that the morphological group "skadarensis" can be easily distinguished by both qualitative and quantitative characters. Nevertheless, this group has not yet been compared with typical *T. montanum* populations from Western Europe. The aim of this study was to compare the morphological features of populations of the two accepted subspecies with "skadarensis" population. The results of multivariate statistic techniques revealed significant differences between the studied groups. In addition, a range of qualitative

features confirm the morphological specificity of the plants from northern Albania. In view of the qualitative and quantitative characteristics exhibited by these populations, there is a strong argument to designate them as a distinct taxonomic entity - *T. montanum* subsp. *skadarensis*.

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A new *Navicula* species (Bacillariophyceae) from Serbia's thermomineral springs

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Thermomineral springs, characterized by higher water temperatures and/or high mineral content, provide unique ecological niches that support specialized microbial communities. During a comprehensive study of the phototrophic microorganisms of thermomineral springs in Serbia during 2023, a new diatom species belonging to the genus *Navicula*, Bacillariophyceae was found in three localities (Omoljica, Poljane and Bukovička spa). The new species has a unique set of morphological features, such as the outline of the valve, the striation pattern and the shape of the central zone, which make it possible to distinguish it from similar *Navicula* taxa such as *N. cryptotenella* and *N. veneta*. The new *Navicula* species was found in biofilm and sediment mineral-rich environments with temperature ranging from 17.5 to 22°C. The discovery of new diatom species for science contributes to the growing knowledge of diatom diversity in extreme environments and emphasizes the ecological importance of thermomineral springs as unique microbial habitats.

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POSTER PRESENTATIONS

Botanical characterization of black locust honey samples from Bosnia and Herzegovina

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The paper aims to describe the botanical characteristics of black locust honey samples from Bosnia and Herzegovina. Twenty samples of black locust honey were collected from beekeepers in Bosnia and Herzegovina and subjected to melissopalynological analysis. The microscopic preparations were prepared in accordance with the *Rulebook on methods for the control of honey and other bee products of Bosnia and Herzegovina* and according to the propositions of the International Commission for Bee Botany. Plant species were identified using the micromorphological features of pollen grains, followed by a qualitative and quantitative analysis of the samples. The melissopalynological analysis has identified 23 types of pollen in 6,000 counted pollen grains. Pollen from 16 plant families was identified, with the most significant being Fabaceae (60.16%), Oleaceae (15.21%), and Poaceae (6.22%). On average, each sample contained six honey plant species. The highest number of species per sample was at the localities Kakanj (9) and Bratunac (8). The research indicated that each black locust honey sample had a distinct combination of honey-bearing plants, reflecting the unique floristic characteristics of the area where the hives were located during the grazing season.

Lichenized and lichenicolous fungi from the southernmost areas of Albania

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A list of 128 species of lichenized and 21 species of lichenicolous fungi from the southernmost part of Albania near the border with Greece is presented. Among these, 56 lichenized and 18 lichenicolous fungi are new to Albania, and 61

lichenized fungi are new to the studied area. The findings reveal several noteworthy aspects. A rich lichen vegetation observed on three old *Castanea* trees on the roadside, might be the remnants of an original forest, indicated by the following species: *Pectenia atlantica*, *Fuscopannaria mediterranea*, *F. olivacea*, *Scytinium teretiusculum*, *S. tenuissimum*, *Varicellaria hemisphaerica*, *Pertusaria coccodes*, *P. hymenea*, *Nephroma laevigatum*. At the old monastery of St. Nicholas in Mesopotam, 17 species were recorded on scattered *Olea* trees around the church, which is high species number considering the substratum. However, the species which are specific for olive trees are absent here, nor were found elsewhere along the journey. This indicates that olive trees were not a natural element of the vegetation in the places visited, but it does not show whether olive trees may have grown wild in the area sometime in the past. Notable findings in Mesopotam are *Staurolemma omphalarioides* and *Lecanora horiza*, both common Mediterranean species, and *Coenogonium luteum* and *Porina aenea*, which appear in shaded bark environments. In the small forest and the ruins of ancient Butrint, only a few samples were taken, but some were recorded without collection. Remnants of a column composed of acid stone were overgrown with species characteristic of this substratum although the broader area consists of basic rocks (limestone).

Orchids of Mount Plješevica in Bosnia and Herzegovina – preliminary research

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Plješevica Mountain is a natural border between the Republic of Croatia and Bosnia and Herzegovina. The direction of this mountain is northwest-southeast, with a length of about 50 kilometers. This massif is built in principle of rocks of Mesozoic age, mainly of limestone and dolomite. In some places, elements of karst phenomena appear, while on a larger area, dense forest is mainly represented, built as the main edificatory species by beech and fir (Directive 92/43/EEC – 91K0). Floristic research on Plješevica Mountain in B&H is scarce. In this regard, the research on the virgin forest in the Plješevica area in B&H is particularly noteworthy. Apart from the initial floristic research on the status of the virgin forest on Plješevica Mountain, no other floristic research has been conducted. This paper presents the results of a five-year survey on orchids in the Plješevica region (B&H). During the research period, an exceptionally high level of species diversity of this group of vascular plants was established. A total of 28 species have been identified, and the most significant are the following: *Cypripedium calceolus* L., *Limodorum*

abortivum (L.) Sw., *Himantoglossum adriaticum* H. Baumann, *Orchis pallens* L., *Epipactis muelleri* Godfery, etc. In order to protect this sensitive group of vascular plants in the future, it is necessary to urgently take certain conservation measures that will be reflected in their inventarisation, mapping, monitoring and habitat conservation.

Diversity of cyanobacteria and algae in selected water habitats in the wide area of Mount Plješevica (Bosnia and Herzegovina) – preliminary research

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The Plješevica mountain, which represents the natural border between the Republic of Croatia and Bosnia and Herzegovina, is characterized by a large number of different freshwater habitats. In this area there are numerous springs, as well as mountain streams and smaller rivers. Although this mountain in B&H is easily accessible, research on the flora of cyanobacteria and algae has not been carried out so far. As part of this work, sampling was carried out at seven different localities, which included different types of freshwater habitats. Sampling was carried out during the autumn season in 2024. Taking into account all investigated habitats in the wider area of Plješevica mountain, a total of 43 taxa were found. The largest number of taxa was found within the classes *Bacillariophyceae* (30 taxa) and *Cyanophyceae* (9 taxa), while the classes *Bangiophyceae* (1 taxon), *Chlorophyceae* (1 taxon) and *Charophyceae* (2 taxa) had a much smaller number of taxa. The most numerous species found in almost all investigated samples are: *Pseudanabaena catenata*, *Achnanthidium microcephalum*, *Cocconeis placentula*, *Nitzschia sigmoidea* and *Ulnaria ulna*. Given that the wider area of Mount Plješevica, and the mountain itself, had not previously been the subject of algal research, within the framework of this preliminary research, the presence of a rare (*Achanthidium trinode*) and a new species (*Achnanthidium rosenstockii*) for the algal flora of B&H was noted. In order to obtain a more complete picture of the diversity of this group of organisms, more detailed research will be carried out in the future.

Variability of leaf anatomical traits of *Gentiana* sect. *Ciminalis* (Gentianaceae) on the Balkan Peninsula

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Earlier studies on *Gentiana acaulis*, *G. clusii* and *G. dinarica* (*G.* section *Ciminalis*) from the Balkan Peninsula had not resolved their taxonomic status. To clarify this, a detailed anatomical study was carried out on leaf samples from ten populations from the Balkans and one from the Carpathians. Measurements were performed on cross-sections of ten rosette leaves from each population. Statistical data analyses were conducted on 14 morphometric traits. A range of statistical techniques were used to assess variability and identify important discriminating traits. These included descriptive statistics, principal component analysis and discriminant analysis. The results indicate that the species can be distinguished based on leaf anatomy, particularly mesophyll thickness and number of crystal cells. The populations of *G. acaulis* have the thinnest mesophyll, *G. dinarica* the thickest, while *G. clusii* lies between these two. Crystal cells are most abundant in *G. clusii*, followed by *G. dinarica*, while they are sparse or absent in *G. acaulis*. These results suggest that leaf anatomy is a valuable diagnostic tool for distinguishing taxa within the section *Ciminalis* of the genus *Gentiana*.

SEM-EDX analysis of calcium oxalate crystals in the fruit of *Scaligeria napiformis* (Apiaceae: Apioideae)

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Calcium oxalate crystals occur in many plant species and can be present in nearly all organs and tissues. The most commonly encountered types of crystals

include raphides, styloids, crystal sands, and druses. This study focuses on the druse crystals found in the fruit endosperm of *Scaligeria napiformis* (Willd. ex Spreng.) Grande. *Scaligerian apiformis*, the type species of *Scaligeria* DC., belongs to the Apiaceae family and the Apioideae subfamily. From a taxonomic perspective, crystals hold critical importance for the genus *Scaligeria*, as they are among the key characteristics that distinguish it from closely related genera such as *Elaeosticta* and *Positiella*. Mature fruits selected from herbarium specimens collected in Antalya, Türkiye, were used in this study. The samples were softened in hot water and manually sectioned as cross-sections before being fixed in 70% ethyl alcohol. Images were obtained using a Scanning Electron Microscope (SEM) under appropriate conditions, and elemental analysis was performed using an integrated Energy Dispersive X-ray (EDX) detector. The obtained images revealed that druse crystals could grow large enough to almost completely fill an endosperm cell, reaching diameters of up to 20 µm. EDX analysis indicated that the crystals consisted of 62% oxygen, 17% calcium, and 21% carbon by weight.

Microscopic examination of *Pimpinella tripartita* Kalen fruits: Anatomy, micromorphology and crystal composition

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Pimpinella tripartita, a member of the Apiaceae family, is native to northern Türkiye, the Caucasus, and northwestern to northern Iran. The fruit anatomy of Apiaceae species has already proven to be valuable taxonomic characteristics. In recent times, the types and structures of fruit crystals have also begun to be examined in detail. In this study, the fruit micromorphological and anatomical properties, and crystal content of *Pimpinella tripartita* are examined. The mericarps of *P. tripartita* are elliptic or semi-circular in the transverse section. The ribs are poorly developed or almost indistinct. There are two vittae in the commissure and 2-3 in the vallecula. There are five vascular bundles, located within the mesocarp layer beneath the ribs. The fruits of *Pimpinella tripartita* are slightly compressed laterally and almost round in outline. The styles are 1.5-2 mm long and extend by curving backward towards the dorsal side of the mericarps. The ribs are prominent towards the stylopodium but become indistinct towards the dorsal and basal parts of the

mericarps. Additionally, calcium oxalate crystals were also observed during the examination of the fruit's cross-section using Scanning Electron Microscopy–Energy Dispersive X-ray Spectroscopy (SEM-EDX).

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A microscopic perspective on *Chaerophyllum crinitum* Boiss. fruits: Anatomy, surface morphology, and crystal analysis

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The genus *Chaerophyllum* L. is distributed across Europe, Asia, North America, and Northern Africa and is represented by 70 species worldwide. In Türkiye, the genus includes 15 species, three of which are endemic. In this study, the fruit micromorphological and anatomical properties, and crystal content of *Chaerophyllum crinitum* are examined. Mericarp of *Chaerophyllum crinitum* is semicircular in transverse section. The ribs are generally indistinct, sometimes slightly protruding. The vittae on the dorsal side are four in total, with one present in each vallecula. These vittae are oblong or elliptical in shape and relatively small in size. There are two commissural vittae, and they are structurally similar to the vallecular vittae.The vascular bundles are poorly developed and are located within the mesocarp layer beneath each rib. The endosperm is compressed on the commissural surface and exhibits a concave shape. The endosperm cells are irregularly polygonal in shape and filled with oil content. The fruit surface ornamentation is smooth or longitudinally striated with slightly protruding features. The stylopodium is elevated on the fruit and conical in shape. The styles are 1-2 mm long and erect. Additionally, calcium oxalate crystals are also observed during the examination of the fruit's cross-sections using SEM-EDX.

Distribution of headspace volatiles in rosette leaves of thirteen *Achillea* species from Serbia

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This is the first study of headspace volatiles (HSVs) distribution in rosette leaves of thirteen *Achillea* species, including eleven from the section *Achillea sensu lato* (*A. chrysocoma*, *A. clypeolata*, *A. coarctata*, *A. collina*, *A. crithmifolia*, *A. distans*, *A. grandifolia*, *A. millefolium*, *A. nobilis*, *A. pseudopectinata*, and *A.* x *vandasii*) and two species from the section *Anthemoideae (A. ageratifolia* and *A. lingulata)* from Serbia. Oxygenated monoterpenes represented the most abundant compound class in the rosette leaves of most of the studied species, ranging from approximately 50% (*A. distans*) to over 70% (*A. clypeolata*, *A. coarctata*, *A. crithmifolia*, *A. grandifolia*, *A. nobilis*, *A. pseudopectinata*, and *A. ageratifolia*). In contrast, monoterpene hydrocarbons were dominant in the rosette leaves of *A. collina*, *A.* x *vandasii*, and *A. millefolium* (60.2, 56.8 and 50.4%, respectively). Furthermore, 1,8-cineole was the dominant HSV in seven studied species: *A. chrysocoma*, *A. clypeolata*, *A. coarctata*, *A. crithmifolia*, *A. distans*, *A. pseudopectinata*, and *A.* x *vandasii*. Other dominant HSVs included: β-pinene (*A. collina*, *A. millefolium*, and *A. lingulata*), camphor (*A. grandifolia*), chrysanthenone (*A. nobilis*), and *trans*-sabinyl acetate (*A. ageratifolia*). Multivariate statistical analyses (Canonical Discriminant Analysis and Agglomerative Hierarchical Clustering) revealed no clear differentiation between the two studied *Achillea* sections based on rosette leaves HSVs.

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Chemical composition of the root essential oil of five *Achillea* species from Serbia

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The aim of this study was to determine the chemical composition of the essential oils (EOs) from the roots of five *Achillea* species from Serbia (*A. crithmifolia*, *A. distans*, *A. grandifolia*, *A. millefolium* and *A. nobilis*). Chemical composition of the EOs was investigated by Gas Chromatography/Mass Spectrometry and Gas Chromatography/Flame Ionization Detector analyses. Oxygenated sesquiterpenes and sesquiterpene hydrocarbons were the two dominant classes of compounds in three out of five studied EOs (*A. distans*, *A. millefolium* and *A. nobilis*). On the other hand, *A. grandifolia* EO was characterized by the dominance of non-terpene compounds and oxygenated sesquiterpenes. Finally, the EO of *A. crithmifolia* was dominated by non-terpene compounds, followed by oxygenated monoterpenes. In this way, oxygenated monoterpenes were highly abundant only in the EO of *A. crithmifolia*, with borneol as the main representative of this compound class. Furthermore, isophytol acetate was the only identified diterpene compound, found in *A. crithmifolia* EO in concentration lower than 1%. Regarding the dominant compounds in the studied EOs, the most abundant were *epi*-α-muurolol (26.8%) in *A. distans*, eudesma-dien-11-ol (31.3%) in *A. millefolium*, globulol (19.8%) in *A. nobilis* and (*Z*)-heptadeca-9,16-dien-7-one in *A. crithmifolia* (35.7%) and *A. grandifolia* (27.4%).

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Fragilaria campyla (Bacillariophyceae) - second record of a rare diatom species in Serbia

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A morphologically and taxonomically very interesting diatom species, *Fragilaria campyla* (Hilse) Van de Vijver, Kusber & D.M.Williams (Fragilariales, Bacillariophyceae), was found for the second time in Serbia during the phytobenthos study of the Orovička River (western Serbia). *Fragilaria campyla* shows some resemblance to the *Synedra rumpens* complex, which still causes much confusion among taxonomists. This taxon was formerly known as *Synedra campyla*, but was transferred to the genus *Fragilaria* in 2022 after analysis of the type material. The morphological peculiarities of this taxon refer to deformed valves in the type population, which are bent, twisted or undulate; this is also the case in our population. *Fragilaria campyla* was recorded during four seasons in 2019 and 2020 at five sites of the Orovička River, where it was often the subdominant taxon, while *Achnanthidium minutissimum* was the dominant. The length and width of the measured *F. campyla* valves varied in the range of 18.72-46.41 μm and 2.3-3.71 μm, respectively, indicating a larger size range of our population compared to the literature data. The striae density was 19-20 in 10 μm. The valves have capitate apices, a large central area with a rectangular hyaline zone extending across the entire valve width.

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Comparative anatomical study of the leaves of *Verbascum* species from Serbia

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The genus *Verbascum* L., whose species are commonly known as "mullein", is one of the largest genera in the Scrophulariaceae family. When mullein is used in folk medicine, it is usually not specified which species was used due to morphological similarities. While anatomical studies can be crucial for the identification of species, many *Verbascum* species, especially those with restricted distributions, remain understudied from an anatomical aspect. Hence, this study aimed to compare leaf anatomical traits of three species from Serbia: *Verbascum niveum* Ten., *V. speciosum* Schrad. and *V. phlomoides* L. Cross-sections of leaves from 15 individuals of each species were analyzed for leaf width, mesophyll thickness, width and length of epidermal cells on the abaxial and adaxial side. The thickest leaf and mesophyll as well as the largest epidermal cells, were observed in *V. niveum*, while *V. speciosum* was characterized by the lowest values of the analyzed traits. Analysis of Variance (ANOVA) identified leaf width and the width and length of the epidermal cells on the abaxial side as the most important parameters for distinguishing the species. Principal Component Analysis (PCA) revealed a clear differentiation between species, highlighting leaf anatomy as a valuable additional diagnostic tool for distinguishing *Verbascum* species.

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Differentiation of Balkan *Abies alba* Mill. populations based on qualitative morpho-anatomical properties of needles

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The variability of qualitative morpho-anatomical properties of lower- and upper-rank needles from seven populations of *Abies alba* Mill. growing wild in the Balkan Peninsula was analyzed. Multiple correspondence analysis revealed a separation of the examined populations into two groups for both needle ranks. The first group consisted of populations from Bosnia and Herzegovina (Vranica) and Serbia (Tara and Kopaonik), while the second group included another population

from Serbia (Stara planina), as well as populations from Bulgaria (Pirin and Rila), and North Macedonia (Šar planina). The first group was characterized by a lack of stomata on adaxial needle surface and a marginal resin canal position, while populations from the second group had a higher number of needles with stomata on the apical region of the adaxial surface and resin canals in the mesophyll. Cluster analysis showed a similar pattern of population grouping as the multiple correspondence analysis. Furthermore, qualitative morpho-anatomical differences between lower- and upper-rank needles were noted. Specifically, stomata on both central and apical regions of the adaxial needle surface, as well as a twisted base, were present only in the upper-rank needles. The results indicate significant variability in the qualitative morpho-anatomical properties of *A. alba* needles on the Balkan Peninsula.

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The essential oil of nine wild-growing *Helichrysum italicum* (Roth) G. Don (Gnaphalieae, Asteraceae) populations in Croatia

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Helichrysum italicum (Roth) G. Don is widespread in Southeastern Europe (mostly from Slovenia to Albania and Greece). The aim of this work was to analyze the variability of nine wild-growing populations of *H. italicum* collected in 2023 in Croatia regarding essential oil (EO) composition. The EOs were obtained from air-dried and grounded aerial parts (5 g) using a Likens-Nickerson type apparatus for 2 h and analyzed using GC-FID and GC-MS (gas chromatography coupled to mass spectrometry). The EOs were dominated by sesquiterpenes (56.04-75.13%). A high percentage of sesquiterpene hydrocarbons characterized the EOs of populations from Ugljan (Kukljica), Banjole, Pula (Stoja), Pariževačka glavica (Jasenice) and Unije, while essential oils of populations from Ugljan (Kali), Frašker island, Pula (AC Stoja) and Brseč were dominated by oxygenated sesquiterpenes. Overall, 136 compounds were detected, of which 134 were identified (an average of 63 per

population). In total, 22 compounds were common to EOs of all populations. There were differences in EO composition and amount of different compounds between populations. The γ-curcumene was the most dominant compound in populations from Ugljan (Kukljica), Pula (Stoja) and Frašker island (17.18%, 11.40%, and 9.77%, respectively); neryl acetate (11.00%) in population from Ugljan (Kali); β-selinene in populations from Banjole, Pariževačka glavica (Jasenice) and Unije (12.76%, 8.91% and 6.63%, respectively); ledol (18.86%) in population from Pula (AC Stoja) and 5-epi-7-epi-α-eudesmol (9.17%) in population from Brseč. Obtained results revealed a new chemotype from population from Pula (AC Stoja), which was characterized by ledol, γ-curcumene, and δ-cadinene.

Taxonomic complexity in the *Crocus chrysanthus* (Herb.) Herb. species complex: Preliminary morpho-anatomical insights

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The name *Crocus chrysanthus* (Herb.) Herb. traditionally refers to yellow-flowered spring crocuses with annulate tunics but likely represents a complex of taxa. This study explores the variation within this complex through morphological and leaf anatomical analyses. Samples from ten populations across Türkiye (type locality), Romania, Bulgaria, Serbia, and North Macedonia were analyzed. Morphological analysis focused on 21 traits related to corms, leaves, and flowers, while anatomical analysis examined 21 traits, including general cross-section, epidermal, mesophyll, and vascular tissue features. Statistical significance was assessed using Kruskal-Wallis or ANOVA. Canonical discriminant analysis (CDA) identified five groups: I (Bulgarian populations), II (Romanian and Southeastern Serbian), III (Bulgarian and Northern Macedonian), IV (Turkish), and V (Western Serbian). Key traits influencing group separation included presence or absence of a

black mark on the anthers, xylem area, section length and number of ribs of the leaves. Future research will integrate cytogenetic and molecular data to clarify the taxonomic rank of the morphological groups identified in this study, which likely represent different cryptic taxa.

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Palynomorphology of *Cerastium decalvans* Schloss. & Vuk. (Caryophyllaceae)

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The pollen morphology of Balkan endemic species *Cerastium decalvans* Schloss. & Vuk. belonging to the South European mountainous chorological group and the chamaephyte life form, was examined using scanning electron microscopy (SEM), as a contribution to the floristic research of the Đetinja River Gorge in Serbia. The pollen grains of *C. decalvans* are radially symmetrical, apolar and spheroidal in shape. Grains are medium-sized, being on average 39.3±1.7 µm in diameter. The exine ornamentation is microechinate, with minute echini of 0.3±0.05 µm length, whose average number per sample area of 5 x 5 µm ranges from 8 to 17. Tectum is microperforate (punctate), and an average of 25.6±6.7 perforations of variable size were found on the area of 25 µm^2. Pollen grains are polypantoporate, with about 18-20 circular operculate pores 6.9±0.6 µm in diameter. The mean interpore distance is 8.8±1.2 µm. The membrane of each operculum covering aperture is ornamented, with 10-18 irregularly arranged granules of variable size averaging 0.9±0.2 µm. Each granule is covered with 1-4 minute echini less than 0.2 µm long. The height of the operculum including the granules amounts to 3.3±1.1.

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Seeds of diversity: What micromorphology says about the *Crocus chrysanthus* complex

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Crocus chrysanthus Herb. s.l. is composed primarily of yellow flowered spring-blooming crocuses found across the Balkans and Türkiye. Increasing evidence suggests that within Türkiye alone, this species complex harbors several distinct taxa, some of which have already been described as species or subspecies. SEM investigations indicate that *C. chrysanthus* s.l has highly variable seed surface micromorphology, consisting of various densities of papillae in various forms and sizes. This study investigates seed coat micromorphology, which is known to have important characters, particularly in crocuses. These include shape, length, posture, density and surface texture of papilla found on the seed coat, raphe and caruncle of 40 populations from across Türkiye. The numerical data was subjected to PCA in exploration of its significance and then added to categorical data types for PCoA. The results indicate that Turkish populations of this species complex can be grouped according to papilla dimensions, shape and density, several of which correspond previously described infraspecific taxa or species separated from *C. chrysanthus*. Furthermore, several populations are distinct enough to warrant further investigation into their affiliations. These observations corroborate our ongoing morphological, anatomical and molecular investigations into this species complex.

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Scape anatomical investigations in the *Crocus chrysanthus* species complex in Türkiye

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The spring-blooming *Crocus chrysanthus* Herb. s.l. occurs across Türkiye and the Balkans. Due to limited data availability, recent taxonomic revisions have synonymized several previously recognized taxa with *C. chrysanthus*, although there is insufficient evidence to support their status. Resolving these infrageneric relationships requires further systematic studies and the identification of new diagnostic characteristics. Scape anatomy is systematically significant in various plant groups and previous studies have demonstrated its potential in distinguishing *Crocus* species. This study investigated the features of fruiting scapes of *Crocus chrysanthus*, collected when they mature in late spring from locations across Türkiye. Cross sections were taken using a rotary microtome and stained with safranin-alcian blue. Scape area and shape, number of vertices, vascular bundle number, crystal type, and density were found to be statistically significant characteristics. PCoA results divided populations into six groups corresponding to previously described intraspecific taxa. Among them, *C. harpkeae* Rukšāns scapes are notable for having the greatest area and rounded shape, while *C. chrysanthus* from Kütahya province is unique in having crystal sand and *C. tuna-ekimii* Yüzb. has the fewest vascular bundles. These findings indicate that scape anatomy contains characters that may be useful in resolving the species complex.

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Micromorphology of *Corylus avellana* L. pollen grains analyzed by scanning electron microscopy

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Hazelnut (*Corylus avellana* L., (Corylaceae)) is a monoecious species in which male flowers - catkins and female flowers - glomerule are spatially separate. According to the flowering time, hazelnuts belong to the group of protandrous plants, meaning that male flowers ripen first. Since pollination is anemophilous, male flowers produce large amounts of pollen for successful fertilization. Examination of the pollen grain morphological features such as size, shape, polarity, symmetry, exine ornamentation, type, number and size of apertures, length of polar (P) and equatorial axis (E), were made using scanning electron microscopy (SEM) in order to contribute to palynological studies of cultivated fruit trees in Serbia. The pollen grains are isopolar, radially symmetrical and medium-sized. Grains are triporate with 3 pori arranged meridionally. The length of the polar axis (P) is 22.34±4.8 μm, and of the equatorial diameter (E) 25.62±4.3 μm. The P/E ratio is 0.86±0.05 indicating suboblate shape. The outline in polar view is triangular convex, since the apertures are situated at the angles. Pore diameter amounts to 3.27±0.68. The exine ornamentation is scabrate. Sculptural elements are less than 1 μm in diameter, while their number per unit area of 5 x 5 μm is 57.14±7.8.

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Relative genome size variation in the *Stachys recta* group in southeastern Europe

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With many subordinate or presumably closely related local endemic or subendemic taxa, *Stachys recta* forms a polymorphic group. To explore the variation in relative genome size and to identify patterns that may unravel the evolutionary history of the taxonomically complex *S. recta* group, relative genome size (RGS) was assessed for a total of 155 accessions from 55 populations of 18 taxa in southeastern Europe (*S. albanica*, *S. angustifolia*, *S. anisochila*, *S. atherocalyx*, *S. beckeana*, *S. goulimyi*, *S. graeca*, *S. leucoglossa*, *S. parolinii*, *S. patula*, *S. recta* subsp. *baldaccii*, *S. r.* subsp. *doerfleri*, *S. r.* subsp. *olympica*, *S. r.* subsp. *recta*, *S. r.* subsp. *rhodopaea*, *S. r.* subsp. *subcrenata*, *S. tetragona* and *S. zepcensis*). Flow cytometry was used to estimate the relative genome size, expressed here as a ratio of fluorescences between the individual and the standard (*Bellis perennis*), and varying from 0.43 to 0.71. Although several studies of other taxonomically complex taxa have shown correlations between intraspecific GS variation and morphology or environmental factors, and geographic segregation, we found no patterns in the RGS variation of the analysed samples with respect to taxonomy, geography or ecology.

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Cytogenetic diversity in *Crocus chrysanthus* Herb. in Türkiye: Insights from karyotype and genome size variation

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Crocus (Iridaceae) is a genus of geophytes found across Europe, Asia and North Africa, but the center of biodiversity is Türkiye and the Balkans. The *Crocus chrysanthus* Herb. complex is found primarily across western Türkiye, and its cultivars and hybrids are prized as ornamental plants. Many populations in Türkiye have been described as separate species, but most are doubtful due to insufficient specimens or lack of comparative analysis. Chromosome count, when used in combination with morphology and genome size, makes important contributions to plant taxonomy. The variable number of chromosomes in this complex (2n=8-22) indicates a need for deeper cytogenetic study to determine taxonomic boundaries and ploidy levels. Although chromosomal characters such as number and morphology are effective in distinguishing closely related taxa and are particularly valuable in crocuses, a comprehensive, geographically broad cytogenetic study is lacking for the *C. chrysanthus* complex. This research aims to address this gap through detailed cytogenetic analyses across its range in Türkiye, as part of a larger multidisciplinary project to determine relationships within the complex. We investigated the chromosome counts and genome sizes of 49 *C. chrysanthus* populations in Türkiye, revealing significant differences in both karyotype and genome size between populations.

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Stem anatomical characteristics of the selected *Polygonum* s. str. taxa from the Balkans and the Pannonian Basin

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Research on the stem anatomy in the genus *Polygonum* is scarce and has mostly focused on the anatomy of *P. aviculare*. Considering this, this study aims to

give a comparative overview of the stem anatomy of seven *Polygonum* s. str. taxa originating from 54 populations from the Central and Western Balkans and the Pannonian Plain and potentially provide new taxonomically significant characters. The shape of the cross-section is polygonal, with more or less prominent ribs. The epidermis is covered by a thick cuticle and comprises rounded or elongated cells with unevenly thickened cell walls. Stomata are rarely present, while trichomes are absent. Strands of sclerenchyma are present subepidermally in the rib zone. The cortex includes two to three layers of chlorenchyma cells and one layer of elongated starch sheath cells. The central cylinder consists of collateral vascular bundles arranged in a ring, with pericyclic fibers forming a cap above the phloem. Large parenchymatic cells with thin walls compose the medulla. Further research, which would include statistical analysis of quantitative anatomical characteristics of the stem, is necessary since it is not possible to distinguish taxa based only on the differences present in the description of the stem anatomy.

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Differences in inner bract shape in *Goniolimon* species (Plumbaginaceae)

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Morphological and molecular studies of *Goniolimon* species in southeastern Europe and the Apennine Peninsula revealed the occurrence of six species: *G. besserianum*, *G. dalmaticum*, *G. heldreichii*, *G. incanum*, *G. sartorii* and *G. tataricum*. In addition to the morphological characteristics used as diagnostic characters to differentiate the species, we wanted to investigate whether the shape of

the inner bract can also be used for species delimitation. We analysed 138 individuals from 14 populations in the southeastern Europe. Canonical variates analysis (CVA) resulted in the categorization into five groups. Individuals of *G. heldreichii*, *G. dalmaticum*, *G. sartorii* and *G. tataricum* formed separate groups, while individuals of *G. besserianum* and *G. incanum* were grouped together. The changes in the shape of the inner bract, which contribute most to the differences between the species, are primarily associated with changes in the shape of the middle part (points 3 and 4) and the middle cusps (points 8, 9 and 10) of the inner bract. This study is an example of how geometric morphometrics can effectively address taxonomic problems in plant species, especially in distinguishing closely related species such as those within the genus *Goniolimon*.

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Nutlet characteristics of selected *Micromeria* Benth. taxa from the Balkan Peninsula and their taxonomical importance

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Traditionally, *Micromeria* represents a diverse and taxonomically complicated genus in the family Lamiaceae. The genus has a wide distribution, with the Mediterranean region being a center of its diversity. In this study, the nutlet shape, dimensions, and micromorphology of seven *Micromeria* taxa from the Balkan Peninsula were investigated to assess the potential taxonomic significance of these characteristics. The taxa included in the analysis were *M. croatica*, *M. cristata* subsp. *cristata*, *M. cristata* subsp. *kosaninii*, *M. graeca*, *M. juliana*, *M. longipedunculata*, and *M. myrtifolia*. The variability of quantitative (length and width) and qualitative characteristics (general shape, shapes of the apex and base) of the nutlets was examined using univariate and multivariate statistical methods. The results of descriptive statistics, univariate analysis of variance (ANOVA), and multivariate statistical analyses (CDA, AHC, MCA) have shown that the examined characteristics were statistically significant in the morphological differentiation. Moreover, multivariate analyses indicated a clear separation between *M. cristata* subsp. *cristata* and *M. cristata* subsp. *kosaninii* based on quantitative features.

However, such differentiation was not supported by the qualitative traits of the two taxa.

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Molecular differentiation of *Crocus chrysanthus* species complex in Türkiye

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The *Crocus chrysanthus* species complex presents significant taxonomic challenges due to morphological similarities and overlapping distribution of the taxa from this complex in Türkiye. Our ongoing project aimed at investigating the complex from a mixed molecular, morphological, anatomical and karyological perspective to elucidate species boundaries, which have long been neglected despite the description of myriad new species and infraspecific taxa. Within the scope of this project we employed molecular markers to assess species boundaries within this complex and to provide genetic evidence supporting species differentiation. The results indicate clear genetic distinctions, reinforcing the presence of multiple species within the complex. However, further taxonomic resolution is necessary, requiring additional morphological and cytological analyses as well as additional molecular markers to refine classifications. This research underscores the importance of integrative taxonomic approaches in resolving species complexes and contributes to a deeper understanding of *Crocus* diversity in the region.

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Palynological characteristics of *Sempervivum ciliosum* complex: Variability and taxonomic implications

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The *Sempervivum ciliosum* complex, including *S. ciliosum*, *S. galicicum*, *S. klepa*, *S. jakucsii*, and *S. octopodes*, comprises a taxonomically challenging group of yellow-flowered taxa endemic to the Balkan Peninsula. While previous studies have focused on vegetative morphology and anatomy, pollen morphology, its variability, and taxonomic relevance have not yet been investigated. To address this gap, univariate and multivariate analyses were conducted on both quantitative (polar and equatorial diameter) and qualitative (pollen grain shape) traits across seven populations. Results showed that *S. galicicum* possesses the largest, and *S. ciliosum* the smallest pollen grains. Furthermore, Principal component analysis revealed complex variability patterns while Canonical discriminant analysis (CDA) suggested that taxa can be differentiated based on the studied traits, although with their somewhat lesser separation. However, both CDA and Agglomerative hierarchical cluster analysis indicated the most significant segregation of *S. galicicum*. Qualitatively, the pollen grains of all taxa were tricolpate and subspheroidal in shape. The unique prolate state of shape was observed only in *S. octopodes*, contributing to its distinct separation from the remaining taxa in Multiple correspondance analysis. Considering that *S. galicicum* and *S. octopodes* are often treated as intraspecific taxa or synonyms of *S. ciliosum*, these findings reveal significant palynological differences supporting their taxonomic distinctiveness.

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Pollen morphology in the *Sempervivum ruthenicum* complex: Novel data and taxonomic implications

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Distributed from the Balkan Peninsula to Ukraine and northwestern Russia, *S. kindingeri*, *S. leucanthum*, *S. ruthenicum*, and *S. zeleborii*, belonging to the *S. ruthenicum* complex, represent a group of taxa with unresolved intrageneric taxonomy. However, the role of pollen morphology in addressing these inconsistencies has been overlooked. This study provides the first assessment of pollen morphology, its variability, and taxonomic relevance within this group. Two quantitative (equatorial and polar diameters) and one qualitative (pollen shape) trait were analysed within seven populations from the Balkan Peninsula and one from Ukraine. The results revealed that *S. ruthenicum* has the largest, and *S. leucanthum* the smallest, pollen grains. Interestingly, Principal component analysis showed substantial differences between the Balkan and Ukrainian populations of *S. ruthenicum*, while Canonical discriminant analysis and Agglomerative hierarchical cluster analysis designated this taxon as the most clearly differentiated. Although often regarded as a synonym of *S. ruthenicum*, *S. zeleborii* displayed greater similarity to *S. kindingeri*, contrary to previous assumptions. All taxa exhibited tricolpate pollen grains, but significant interspecific differences in pollen shape were evident. According to Multiple correspondance analysis, *S. leucanthum* and *S. kindingeri* have subspheroidal, *S. zeleborii* prolate, and *S. ruthenicum* perprolate pollen grains. These findings suggest pollen morphology as a valuable tool for distinguishing taxa within this complex.

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Ophrys × *diocleae* (Orchidaceae), a new nothospecies from Montenegro

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A new natural hybrid between *Ophrys montenegrina* (H. Baumann & Künkele) Devillers-Tersch. & Devillers, and *O. rhodostephane* Devillers & Devillers-Tersch. has been described based on the morphological evidence as *O.* ×*diocleae* Peškanov, Radak, Bogdanović, Vlku & Anačkov from Montenegro. A population of O. *montenegrina*, along with five hybrid individuals, was discovered on the roadside at the entrance to the town of Igalo. Other parent, *O. rhodostephane*, was recorded in the vicinity of the hybrid plants. The new nothospecies share most of the morphological characteristics of *O. montenegrina*, including the shape of the sepals and petals and the shape of the stigmatic cavity and speculum. The colour of the sepals is pink/purple, resembling that of *O. rhodostephane*. The shape of the labellum is inherited from that of *O. rhodostephane*, with a deep three-lobed basal part and the sides of the middle lobe bent back. Apical appendages are similar to those of *O. montenegrina*, but their dimensions are significantly larger and similar to the dimensions of the apical appendage of *O. rhodostephane*. The bulges have intermediate values between the parent species, being substantially smaller than *O. rhodostephane* but larger and similar in shape to *O. montenegrina*.

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Molecular analysis of the rbcL chloroplast DNA region in *Leonurus glaucescens* and *Leonurus persicus*

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The Lamiaceae family comprises plants of significant importance in diverse fields including food production, agriculture, cosmetics, and pharmacology, holding substantial cultural and economic value worldwide. This study showed differences between *Leonurus glaucescens* and *Leonurus persicus* at the molecular level through analysis of the chloroplast DNA's rbcL gene region. Following collection from natural populations, plant samples underwent DNA isolation. The target rbcL region was subsequently amplified via PCR, and the products were separated and visualized through agarose gel electrophoresis. Sequence analysis and phylogenetic evaluation using MEGA 11 software revealed a nucleotide divergence of 0.457% (p-distance=0.00457) between the species, indicating an average of 4.57 base differences per 1000 nucleotide positions. These findings provide molecular evidence supporting the observed morphological variations, thereby contributing to taxonomic classification. As the first comparative study of these species based on the rbcL chloroplast DNA region, this research offers novel insights into their phylogenetic relationship.

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15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Niš 23th-25th May, 2025

Phytogeography, Floristics and Phytoecology

INTRODUCTORY LECTURES

Diversity and dynamics of sand dune habitats in Serbia

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Inland sand dunes are endangered to critically endangered habitats in Europe. Their vegetation is under strong anthropogenic influence. However, their value for biodiversity conservation is very high, since species of narrow distribution and specific affinities are related to these habitats. Vegetation on inland sand dunes can change over time due to a variety of natural and human-induced factors. Natural changes of vegetation on inland sand dunes include the decline of vegetation cover due to erosion and the reopening of sand masses. On the other hand, natural successional changes imply a gradual increase of biomass on the sand (through the continuous overgrowth of sand) and the transition from pioneer grassland to sand to steppe, forest-steppe, shrub and forest vegetation. Changes in temperature and precipitation patterns due to climate change can affect the vegetation on sand dunes. For example, changes in rainfall patterns may lead to changes in the types of plants that can survive in the area. These habitat types are often in conflict with the development of agriculture and modern society in general. Very often, they are degraded by humans. Degradation of the plant cover on the sand allows the movement of sand masses. Due to its unique natural characteristics, sandy areas in Serbia have always attracted numerous researchers who study its flora and vegetation. This survey analyses and synthesizes the present knowledge of dry grassland vegetation on inland sandy soils of the Republic of Serbia and provides a comprehensive overview of their diversity with a clearly defined classification system and definitions of high-rank syntaxa, as well as their position in the European classification scheme.

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Montenegrin coastal bryophyte vegetation – 100 years later in the footsteps of the earlier bryologists

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Working on a new Catalogue of Bryophytes of Montenegro it turned out, that many bryophytes had been recorded in the past from the Mediterranean part of the country, which had no any recent data. In spring of 2023 we organised a field trip to visit localities known from the historical records and literature. During the expedition extant populations of several Mediterranean bryophytes were discovered, which were data-deficient so far. *Sematophyllum substrumulosum* was found on a palm tree and on decaying wood. Liverworts living on acidic soil (*Calypogeia fissa, Cephaloziella turneri, Scapania compacta*) were collected in *Erica arborea* stands. Many populations of *Myriocoleopsis minutissima*, a tiny epiphyte liverwort, were discovered. Maquis with limestone rocks were rich in mosses of little known recent distribution, like *Bryum canariense, Tortella mediterranea, Weissia levieri*. A volcanic rock outcrop maintained large population of rarities e. g. *Bartramia aprica, Grimmia lisae*. Besides of these findings two species (*Grimmia meridionalis* and *Microbryum conicum*) were recorded for the first time in Montenegro. With our presentation we would like to emphasize the importance of field works in the light of rapid environmental and climate changes and also pay tribute to the memory of a great field botanist, Vladimir Ranđelović.

ORAL PRESENTATIONS

Contribution to the knowledge of endangered and vulnerable species of the genus *Euphorbia* L. in the flora of the Republic of Serbia

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Of the 33 confirmed native species of the genus *Euphorbia* in Serbia, one is assessed as endangered (*E. exigua*) and five as vulnerable (*E. angulata*, *E. maglicensis*, *E. montenegrina*, *E. serpentini*, and *E. subhastata*). In this study, *Euphorbia* specimens from BEO, BEOU, BUNS, PZZP and HMN were analysed to assess the distribution of these threatened species in Serbia using 10×10 UTM squares. Among them, *E. subhastata* has the widest distribution, recorded in 24 squares in W and SW Serbia and Metohija. The other vulnerable species have more restricted distribution areas: *E. angulata* eight squares, NW and W Serbia, *E. serpentini* seven squares, W Serbia, *E. maglicensis* five squares, W and SW Serbia, and *E. montenegrina* four squares, SW Serbia, Kosovo and Metohija. *Euphorbia*

exigua has been found in six squares in Banat, E and SW Serbia. The Balkan endemics *E. montenegrina*, *E. serpentini*, *E. maglicensis* and *E. subhastata* are particularly vulnerable, with *E. maglicensis* and *E. subhastata* having the narrowest distribution ranges, which are restricted to the SE Dinarides. The population of *E. serpentini*, an obligate serpentinophyte, in Serbia, is the southernmost population of the species, which emphasises its vulnerable status.

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The genus *Ornithogalum sensu stricto* in the flora of Montenegro

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Ornithogalum sensu stricto (Asparagaceae) represents a taxonomically complex and insufficiently studied group, often affected by historical misidentifications and inconsistent classification - particularly in the Balkan Peninsula. In Montenegro, literature sources list ten taxa, yet many of these records require revision. This study provides a critical review of historical data alongside extensive field research and herbarium analysis conducted from 2022 to 2025, offering a comprehensive update on the genus in Montenegro. New distributional records, ecological observations, and population data reveal previously unrecognized diversity, including taxa newly reported for the national flora. Detailed mapping highlights broader ecological amplitudes and occurrences in Natura 2000-relevant habitats. Although *Ornithogalum* s. str. species in Montenegro have not been previously assigned conservation value at the national level, these findings suggest that some may deserve such recognition. They highlight the urgent need for continued taxonomic clarification and provide a solid foundation for conservation assessments based on IUCN criteria. The results of this study significantly

contribute to the understanding of plant diversity and endemism in the Balkan Peninsula.

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What do we know about vegetation diversity of Bulgaria?

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The territory of Bulgaria is characterized by a significant diversity of abiotic conditions (topography, climate, soils, etc.), which has led to the formation of diverse flora and vegetation. This research aims to present and overview the vegetation diversity of Bulgaria. Over the last 25 years, phytosociological studies have gradually increased significantly and followed the Braun-Blanquet method. Currently, 33781 phytosociological relevés are available in the Balkan Vegetation Database and Balkan Dry Grassland Database, which combine digitized data from the literature and personal data of the authors. A significant proportion of the relevés are unpublished (77.7%) and were collected between 2010 and 2024 (67.8% of all relevés). After statistical processing of the data, the vegetation diversity of Bulgaria is currently represented by 53 classes (98.2% of all plots), 71 orders (38.5%), 103 alliances (38.3%), and 136 associations (28%). The richest in syntaxa classes are *Festuco-Brometea, Carpino-Fagetea sylvaticae* and *Molinio-Arrhenatheretea*. Significant data were collected during the period 2017-2023 for the classes *Papaveretea rhoeadis, Phragmito-Magnocaricetea, Digitario sanguinalis-Eragrostietea minoris, Artemisietea vulgaris, Crataego-Prunetea, Helianthemetea guttati, Sisymbrietea, Epilobietea angustifolii, Lemnetea, Bidentetea* and *Potamogetonetea*. The classes *Carici rupestris-Kobresietea bellardii, Thero-Salicornietea strictae, Charetea intermediae, Littorelletea uniflorae, Juncetea maritimi, Cakiletea maritimae, Adiantetea, Cymbalario-Parietarietea diffusae, Oxycocco-Sphagnetea* are still largely unexplored.

The BEOU herbarium as a source of information on protected plant species in Serbia, focusing on plant taxa protected by the Habitats Directive and the Bern Convention

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Herbaria are considered an invaluable resource for conservation initiatives as they provide a valuable information base for future conservation efforts. We searched the collection of the Herbarium of the University of Belgrade (BEOU) for the specimens of the plant taxa listed in the Annexes II and IV of the Habitats Directive (HD) and Appendix I of the Bern Convention that have been collected in Serbia in the last 50 years, as the World Conservation Union considers a species extinct if it has not been observed during this period. Thirty-four taxa listed in the Habitats Directive and 28 taxa listed in the Bern Convention, with 22 taxa protected by both, were recorded in Serbia based on literature data. Specimens of 29 taxa were found in BEOU: eight of them are listed only in the Habitats Directive, five only in the Bern Convention, and 16 are mutually protected. This study highlights 11 taxa reported to occur in Serbia, but of which no specimens collected in Serbia in the last 50 years have been deposited in BEOU: *Arabis scopoliana*, *Artemisia eriantha*, *A. pancicii*, *Caldesia parnassifolia*, *Cerastium dinaricum*, *Dianthus serotinus*, *Lycopodium alpinum*, *L. complanatum*, *L. annotinum*, *Klasea lycopifolia* and *Tulipa hungarica*.

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Syntaxonomical diversity of the *Phragmito-Magnocaricetea* class in Bulgaria – an overview

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This research aims to uncover the syntaxonomical diversity of the *Phragmito-Magnocaricetea* class in Bulgaria. A dataset of 1724 relevés was analysed. The majority of them are unpublished, sampled between 2017-2024 and follow the Braun-Blanquet approach. The plot size was 10-16 m^2. GPS coordinates and water depth measurements were also collected. The species names were standardized according to the Euro+Med PlantBase. Hierarchical clustering was performed in the PC-ORD software package. Bray-Curtis dissimilarity and the flexible beta clustering algorithm were used. The diagnostic species were determined by calculating the Phi-coefficient. Species with covers above 50% at least in 20% of the relevés in any cluster were considered as dominants, whereas constant species were those having at least 50% presence in a cluster. The syntaxonomical diversity of the *Phragmito-Magnocaricetea* class in Bulgaria is represented by 4 orders (*Magnocaricetalia, Nasturtio-Glyceretalia, Oenanthetalia aquaticae, Phragmitetalia communis*), 5 alliances (*Carici-Rumicion hydrolapathi, Glycerio-Sparganion, Magnocaricion gracilis, Glycerio-Sparganion, Eleocharito palustris-Sagittarion sagittifoliae*) and 27 associations. Seventeen of them are new for the territory of Bulgaria (*Beruletum erectae, Butometum umbellati, Caricetum acutiformi-paniculatae, Caricetum acutiformis, Caricetum buekii, Caricetum hirtae, Caricetum ripariae, Caricetum vulpinae, Cyperetum serotini, Equiseto fluviatilis-Caricetum rostratae, Glycerio-Sparganietum neglecti, Nasturtietum officinalis, Oenantho aquaticae-Rorippetum amphibiae, Phalaridetum arundinaceae, Sagittario*

sagittifoliae-Sparganietum emersi, Schoenoplectetum lacustris, Schoenoplectetum tabernaemontani).

Vascular flora and floristic peculiarities of the Čakor Pass area and surroundings

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The Čakor Pass, situated within the Plav-Gusinje sector of the Prokletije Mountains (border between Montenegro and Kosovo), was the subject of a systematic floristic investigation conducted in the period of 2022 and 2023. The diversity of vascular flora was documented by herbarium specimens, which were incorporated into the herbarium collection of the Faculty of Science and Mathematics, University of Montenegro (TGU). Plants were identified up to the subspecies level using standard identification keys and regional floras. Through the integration of the field data and critical review of existing literature, a total of 662 taxa were recorded from the study area. Notably, 288 of these taxa represent novel records for the area. The most represented families included Asteraceae (13%), Poaceae (6.6%) and Rosaceae (6.5%), as well as genera *Alchemilla* (2%), *Viola* and *Carex* (1.8% each), *Veronica* and *Campanula* (1.7% each). 118 plants (17.8%) are endemic or subendemic in the Balkan Peninsula, while 44 (6.6%) have conservation value. Among the latest category, the most significant value has *Eryngium alpinum* L., a species listed in Annex II of the EU Habitats Directive and under the Bern Convention, which has restricted distribution within both Montenegro and Europe. Čakor area is also recognized as potential Natura 2000 site.

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New orchid records from Tupižnica Mt. (Eastern Serbia)

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Tupižnica Mt. is a limestone mountain in eastern Serbia, located near Boljevac, between the Timok River valley and the Kučaj-Beljanica mountain range. With an elevation of 1160 m asl, it features diverse habitats such as beech and oak forests, submontane meadows, and rocky slopes. Previous botanical research recorded 221 vascular plant taxa, including two orchid species: *Orchis purpurea* Huds. and *Cephalanthera longifolia* (L.) Fritsch. However, no other orchid records had been reported for this area. Field research conducted in 2024 yielded new chorological data for eight additional orchid taxa: *Cephalanthera damasonium* (Mill.) Druce, *Dactylorhiza sambucina* (L.) Soó, *Epipactis helleborine* subsp. *helleborine* (L.) Crantz, *E. microphylla* (Ehrh.) Sw., *Gymnadenia conopsea* (L.) R. Br, *Himantoglossum calcaratum* subsp. *rumelicum* (H. Baumann & R. Lorenz) Niketić & Djordjević, *Limodorum abortivum* (L.) Sw., and *Neottia nidus-avis* (L.) Rich. Their distribution was mapped using 10 × 10 and 1 × 1 km UTM grids. These findings increase the total number of orchid species on Tupižnica Mt. to 10, representing approximately 12% of Serbia's total orchid flora. The results highlight the floristic significance of this underexplored mountain and the need for further field investigations and conservation-oriented studies.

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Diversity and distribution of *Allium* sect. *Scorodon* Koch 1837. in the flora of Serbia

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The genus *Allium* L. is widely distributed in Serbia, which, as part of the Balkan Peninsula, represents one of the global centers of diversity for this genus. This region serves as a crucial hotspot for speciation, underscoring its ecological and evolutionary importance. Studying the genus *Allium* is important for agriculture, medicine, and gastronomy, because species within this genus are genetic resources for breeding, and are edible and medicinal plants. The aim of this study is to synthesize literature, herbarium data, and field observations in order to describe distribution of *Allium* sect. *Scorodon* Koch species across Serbia. All data were georeferenced. Distribution maps were constructed using data from fieldwork, literature reviews, and an analysis of 936 BUNS herbarium specimens (59 belonging to *Allium* sect. *Scorodon*). Presence of three species within Serbian territory was confirmed: *Allium moschatum* L, *Allium cupani* Raf. and *Allium meteoricum* Heldr. et Hausskn. ex Halácsy. Notably, field surveys confirmed the presence of *A. moschatum* in northern Serbia. Species diversity and distribution within the *Allium* genus serve as a crucial foundation for further biochemical and pharmacological research, as well as for a deeper understanding of the taxonomy and evolution of this genus.

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POSTER PRESENTATIONS

Species distribution model of *Pseudofumaria alba* (Mill.) Lidén in W Balkan

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The distribution model of *Pseudofumaria alba* (Mill.) Lidén in W Balkan is being presented. It is produced based on 11 georeferenced localities and 19 bioclimatic factors extracted from the WorldClim 2 dataset at resolution of 30 arc sec, which were processed in MaxEnt (ver. 3.4.1). The MaxEnt output showed that precipitation seasonality (68.1%) and precipitation of the driest month (12.9%) were the most significant bioclimatic factors for the distribution of *P. alba* in W Balkan. Moreover, the obtained distribution model of *P. alba* shows that the highest possibility of its occurrence is in the basin of upper Drina river, in central Bosnia and Herzegovina and W Slovenia.

The morpho-anatomical variability of *Myriophyllum verticillatum* L. in Serbia

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The primary objective of this study was to determine the morpho-anatomical variability of *Myriophyllum verticillatum* in lentic ecosystems. A morphometric analysis was conducted on eight populations (80 individuals) collected from Serbia, examining 13 quantitative morphological and anatomical characters of leaves and stems. These included the number of leaves in the node, leaf length and width, number of lobe pairs of the leaf, lobe length, internode length, stem diameter, central cylinder diameter, aerenchyma thickness, air cavity area, number of air cavities,

epidermis thickness and primary cortex thickness. Morphometric data were analyzed using descriptive statistics and Analysis of Variance (ANOVA). Most analyzed characters showed moderate variability (10<CV%>30), while leaf width, stem diameter, and air cavity area exhibited the highest coefficient of variation (CV%>50). The ANOVA identified internode length, leaf length, leaf width, number of lobe pairs, lobe length, central cylinder diameter, number of air cavities, and primary cortex thickness as statistically significant characters. Notably, *M. verticillatum* individuals from lake ecosystems were characterized by the narrower stems, thinner epidermis, and fewer air cavities compared to those from pond ecosystems. In addition, lake populations developed thicker aerenchyma and larger air cavity areas.

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Morphological variability of the free-floating macrophyte *Spirodela polyrhiza* (L.) Schleid. in Serbia

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This study aimed to assess the macro- and micromorphological variability of *Spirodela polyrhiza* (L.) Schleid. based on plant material collected from lentic and lotic ecosystems in the catchment areas of the Great Morava and Danube Rivers. To determine the degree of interpopulation variability, both macromorphological (number of fronds and turions, frond-to-turion ratio, area of the largest frond and turion, average and total turion area, percentage of frond coverage by turions, frond length and width) and micromorphological characters (epidermal cell area, guard cell length and width, stomata width, number and density) were analyzed. Among the examined characters, total turion area exhibited the highest coefficient of variation (96.33%), while frond length showed the lowest (15.52%). The lowest median and mean values for most characters were observed in individuals collected from aquatic ecosystems near the settlements of Glogovac and Zaječar, whereas individuals from a pond near the village of Čepure had the highest values. Cluster analysis revealed three distinct morphological groups, with the population from Glogovac showing the greatest degree of separation at the highest classification

level. Future research should focus on identifying ecological factors contributing to the observed morphological variability in this species.

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Insights into an *Asplenium ceterach*-dominated chasmophytic community on Stara Planina Mt.

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This study aimed to identify the diversity of chasmophytic communities on Stara Planina Mt. Using hierarchical cluster analysis on 210 relevés and 146 taxa, 18 distinct communities were identified. One of these communities, newly recorded for the region, is dominated and diagnosed by the fern species *Asplenium ceterach* L. Among its constant species are *Asplenium ruta-muraria* L., *Sedum album* L., and *Silene flavescens* Waldst. & Kit. The community comprises 17 species and was recorded in the Visočica River Gorge near the village of Rsovci, at altitudes ranging from 732 to 812 m a.s.l., within the oak vegetation belt. This community develops in dry crevices of limestone rocks and is characterized by a well-developed moss layer with an average coverage of 38.75%. The stands are mainly found on steep (80°) and vertical, sunlit slopes with a southern orientation, though occurrences on north- and east-facing exposures have also been observed. The community belongs to the *Edraiantho graminifolii-Erysimion comati* Mucina et al. 1990 alliance and the *Potentilletalia caulescentis* Br.-Bl. in Br.-Bl. et Jenny 1926 order. This finding reveals a greater diversity of chasmophytic communities in the region than previously recognized.

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Floristic and syntaxonomic diversity of the Svrljiški Timok river in the anthropogenic-altered section of the watercourse

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In order to assess the diversity of vascular plants and their phytocoenoses along the section of the Svrljiški Timok River that flows through the town of Svrljig, the field surveys of aquatic and semi-aquatic habitats were conducted during 2022 and 2023. A total of 128 species and 2 subspecies were identified, belonging to 94 genera, 40 families, 23 orders, 7 superorders, and 2 classes. The most species-rich families were Compositae (14 species), Fabaceae (14), and Poaceae (13). According to national legislation, *Typha shuttleworthii* is the only strictly protected species recorded, while eight other species - *Carex acuta*, *Ranunculus serbicus*, *Hypericum perforatum*, *Epilobium hirsutum*, *E. parviflorum*, *Althaea officinalis*, *Potamogeton nodosus*, and *Symphytum officinale*, are classified as protected. Several invasive species were also observed in the study area, including *Ailanthus altissima*, *Sorghum halepense*, *Lolium multiflorum*, *Echinochloa crus-galli*, *Erigeron canadensis*, *E. annuus*, *Xanthium strumarium*, and *Bidens frondosus*. A total of eleven aquatic and marshland phytocoenoses characterized by the dominance of *Ceratophyllum demersum*, *Potamogeton crispus*, *P. nodosus*, *Berula erecta*, *Typha shuttleworthii*, *T. latifolia*, *Sparganium erectum*, *Schoenoplectus lacustris*, *Glyceria notata*, *Phalaroides arundinacea*, and *Carex acuta* were recorded and phytocoenologically described. These findings highlight that aquatic and wetland habitats within particular urban environments can serve as important centers of floristic and syntaxonomic diversity, emphasizing the need for appropriate conservation measures in the future.

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Conservation ecology of *Cardamine serbica*, a rare and threatened species of the Balkan Peninsula

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Cardamine serbica Pančić (Brassicaceae) is a rare and narrowly distributed species inhabiting steep calcareous screes in gorges and mountainous regions of the Balkan Peninsula. Its known range is limited to a few localities in Bosnia & Herzegovina, Montenegro and Serbia. All recorded populations are relatively small, with the smallest occuring at the *locus classicus* near Perućac (Mt. Tara), representing the only known population of *C. serbica* in Serbia. This population is critically endangered due to habitat degradation and its extremely limited size. The present study investigates the ecological requirements of *C. serbica* and evaluates the effectivness of both ex-situ and in-situ conservation strategies aimed to help this threatened plant species to survive. To assess genetic diversity and structure across the species' range, population genetic analyses were conducted using microsatellites and ddRADseq. These analyses also evaluated the genetic similarity among populations and the impact of implemented conservation measures on the population in Serbia. Preliminary results indicate a positive effect of implemented conservation measures; however, additional efforts are required to ensure the long-term survival and recovery of *C. serbica* in Serbia.

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Serapias × *demadesii*: A new orchid hybrid taxon for Montenegro

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The genus *Serapias* L. (Orchidaceae) is primarily of Mediterranean distribution. The number of species within the genus varies depending on the author, ranging from 17 to around 30. Many species have overlapping ranges, which leads to interspecific hybridization – a common occurrence among almost all species within this genus. In the territory of Montenegro, five species have been recorded so far: *S. bergonii* E. G. Camus, *S. cordigera* L., *S. lingua* L., *S. parviflora* Parl., and *S. vomeracea* (Burm. f.) Briq. Three hybrid taxa have also been recorded: *S.* × *ambigua* Rouy ex E. G. Camus, *S.* × *intermedia* Forest. ex F. W. Schultz, and *S.* × *kelleri* A. Camus. A newly recorded hybrid, *S.* × *demadesii* Renz, was found in Čanj. Within a small enclosed pasture, currently undergoing an advanced stage of overgrowth into maquis vegetation, a large mixed population of over 1000 individuals was recorded. This population includes both parental species, *S. bergonii* and *S. lingua*, as well as their hybrid, *S.* × *demadesii*. Given that both parental taxa are widespread throughout the Mediterranean part of Montenegro and occupy the same habitat types, the distribution of the newly recorded hybrid in Montenegro is almost certainly much broader than has been recorded so far.

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Early spring therophytic ephemeral grasslands (alliance *Romuleion*) in North-eastern Mediterranean

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The study deals with dry grasslands dominated with *Romulea bulbocodium*, *Romulea linaresii* ssp. *graeca* and *Romulea columnae* that develope in early spring aspect in Montenegro and east Mediterranean. These grasslands, characterized by high floristic and phenological diversity, represent typical elements of Mediterranean landscapes maintained by traditional land use. In the context of the EU Habitat Directive, they belong to priority habitat type *6220 Pseudosteppe with grasses and annuals of the *Thero-Brachypodietea*. Based on numerical classification, we described two new associations: *Romuleo bulbocodii-Poetum bulbosae* ass. nova and *Ornithogalo excapii-Poetum bulbosae* ass. nova. The studied communities are classified within the *Romuleion* alliance, order *Poetalia bulbosae* and class *Poetea bulbosae*. We analysed all available relevés of *Romuleion* communities from Eastern Mediterranean and ordination analysis (NMDS) revealed that temperature and altitude are the most important ecological factors influencing the vegetation composition and distribution of dry grasslands of *Romulion* alliance. Newly described associations from Montenegro are floristically and ecologically similar to the *Alyssum alyssoides-Poa bulbosa* community from Epirus (Greece).

Ophrys cephalonica – A newly confirmed orchid species for Montenegro

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Ophrys cephalonica (B. Baumann & H. Baumann) J. Devillers-Terschuren & P. Devillers is one of 12 species within the taxonomically challenging *O. exaltata* group, part of the *O. sphegodes* complex. It was originally described from Cephalonia, Greece. To date, Greece and Albania remain the only Balkan countries where the species has been definitively confirmed. Reports of this species from Croatia remain unverified and are considered doubtful. The presence of *O. cephalonica* in Montenegro had remained unconfirmed, as previous reports lacked definitive taxonomic or herbarium evidence. During field research conducted in March 2024, *O. cephalonica* was recorded at two sites in Montenegro: the ridge

between Lučice and Buljarica, and Spičko Polje. In both cases, the species was found in Mediterranean *Pinus* forests (EUNIS T3A code). A small population of only 12 flowering individuals was observed between Lučice and Buljarica. At Spičko Polje, 40 individuals were recorded, 17 of which were in flower. Additionally, the more widespread *O. montenegrina* (H. Baumann et Künkele) Devillers-Tersch. et Devillers was also recorded at this site, along with *O. archipelagi* Gölz et H. R. Reinhard, for which this represents the second known locality in Montenegro.

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Helinathemo jonii-Artemisietum campestris a novel retrodunal dry grassland community in the Hinterland of Velika Plaža (Ulcinj, Montenegro)

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This retrodunal dry grassland community has developed as a result of the progressive natural succession of the highest part of the dune system and the regression stage on artificially destabilized sands in the hinterland of Velika plaža. It is represented by 2 subassociations: *typicum* and *asphodeletosum ramosii*. The stands of the first one are usually protected by a windbreak belt of floodplain riparian forest fragments or pine plantations. Due to the dynamics of the relief and the conversion of land and infrastructure works, it is often fragmented and interspersed in a mosaic with dune depressions, mown meadows or anthropogenic habitats. The second subassocation represents a final stage of development of the association during the progressive natural overgrowth of dune sands, driven by sand stabilization and the accumulation of humus in the upper soil layers. Compared to the *typicum*, grazing intensity is lower, and the increased humus in the surface layer leads to sand stabilization. This is reflected in the colonization by more geophytes

and species that do not typically inhabit the sand, as exemplified by the spread of *Asphodelus ramosus*. According to current knowledge, the distribution of both subassociations is limited to the hinterland of Velika Plaža.

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Floristic analysis of riparian areas in the Timok catchment area (Eastern Serbia)

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Riparian areas have long been exposed to extensive human pressures, contributing to their degradation and changes in plant community composition. Consequently, our aim was to analyze the floristic characteristics of riparian vegetation of these anthropogenically-affected areas in the Timok catchment area. Fourteen riparian field sites distributed along 3 rivers (Beli Timok, Crni Timok and Grliška reka) were studied. Vegetation data was collected on 100 m long longitudinal transects, with a total of 70 relevés (five per field site) made. Across the analyzed field sites, a total of 106 plant taxa were recorded. The most common plant species across the analyzed field sites were *Bidens tripartita* and *Salix alba*, found at 12 field sites (85.7%). Similarly, they were also recorded in the highest number of relevés: 56 and 47, respectively. Regarding the biological spectrum, hemicryptophytes were the dominant life form (32.06%), followed by therophytes (25.47%) and phanerophytes (24.52%). Floristic elements were grouped into eight areal types, dominated by species of Eurasian origin (35.85%). The presence of 23 alien species (21.7%) is especially alarming. Five invasive alien species with the highest number of records were: *Xanthium strumarium* subsp. *italicum* (38), *Amorpha fruticosa* (38), *Erigeron canadensis* (36), *Echinocystis lobata* (30) and *Robinia pseudoacacia* (21).

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WMA: A web-based application for mapping and analyzing distribution of plant taxa

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WMA is a web-based tool designed to visualize and analyze botanical data. Unlike traditional GIS software, this platform provides an intuitive, automated solution for mapping plant taxa distributions without requiring advanced GIS expertise. It supports multiple UTM grid resolutions (10 × 10 km, 50 × 50 km, and 100 × 100 km) and automates tasks that would otherwise require extensive manual work in software such as QGIS or OziExplorer. By integrating georeferenced field data, the application accurately maps species distribution using latitude and longitude, allowing users to identify biodiversity hotspots and streamline data visualization quickly. The platform enables simultaneous visualization of different data sources (field, literature, herbarium, and oral records), filtering by taxonomic levels, and determining centers of diversity. Additional features include importing various data formats and exporting visualizations in high-resolution picture formats. The tool is built using JavaScript and Python programming languages, with automation scripts that optimize batch data processing, significantly reducing the time required for repetitive tasks. Future improvements include integration with QGIS layers, expanding geographic coverage, linking to external databases for advanced filtering, generating KMZ/KML files and PDF reports with statistical analyses and graphical outputs, further improving its role in biodiversity research and conservation planning.

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Bryoflora of Novi Sad: Epiphytic diversity in parks and selected tree-lined streets

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Novi Sad, the administrative center of Vojvodina, is characterized by a temperate continental climate and a well-developed network of urban green spaces. Parks and tree-lined avenues create specific microclimatic conditions that facilitate the development of epiphytic bryoflora, despite the challenges posed by urbanization. Bryophytes are a significant component of urban ecosystems, providing important habitats for numerous animals and microorganisms, in addition to serving as bioindicators of air quality. A field survey conducted in spring and summer 2023 included seven locations in Novi Sad: Limanski park, Futoški park, Železnički park, Bulevar Oslobođenja, Bulevar Vojvode Stepe, Futoška ulica and Futoški put. A total of 36 epiphytic bryophyte species were recorded belonging to 21 genera across 11 families. Bryophyte diversity was higher in parks compared to roadside environments, where pollution-tolerant species predominated. These variations in diversity were associated with substrate type, bark properties, and possibly the intensity of anthropogenic influences. The study results highlight the importance of urban green spaces for bryophyte conservation and emphasize the need for further analysis and potential protective measures. Maintaining and enhancing green spaces can contribute to biodiversity preservation and the improvement of ecological conditions in urban environments.

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The orchid flora of the Šumadija region (Serbia)

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Research on orchids in the Šumadija region (Serbia) has been carried out with a great discontinuity in time and mostly within the framework of floristic or phytocoenological studies of specific areas. In this study, data on the distribution of orchids in the Šumadija region were collected through field research, based on herbarium material from herbarium collections and extracted from published sources. The field research was conducted from 2021 to 2024. The presence of 38 orchid species and subspecies and one hybrid was established in the study area. The orchids are classified in 14 genera. The most species-rich genera are *Anacamptis* (six taxa) and *Orchis* (five taxa). Analysis of life forms revealed that tuberous geophytes (28 taxa) are the most numerous, while rhizomatous geophytes are represented by 10 taxa. The phytogeographical analysis shows that representatives of Central European chorological group dominate (14 taxa), followed by orchids of Mediterranean-Submediterranean (11 taxa) and Eurasian (10 taxa) groups. The most important centres of orchid diversity are Mts. Rudnik, Gledić and Kotlenik. Although there is a considerable number of orchid findings in the vicinity of Belgrade, most of these records are old and have not been confirmed recently. Therefore, further field research is needed to complete the knowledge about the orchids of the Šumadija region.

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Adaptive traits of *Najas marina* L. in lotic and lentic ecosystems across six districts of Serbia

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Understanding the morpho-anatomical variability of aquatic plants across distinct freshwater habitats is essential for interpreting the ecological plasticity and adaptive strategies of species. This study analyzes 200 individuals from 18

populations of *Najas marina* L. (Hydrocharitaceae) collected from rivers, lakes, and ponds across six districts in Serbia (Jablanički, Pirotski, Nišavski, Pomoravski, Raški, and Zaječarski). Leaf-related traits (number of teeth per leaf, leaf width - with and without teeth, leaf length) and stem-related traits (number of teeth per internode, internode length, stem diameter, epidermis thickness, primary cortex thickness, number and area of air cavities, and central cylinder diameter) were examined using descriptive statistics and ANOVA. The number of air cavities had the lowest coefficient of variation (10%), while most traits showed moderate variability (10-30%). High variability was found in the number of teeth per internode (59%) and area of air cavities (66%). The ANOVA revealed statistically significant differences among populations for all traits except number of teeth per leaf, stem diameter, and area of air cavities. Compared to lentic ecosystems, individuals from lotic habitats exhibited a larger stem diameter, accompanied by more developed epidermal, primary cortex, aerenchyma and central cylinder tissues, suggesting an adaptation to the dynamic conditions of flowing waters.

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Revision of the genus *Veronica* L. (fam. Plantaginaceae) in the BUNS herbarium

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The genus *Veronica* L. comprises about 500 species distributed across diverse habitats, from sea level to high alpine regions. This study presents significant findings from the ongoing revision and digitization at BUNS, aimed at understanding distribution patterns and ecological preferences of the genus *Veronica* in Serbia. A total of 892 herbarium sheets were examined, representing 37 species classified within four subgenera *Beccabunga* (6), *Pocilla* (15), *Pseudolysimachium* (5), and *Veronica* (11). Compared to the *Flora of the Republic of Serbia*, which lists

46 species, our dataset captures 86% of the genus's known diversity. Herbarium specimens, mostly from Serbia, were collected in 1953–2024. The most frequently sampled species is *V. chamaedrys* (117), while five species are represented by a single specimen – *V. baumgartenii*, *V. bellidioides*, *V. catenata*, *V. dillenii*, and *V. scardica*. Based on these data and comparisons with published sources, we provide updated distribution records for one strictly protected (*V. barrelieri*), three protected (*V. crinita*, *V. scardica*, *V. spuria*), two invasive (*V. peregrina*, *V. persica*), and eight species considered rare or lacking detailed distribution data in Serbia: *V. acinifolia*, *V. anagalloides*, *V. dillenii*, *V. orchidea*, *V. serpyllifolia*, *V. spuria*, *V. triloba*, and *V. triphyllos*.

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Where did *Astragalus varius* S.G. Gmel. subsp. *varius* and *Veronica bachofenii* Heuff. disappear from?

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This study provides a comprehensive revision of historical distribution data for two extinct plant taxa in Serbia – *Astragalus varius* subsp. *varius* and *Veronica bachofeni*, undertaken under the evaluation process of the IUCN threatened status of the Serbian flora. To verify existing data and gather new information, we critically reviewed botanical literature spanning over the last 200 years, examined relevant specimens in 20 online, nine national and two international herbarium collections, as well as over 15 botanical databases. We also conducted field research at selected locations to find any potentially remaining individuals of these taxa in Serbia. Our findings not only confirmed that both taxa are regionally extinct, but also significantly revised their known historical distribution and ecological preferences in Serbia. Based on a revision of herbarium material, *A. varius* subsp. *varius* was found to have occurred in the Deliblato Sands in the early 20th century, but not around Vršac or in the Subotica Sands, as previously claimed. However, the presence of *A. varius* subsp. *varius* near Sombor, Krčedin and Slankamen remains uncertain. In contrast, *V. bachofeni* was never found in the Deliblato Sands. Although it was reported from the Đerdap Gorge, where suitable habitats exist, we have not confirmed these literature reports through field or herbarium research.

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New data for the flora of Serbia

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The urban flora of Serbia has been the subject of several studies in the past. However, previous research has mainly covered larger cities. The results of a systematic floristic investigation of the urban habitats of southeastern Serbia, which began in 2024, indicate an interesting floristic composition not only in large human settlements, but also in the ruderal habitats along the infrastructure of facilities. This especially applies to synanthropic, often invasive species spreading from the southern parts of the Balkan Peninsula toward Central Europe. New chorological data on three vascular plants in the Serbian flora have been reported. *Pterocephalus plumosus* (L.) Coult was discovered along the railway line in the City of Niš, which is probably the northernmost occurrence of this species in Serbia. The insufficiently known distribution of *Rubia tinctorum* L. is contributed by a new locality beside the road in the Municipality of Crveni Krst in the same city. Finally, *Dysphania pumilio* (R. Br.) Mosyakin & Clemants, known only for the valley of the Pčinja River in Serbia, was discovered in the urban habitats in the City of Vranje. The distribution extensions of these three taxa should be considered a noteworthy contribution to the flora of Serbia.

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Orchids of the Kopaonik National Park (Serbia): distribution and ecological preferences

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The Kopaonik Mountains are one of the most important centers of vascular flora diversity in Serbia. Data on the distribution and ecological preferences of the orchids of the Kopaonik National Park were collected during field research in the period between 2021 and 2024. In addition, data from herbarium collections and published sources were analyzed. The presence of 40 orchid species and subspecies and one hybrid, belonging to 18 genera, was established in the study area. The most species-rich genera are *Epipactis* (seven taxa) and *Dactylorhiza* (six taxa). Among the orchid taxa recorded, rare species such as *Gymnadenia frivaldii*, *Pseudorchis albida*, *Epipactis exilis*, *E. pontica* and *E. purpurata* stand out. The orchids were recorded at altitudes between 749 and 1,950 m in plant communities from 14 classes, 20 orders, and 24 alliances. Most orchid taxa were found in communities of the classes *Vaccinio-Piceetea*, *Carpino-Fagetea sylvaticae*, *Festuco-Brometea*, *Nardetea strictae* and *Scheuchzerio palustris-Caricetea fuscae*, and the orders *Fagetalia sylvaticae*, *Nardetalia strictae*, *Athyrio filicis-feminae-Piceetalia*, *Caricetalia fuscae* and *Brachypodietalia pinnati*. The largest number of orchid taxa was recorded on granodiorites, followed by limestones, schists-gneiss-phyllites, quartz monzonites, and granites. The study provides an important basis for the successful organisation of orchid conservation in this area.

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Protected areas in Belgrade - their susceptibility to allochthonous invasive species

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The presence of invasive allochthonous species in urban environments is most often the result of constant and intense anthropogenic impacts that facilitate their entry, enable the establishment of sustainable populations, and accelerate their evolution. The main research objective was to determine the presence of invasive plants, their diversity and distribution patterns in formally protected natural areas of Belgrade, like Avala, Kosmaj, Ada Ciganlija and Veliko Ratno Ostrvo. Research on invasive flora was conducted during the 2024 vegetation season. The field research revealed the presence of 36 invasive allochthonous species, classified into 20 families, of which the Asteraceae (31%) and Fabaceae (11%) are the richest in species. In the biological spectrum of invasive flora, therophytes are the most abundant (30%), and in the chronological spectrum, neophytes (72%). Twenty-three species are of North American origin. The most frequent invasive plant species in the studied areas are *Erigeron annuus* (L.) Pers. and *Robinia pseudoacacia* L. The obtained results should enable the adaptation of an appropriate management plan for more efficient protection of biodiversity in the studied area. Therefore, it is important to conduct monitoring for the early detection of potentially invasive plant species and the introduction of adequate measures for their control and removal.

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Distribution, morphological and genome size variation in *Alnus rohlenae* (Betulaceae) on the vertical profile of Mt. Šarplanina – preliminary results

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The tetraploid *A. rohlenae* Vit, Douda and Mandak is an endemic species of the Balkan Peninsula that occupies the western part of the peninsula, where it has likely completely replaced the diploid species *A. glutinosa* (L.) Gaertn. Given that the precise distribution range of the tetraploid *A. rohlenae* is insufficiently known, especially with regard to the altitudinal distribution of populations, the present study reports the first precise data on the distribution of *A. rohlenae* in the subalpine zone of Mt. Šarplanina. In this area, *A. rohlene* was observed to co-occur with *A. incana*, thriving in frigophilous heaths of dwarf juniper (*Juniperus sibirica* Burgsd.) and blueberry (*Vaccinium myrtillus* L.) on a silicate substrate, at an altitude between 1700 and 1800 m. We analyzed morphological and genome size variation of *A. rohlenae* along the vertical profile of Mt. Šarplanina, including populations from the submontane to the subalpine zone, i.e. from 400 to 1800 m. Furthermore, we compared the main morphological characteristics and genome size of the two species in the sympatric zones of Mt. Šarplanina.

Effects of urbanization on flora of Sarajevo (Bosnia and Herzegovina)

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The comparison of historical (before 2015) and recent vascular flora of the city of Sarajevo indicates a 27.75% decline in species richness. Phytogeographically, both floras are dominated by cosmopolitan and Eurasian elements. Life form analysis reveals hemicryptophytes and therophytes as dominant in both floras, but the share of hydrophytes has declined. While the indicator values for light,

temperature, and humidity remained relatively stable, the recent flora favors more nutrient-rich soils and less acidic environments. Competitive taxa have become more dominant, whereas the share of CSR strategists has decreased. Generalist taxa still dominate in terms of social behavior, but there has been an increase in allochthonous weeds, invasive species, competitive taxa, and species tolerant of anthropogenic disturbance, and a decline in pioneer, specialist, and native weed taxa. Numerous endemic and Red List taxa have disappeared from the surveyed area, while none were newly recorded. The share of urbanophilic taxa has increased. The therophyte/hemicryptophyte ratio slightly dropped, the naturalness value declined, and the share of polyhemerobic taxa increased. All anthropogenic indices are significantly higher in the recent flora. These findings confirm significant floristic shifts driven by urbanization and anthropogenic influence.

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15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Niš 23th-25th May, 2025

Ecology and Environmental Protection

ORAL PRESENTATIONS

Expansion of *Lychnothamnus barbatus* in response to climate change

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Global climate change is reshaping biodiversity, driving shifts in species distribution. Rising temperatures and milder winters have facilitated the expansion of the endangered charophyte *Lychnothamnus barbatus* in Central and Eastern Europe. This species, once considered rare, now dominates the littoral vegetation of some lakes, including Lake Kuźnickie in western Poland. Our study highlights that *L. barbatus* has developed adaptations enabling it to persist and thrive in changing environmental conditions. Its ability to overwinter successfully has been enhanced by reduced ice cover and higher winter temperatures. Predictive climate models suggest that the species' range is expanding northeastward, with potential for further colonization as global warming continues. These findings have significant implications for the conservation of aquatic habitats, particularly within the Natura 2000 network. Understanding the response of *L. barbatus* to climate change provides valuable insights for ecosystem management and water quality monitoring. As a species once facing severe decline, its resurgence highlights the complex ecological consequences of a warming climate. Recent surveys have identified new populations of *L. barbatus*, including a previously undocumented site in Lake Malo Blato, Montenegro, recorded in 2019. This underscores the need for ongoing monitoring and conservation efforts.

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Air quality in the urban and surrounding area of a mining center in eastern Serbia using lichens as an biological indicators

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The city of Bor is a significant mining center in eastern Serbia that affects air quality. In this survey, corticolous lichens were used as indicators of air purity/pollution together with the quantitative method of the Index of Atmospheric Purity (IAP). The territory of the city of Bor and the surrounding area with radii of 5, 10, 15, 25 and 30 km was covered. At 37 surveyed points, a relatively small number of lichen species were found, with a dominance of pollution-tolerant, crustose and foliose species. It indicates a high degree of air/environmental degradation. According to the IAP values, the city of Bor and its immediate surroundings are in the "Lichen Desert" zone. Furthermore, at certain locations, there is a lichen "Struggle zone" with moderately impaired air quality. Very distantly only (25, 30 km) surveyed points indicate the "Normal" lichen zone, with slightly altered air quality. The results of the research conducted on the lichens indicate that the air quality of the wider city area is very poor to extremely poor, so its further monitoring and remediation are necessary.

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From algae to zooplankton: what *Pelophylax* kl. *esculentus* tadpoles eat in the Morava River Basin (Republic of Serbia)

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Anuran amphibians play a crucial role in aquatic and terrestrial food chains, attributable to their complex life cycle that requires diet and feeding strategies shifts.

Examining the diet and trophic status of amphibians is essential for understanding population fluctuations, habitat alterations, life history, and the formulation of conservation strategies. The examination of anuran amphibian larvae diets provides valuable information regarding their foraging behaviors, nutritional requirements, and trophic relationships in aquatic ecosystems, alongside the dietary composition and diversity of the larvae. The green frog complex, *Pelophylax* kl. *esculentus*, is prevalent in Serbia; however, its dietary habits in both adults and larvae remain inadequately studied. An analysis of intestinal contents was conducted on 197 tadpole samples from 10 distinct localities in Serbia to gather data on the diet of green frog larvae. The findings indicate that the intestinal contents exhibit diversity, primarily comprising algae (including diatoms, Cyanobacteria, green algae, and euglenoids), detritus, pollen, protozoans (such as rotifers), other invertebrate remains, and inorganic matter. The findings provide important insights into the nutrition of anuran amphibian larvae and establish a basis for future, more extensive research.

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Ecological and molecular assessment of toxic cyanobacteria in macrophyte-associated biofilms

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Benthic cyanobacteria are recognized as significant producers of potent neurotoxins, particularly anatoxins (ATXs), which have been linked to numerous animal poisonings. Among these, the genus *Microcoleus* has emerged as a key anatoxin-producing taxon. These cyanobacteria often colonize submerged macrophytes, which may facilitate their spread toward recreational areas, increasing exposure risks for humans and animals. However, the ecological dynamics of toxic, macrophyte-associated cyanobacteria remain poorly understood. To address this

gap, we conducted a year-long study (May 2023–May 2024) in Lake Tegel (Berlin, Germany), analyzing the occurrence and toxic potential of cyanobacteria associated with aquatic macrophytes. Samples were collected monthly from various locations and depths, and filamentous cyanobacteria were grouped by abundance using inverted microscopy. The most frequently detected genera were *Microcoleus*, *Geitlerinema*, *Oscillatoria*, and *Phormidium*. To assess anatoxin production potential, PCR analyses targeting the anaC (anaC-osc**)** gene - an established marker for potential anatoxin biosynthesis - were performed on DNA extracted from biofilm samples. A strong correlation was found between the presence of *Microcoleus* and positive anaC-osc detection in 32 screened samples, suggesting its prominent role in anatoxin production in these habitats. These results highlight the value of anaC-osc as a molecular tool for detecting potential neurotoxin-producing cyanobacteria and emphasize the need for continued monitoring of benthic communities in freshwater ecosystems to support water quality management and public health protection.

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From fire history to conservation strategy: An integrated biodiversity and risk assessment in Lalinačka slatina

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The Natural Monument "Lalinačka slatina", one of Serbia's last remnants of continental salt marshes, is increasingly threatened by anthropogenic pressures and climate change-induced fire risk. This study presents an integrative methodology to assess habitat vulnerability through modernized fire risk analysis and biodiversity mapping, focusing on plant microhabitats and bird diversity. From 2023 to 2024, we conducted microhabitat mapping of six strictly protected and/or critically endangered plant species using GPS tracking and geospatial analysis. Bird fauna was surveyed using line transects and point count methods across heterogeneous habitats. Our findings revealed 163 bird species in the wider saltmarsh area,

including 134 strictly protected species under national legislation, over twice the number previously documented within this area. To assess fire susceptibility, a decadal analysis (2013-2023) of meteorological variables and NASA FIRMS satellite fire data was conducted, demonstrating a strong positive correlation between increasing temperatures and fire frequency. Complementary socioecological surveys in 10 adjacent settlements indicated that illegal crop and stubble burning are frequent large-scale fire ignition sources, directly impacting key biodiversity zones. Integrating species distribution, land use mapping, and fire history data, we created risk maps, highlighting hotspots where fire pressure overlaps with vulnerable habitats. These maps serve as a foundation for early warning systems, fire prevention protocols, and adaptive conservation management. This underscores the need for modernized, interdisciplinary monitoring practices to ensure the resilience of sensitive ecosystems like Lalinačka slatina.

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Allelopathic potential of Microcystin-RR at environmentally relevant concentrations: Species-specific growth responses of cyanobacteria and green microalgae

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Microcystin-RR (MC-RR), a common cyanotoxin frequently detected in freshwater ecosystems, can influence phytoplankton dynamics by altering the growth patterns of coexisting species. This study investigated the effects of an

environmentally relevant concentration of MC-RR (10 µg L^{-1}) on the growth of five phytoplankton species: three cyanobacteria (*Trichormus variabilis*, *Nostoc sp.*, *Microcystis sp.*) and two green microalgae (*Chlorella sp.*, *Scenedesmus sp.*), under laboratory conditions. Growth responses were monitored spectrophotometrically to determine chlorophyll *a* concentration over a 14-day period. Additionally, MC-RR was identified and quantified in the treated cyanobacterial cultures using the HPLC-DAD technique. The results demonstrated species-specific responses. MC-RR exhibited a stimulatory effect on both green algae species. In contrast, *T. variabilis* showed progressive growth inhibition, which became statistically significant after day 7. *Nostoc sp.* displayed slight, non-significant inhibition, while *Microcystis sp.* showed tolerance to MC-RR exposure. Quantification of intracellular MC-RR revealed detectable levels in all treated cyanobacteria: 16.62 µg/g in *T. variabilis*, 8.13 µg/g in *Nostoc sp.*, and 4.95 µg/g in *Microcystis sp.* These findings demonstrate the allelopathic potential of MC-RR, with species-specific effects on growth that reflect differential sensitivity among phytoplankton taxa. The results underscore the ecological relevance of this toxin in shaping phytoplankton community structure and species interactions in freshwater ecosystems.

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POSTER PRESENTATIONS

The first records of the pollinators of *Gymnadenia frivaldii* (Orchidaceae) on the Balkan Peninsula

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Gymnadenia frivaldii (Orchidaceae) is a subendemic taxon of the Carpathians and the Balkans, growing mainly in fen habitats of the high mountain areas. It is a nectar-producing species that is rewarding for its pollinators. However, the pollinators of this species are insufficiently known. The aim of this study was to determine the pollinator diversity of this species and identify the insects that visit its flowers. The study was conducted in July 2023 in the Kopaonik Mountains (Serbia) and the Rila Mountains (Bulgaria). Only diurnal insects were investigated. A total of five pollinators and three visiting insects were recorded. In the Kopaonik Mountains, representatives of the order Diptera – *Empis* (*Euempis*) *tessellata*, *Empis* (*Leptempis*) *dimidiata*, *Empis* (*Leptempis*) *discolor* and *Rhamphomyia* (*Lundstroemiella*) *magellensis* were identified as orchid pollinators, whereas the visiting insects were *Botanophila fugax* (Diptera) and *Melanthia procellata* (Lepidoptera). On the Rila Mountains, the orchid pollinator was *Coenonympha rhodopensis* (Lepidoptera), while the insect visitor was *Erebia oeme* (Lepidoptera). In addition, a new genus (*Botanophila*) and five new species were discovered for the fauna of Serbia for the first time during this study: *Empis* (*Euempis*) *tessellata*, *Empis* (*Leptempis*) *dimidiata*, *Empis* (*Leptempis*) *discolor*, *Rhamphomyia* (*Lundstroemiella*) *magellensis* and *Botanophila fugax*.

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Bioindicator potential of *Pinus nigra* J.F. Arnold needles in polluted areas: Morphological and anatomical insights

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Mining activities release substantial amounts of atmospheric pollutants that significantly affect plant morphology and anatomy. Coniferous trees are particularly sensitive to these environmental stressors, with their needles serving as reliable indicators of air quality. This study investigates the impact of air pollution on needle morphology and anatomy in *Pinus nigra* J.F. Arnold across polluted sites (Bor, Krivelj, Donja Bela Reka and Brestovačka Banja) and a control site (Gornjane). Needles of varying ages (1-, 2-, and 3-year-old) were sampled, and a total of 11 morphological and 33 anatomical traits were measured. ANOVA was used to identify traits significantly affected by pollution, with separate analyses conducted for each needle age. The results revealed that maximum needle width, number of stomata/mm of the central part of both adaxial and abaxial surfaces of the needle, mesophyll area, needle cross-section thickness, lower epidermis height, and hypodermal cell width were the most consistent indicators of pollution-related stress across all needle age classes. Additional traits, such as needle length, needle width at 50% of its length, distance from the base of the needle to its maximum width, needle cross-sectional area, needle cross-sectional area excluding the hypo-epidermal region, upper mesophyll height, and endodermis width, were particularly significant in 2- and 3-year-old needles. The lowest mean values for these traits were observed in Bor, the most polluted site, while the highest were recorded in Gornjane, the least polluted location. These findings suggest that air pollutants from mining activities induce morpho-anatomical changes in needles, inhibiting growth and reducing leaf development due to their toxic effects.

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Water quality assessment of the Ćelije reservoir based on periphytic diatoms inhabiting artificial substrate

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The protection of aquatic ecosystems and the improvement of water quality through continuous monitoring are crucial steps in sustainable water management. This study aimed to compare diatom indices values, as tools for assessing reservoir water quality, using periphyton developed on artificial substrate after different exposure times (one to four months). Polyacrylic substrate carrier for periphyton development was submerged in two basins (eutrophic and mesotrophic) of the Ćelije reservoir (central Serbia) from June to October 2019. Diatom frustules were cleaned following the standard protocol. Five diatom indices (IPS, EPI-D, CEE, IBD, TDI) were calculated based on the indicator values of identified taxa using OMNIDIA software. The results indicated that water quality of the Ćelije reservoir ranged from high to moderate during the investigated period. Consistently across all indices, the mesotrophic basin exhibited better water quality than the eutrophic one. Indices from monthly samples indicated better water quality compared to those obtained from multi-month periphyton, particularly the CEE index. However, multi-month periphyton provided more consistent information on water quality whereas monthly samples appeared to be more sensitive to short-term environmental changes. These findings raise important questions about the relationship between periphyton exposure time in monitoring design and the informativeness of diatom-based assessments.

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Life under lighting system in Stopić Cave: phototrophs and fungi on artificial substrates

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Lampenflora is a distinctive biological community that develops near artificial light sources in show caves worldwide. In this study, we investigated the possible colonization of artificial substrates by phototrophs and fungi in addition to the already established lampenflora in Stopić Cave. The substrates (stone plates) were placed at varying distances from a light source and exposed for 10 months. Although no macroscopically visible biofilm formed on the plates during the observation period, phototrophic organisms were detected through microscopic examination of adhesive tape strips, and fungi after analysis of dip slides (containing Rose Bengal CAF medium) used for sampling. Considering phototrophs, members of the Chlorophyta, particularly coccal forms, were present on many plates throughout the entire experiment; Cyanobacteria showed increased species richness towards the end of the study when aerophytic Bacillariophyta (diatoms) were also recorded. However, no clear pattern of colonization was observed in relation to the distance from the light source. Fungal concentration ranged from 0.1 to 6.3 CFU cm^{-2} throughout the study period, and the highest concentrations were documented at the highest distance from the artificial light source (2.3 m). A total of seven fungal isolates (*Alternaria alternata*, *Aspergillus niger*, *Cladosporium cladosporioides*, *Epococcum nigrum*, *Fusarium proliferatum*, *Penicillium bialowiezense* and *P. expansum*) were identified on artificial substrate based on the ITS and BenA sequencing.

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Environmental gradients in wetlands: Soil pH variability and its role in structuring wetland vegetation

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Soil pH is a valuable parameter for the classification of wetland types and the assessment of their ecological condition or successional stage. In this study, 126 soil samples were collected from the South Morava River valley, within stands of the following plant communities: *Typhetum latifoliae*, *Typhetum angustifoliae*, *Typhetum domingensis*, *Typhetum laxmannii*, *Phragmitetum australis*, *Sparganietum erecti*, *Schoenoplectetum lacustris*, *Eleocharitetum palustris*, *Schoenoplectetum tabernaemontani*, *Bolboschoenetum glauci*, *Bolboschoenetum maritimi continentale*, *Cypero-Paspaletum distichi*, and *Cyperetum glomerati*. The results of soil pH measurements, conducted in both water and 1M KCl solution, showed that all analyzed plant communities grow on neutral to slightly alkaline soils (pH-KCl>7.2). The most significant differences were observed for species such as *Cyperus glomeratus* (ΔpH≈1.06), *Eleocharis palustris* (ΔpH≈1.01), and *Paspalum distichum* (ΔpH≈0.78), suggesting a higher content of acidic ions in the sorption complex of their habitats. In contrast, the smallest pH differences, observed in *Schoenoplectus lacustris* and *Typha laxmannii*, imply more stable, base-rich substrates with lower potential acidity. These pH values are characteristic of alkaline wetland habitats commonly found in lowland river valleys. This study offers valuable insights into species-environment relationships, particularly the ecological preferences of particular wetland plant communities regarding pH.

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Protecting orchid biodiversity in the age of "green energy": first report of the large-scale terrestrial orchid *Neotinea tridentata* Scop. (Orchidaceae) conservation translocation in Slovenia. How to measure it's success?

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With global biodiversity in decline, there is now an urgent requirement to take ameliorative action for endangered species in the form of re-introductions and translocations. Conservation translocation is the deliberate movement of organisms from one site for release in another. For the highly diverse orchid family (Orchidaceae), many species face imminent extinction. Conservation translocation of threatened terrestrial orchids is increasingly seen as a viable ameliorative conservation option when habitat is destroyed or modified through changing land use or habitat alternation. In this particular case, first and largest orchid translocation in Slovenia is being presented but also documented here for the first time. Due to the planned construction of the large solar power plant station south of Maribor (NE Slovenia), all the specimens of the endangered *Neotinea tridentata* Scop. were translocated in order to protect the local population from extinction. Translocation protocol, project long-term monitoring and further conservation guidelines are presented.

Effects of *Thuja plicata* essential oil on wing morphology in *Drosophila melanogaster*

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Plant essential oils, as natural sources of bioactive compounds, are increasingly studied as environmentally friendly alternatives to synthetic pesticides. The essential oil of *Thuja plicata* (EOTP) is characterized by a complex chemical composition and a broad spectrum of biological activities, including notable bio-pesticidal properties. The aim of this study was to investigate the effects of five different concentrations of EOTP (0.187% – 3%) on wing morphology in the insect model *Drosophila melanogaster* females using geometric morphometric methods. Wing size and shape were analyzed based on 15 specific landmarks, and the

symmetric response between left and right wings to the EOTP exposure was assessed. Different concentrations of EOTP did not result in statistically significant changes in wing size. However, wing shape was significantly altered, with the greatest variation observed at the highest EOTP concentration, particularly in the marginal and first posterior cell regions, while lower concentrations induced milder deviations. No significant differences were observed between the left and right wings, indicating a symmetric morphological response to EOTP exposure. These findings suggest that EOTP alters wing shape in *D. melanogaster* females, while wing size remains relatively unaffected. The results contribute to the known detrimental activity of EOTP in the insect model.

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Could cyanobacterial metabolites be responsible for the decline of *Pistia stratiotes* L.?

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Some cyanobacteria produce potent secondary metabolites with toxic and allelopathic effects that can profoundly influence aquatic organisms and ecosystem processes. This study investigates a potential connection between cyanobacterial proliferation and the disappearance of *Pistia stratiotes*, focusing on the qualitative composition of the algal community within its former habitat. Water samples collected in October 2022 and August 2024 from an artificial non-thermal gravel pit along the South Morava River revealed a persistent cyanobacterial community comprising representatives of the orders Oscillatoriales (*Lyngbya*, *Oscillatoria*), Chroococcales (*Microcystis*, *Chroococcus*), and *Dolichospermum planctonicum* (Nostocales). These taxa are known for their capacity to produce bioactive compounds capable of modulating interspecies interactions, potentially altering community composition and ecosystem balance. In addition to cyanobacteria, siliceous and filamentous green algae were consistently detected in both sampling

periods, suggesting relatively stable environmental parameters. Nevertheless, the complete loss of *P. stratiotes* and a noticeable decline in macrophyte diversity in 2024 raise concerns about underlying biological drivers. The potential involvement of cyanobacterial allelochemicals and toxins in the suppression or elimination of aquatic plants warrants further investigation, particularly regarding their role in structuring freshwater vegetative communities.

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The influence of phosphorus enrichment on the growth of *Ceratophyllum demersum* L. in ponds: a mesocosm approach

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Eutrophication is one of the major threats to freshwater biodiversity, often leading to the decline of submerged macrophytes. Phosphorus (P), while essential for plant growth, is a key driver of eutrophication when present in excess. We tested the effects of P enrichment on the growth of the submerged macrophyte *Ceratophyllum demersum* using outdoor pond mesocosms. Six mesocosms were set up to reproduce two treatments (with or without weekly P addition as NaH_2PO_4 at a rate of 0.10 mgPO_4/L) in triplicate. Over 35 days, we monitored nutrient concentrations (orthophosphate and nitrate) and several environmental parameters weekly (pH, dissolved oxygen, water temperature, electrical conductivity, turbidity, sulphate and chloride concentrations) and measured three morphometric parameters (internode, leaf base and leaf lobe lengths) and biomass of *C. demersum*. Phosphorus-enriched mesocosms were characterised by significantly higher orthophosphate concentrations, higher nitrate concentrations and increased turbidity. One-way ANOVA revealed significantly lower leaf-base length in enriched mesocosms ($F=8.48$; $p=0.005$), which was negatively related to orthophosphate concentration ($F=32.08$; $p=0.005$). Although internode and leaf lobe lengths and

biomass were also lower under P enrichment, these differences were not statistically significant. Our results indicate negative effects of P enrichment on *C. demersum* growth if exposed in the long-term.

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Evidence-based proposal for boundary revision of Lalinačka slatina using bird diversity data

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Natural Monument "Lalinačka slatina" spans 251.75 ha and is recognized for its halomorphic soils and high biodiversity. The area is classified as both an Important Bird Area (IBA) and Important Plant Area (IPA). Recent fieldwork conducted in 2023–2024 documented 163 bird species within the wider "Lalinačka Saltmarsh Area", which includes scattered remnants of saltmarsh habitats extending to and around the Oblačinsko Lake region. Of these, 134 are strictly protected under national law, 155 are listed under the Bern Convention, 21 under CITES and 88 species are included in the EU Birds Directive, including 38 in Annex I. Among the recorded species, 22 are classified as nationally threatened based on the conservation status of their breeding populations in Serbia. In contrast, only 72 bird species have been documented within the current boundaries of the protected area, according to existing literature. This striking difference in diversity underscores the conservation value of the surrounding habitat mosaic. The entire area is under increasing anthropogenic pressure, including agriculture, tourism and land conversion. We strongly advocate for the urgent expansion of the "Lalinačka slatina" boundaries to

include Oblačinsko Lake and adjacent saltmarsh fragments to ensure long-term protection of critical bird populations and their habitats.

Acknowledgements: Part of the data presented in this study was collected through the project "Ecotoxicological Assessment of Northern Lapwing (*Vanellus vanellus*) Breeding Sites: Unraveling Contaminant Impact in Lalinačka Saltmarsh Area, Serbia", led by Marko Nikolić and funded by The Waterbird Society. We gratefully acknowledge their support.

Cadmium accumulation and its impact on photosynthetic pigments in basil (*Ocimum basilicum*)

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Metals are the most common source of soil pollution. Cadmium is considered to be one of the most toxic elements, which has a negative effect on biological processes in humans, plants and animals. Elevated Cd concentrations in soil are due to human activities such as mining, coal extraction, burning of fossil fuels, industrial activities, constant use of pesticides and fertilizers etc. A reduction in the levels of potentially toxic elements in the soil can be achieved by growing plants that can tolerate and absorb high concentrations of pollutants. In this study *Ocimum basilicum* L. was grown for two months in soils spiked with 1, 5, and 10 mg Cd/kg soil. With increasing Cd concentration in the soil, the concentration in the roots increased significantly and proportionally to the soil concentration. The results show that an increasing Cd concentration leads to a decrease in the concentrations of Chl a, Chl b and total carotenoids. These results suggest that basil may be a candidate for phytostabilization of Cd-contaminated soils due to its limited ability to tolerate and accumulate cadmium in the shoots. Further research is needed to investigate possible physiological and biochemical mechanisms that influence the response of basil to cadmium stress.

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15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Niš 23th-25th May, 2025

Nature Protection

INTRODUCTORY LECTURE

Protection of the Banat peony *(Paeonia officinalis* subsp. *banatica* (Rochel) Soó) within the outstanding natural landscape Rudnik Mountain

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In accordance with the Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals, and fungi, the conservation of strictly protected and protected species is carried out through measures and activities aimed at population management, with habitat protection being the most important aspect. The Banat peony, a strictly protected species, has been recorded on Rudnik Mountain only at the Kotraža (Karaula) locality, its sole habitat south of the Sava and Danube rivers. At the end of 2024, Rudnik Mountain was protected by the state as an Outstanding Natural Landscape, and the peony habitat was placed under a third-degree protection regime, accompanied by specific protection and conservation measures, including a ban on clear-cutting and all forms of construction. Any planned activities on the site are permissible only under special conditions for nature protection. The peony population in this habitat is substantial, with numerous blooming individuals observed in April 2022, alongside many non-blooming specimens. Before the adoption of the Decree on the Proclamation, experts from the Institute for Nature Conservation of Serbia monitored the site and the species population - responsibilities now assumed by the appointed manager from 2025 onward through the Management Plan and annual Programs.

ORAL PRESENTATIONS

Contribution to knowledge of the flora of the Gornjačka gorge

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Serbian gorges are significant ecological areas characterized by rich biodiversity and the presence of rare and endemic plants. The first botanical records of the Gornjačka Gorge date back to 1863, when Josif Pančić explored this region. A century later, Vojislav Mišić investigated the endemo-relict vegetation of the area as part of his study of limestone gorges in eastern Serbia. The first comprehensive floristic list of the Gornjačka Gorge, comprising 239 taxa, was published in 2005 by Ranđelović. By synthesizing previously published data on the vascular flora of the gorge and the surrounding peaks, as well as unpublished data from three master's theses, a total of 520 vascular plant species were recorded. Among the 70 nationally and internationally significant species, three are of particular importance: *Cardamine glanduligera*, a strictly protected species newly recorded by D. Sokolović on Ježevac in 2015; *Ranunculus flabellifolius*, unconfirmed since 1986 from other site in Serbia; and *Viola jooi*, restricted to Veliki Vukan and proposed for protection. The presence of these and other rare plant species underlines the urgent need to protect the Gornjačka Gorge and ensure the implementation of strict conservation measures at the sites where these species occur.

New species in the flora of SNR Zasavica

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According to the Zasavica reserve protection study from 2012, there are 655 taxa of vascular flora in the reserve. Then, Stanković (2018, 2022) publishes a total of 28 new taxa for the flora of the reserve, totaling 683 taxa. With new field research and the determination of previously unprocessed herbarium material, the list was supplemented with 73 taxa, and now the flora of the reserve has a total of 756 taxa. A strictly protected taxon and on the International CITES list is *Epipactis palustre*. Pannonian endemics are *Thymus pannonicus* and *Achillea panonica*, and rare taxa in Vojvodina are *Achillea distans, Centaurea biebersteinii, Dipsacus pilosus, Erythronium dens-canis, Luzula multiflora,* and *Trifolium montanum.* New allochthonous taxa are *Amaranthus crispus, A. tuberculatus, Celtis occidentalis, Cirsium creticum, Dysphania ambrosioides, Eclipta prostrata, Eragrostis minor, Miscantus giganteus, Rudbeckia laciniata, Salix schwernuii* x *S. viminalis* and ornamental taxa are *Aquilegia vulgaris, Petunia axillaris, Viola wittrockiana,* and *Helianthus annuus* agg. Among the taxa, *Dipsacus pilosus* stands out as rare in Serbia, and in Vojvodina it is known only from Upper Podunavlja and *Rudbeckia lanciniata,* for which these are the first herbarium finds in Serbia, and until now it was only known as literature data without a herbarium specimen.

New dangerous invasive species of lionfish (*Pterois miles*) on the Montenegrin coast, Adriatic Sea, how to react?

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Climatic changes occurring in the marine ecosystem are very present and visible. The best indicator of these changes are new species that have not been in our sea until now, which we label as bioindicators. The largest number of new species of fish came to the Mediterranean Sea via the Suez Canal, and after that to its northernmost part, the Adriatic Sea. Given that these are species of warm seas, their presence indicates the influence of climate change, and the gradual warming of the Adriatic Sea. Lion fish has been present in the Adriatic since 2019, and has already been caught in Montenegrin waters. The fish is dangerous because of its poisonous dorsal fins, it reproduces throughout the year and has almost no natural enemies. An increase in the number of this species is expected, and since it directly affects domestic fish species, feeding on the eggs and juvenile stages of those species, it represents a great danger to the ecosystem. Contact with it, due to the poison in the spines, can be very painful and dangerous. One way to reduce its numbers is

targeted fishing by fishermen and underwater fishermen, in accordance with the international protocol, or the Action Plan.

Acknowledgements: We would like to thank the Montenegrin fishermen for their cooperation and for the delivered lion fish individuals.

Rediscovery and conservation of the population of *Hypecoum pseudograndiflorum* (Papaveraceae) at the Niš Fortress

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Hypecoum pseudograndiflorum Petrović is an annual, subendemic, ruderal plant species primarily distributed across the eastern parts of the Balkan Peninsula and Anatolia, but extremely rare in Serbia. It has been recorded at few sites in southeastern Serbia, most of which have experienced local extinction. As of 2024, the only confirmed population is located in Malošište, Doljevac municipality, inhabiting ruderal areas along a railway line. Due to its small population size, fragmented habitat, as well as strong and diverse anthropogenic pressures, it is listed as critically endangered in the Red Data Book of Flora of Serbia (1999). Recent research has confirmed the presence of the plant at the site where it was previously regarded to be extinct. A very small subpopulation of around 50 individuals was observed in Niš Fortress, at the very center of the city, which is considered the "*locus classicus*" of this species. The biological and ecological traits of these known subpopulations indicate a high degree of specialization and adaptation to secondary habitats, as well as low competitive fitness of the species, thus complicating conservation efforts. Conservation measures include legal protection of known sites, ongoing population monitoring and the development of strategic conservation plans.

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Protecting habitat of *Cordulegaster heros* Theischinger, 1979 (Insecta: Odonata) as a strategy for conservation of plant species and their communities

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The Ratajska River is located in southwestern Serbia, south of municipality of Prijepolje, and it's a left tributary of the Lim River. Investigations of its basin were carried out during 2024 with an aim of protecting habitats of *Cordulegaster heros* (Theischinger, 1979) and *Austropotamobius torrentium* (Schrank, 1803) which are present along the entire course of the river. Since the health of the watercourse is of key importance for the preservation of these two arthropod species, it is necessary to protect the wider area and sustain the vegetation in the best possible condition. This fact initiated floristic research in the area, where 160 plant taxa have been registered so far. Among the listed species, 25 of them are protected by Serbian law. This is a significant number of protected taxa, especially considering that the area is predominantly covered with forest vegetation. The most interesting and attractive species recorded in the area are from the Orchid family: *Himantoglossum calcaratum* subsp. *calcaratum* (Beck) Soó, *Neottia nidus-avis* (L.) Rich. and *Orchis purpurea* Huds. It's necessary to continue research of basin, especially in the vicinity of the Rijeka stream (southwestern part of the area), where different types of vegetation are present.

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Chasmophytic vegetation of the high-mountain belt of Suva Planina Mt.: a call for conservation efforts

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Suva Planina Mt. is rich in habitats conducive to the development of chasmophytic phytocoenoses; however, the inaccessibility of the terrain has limited their thorough research. In 2024, the floristic composition of chasmophytic stands was assessed in the high-mountain region, particularly on the peaks of Trem (1,810 m a.s.l.) and Sokolov kamen (1,523 m a.s.l). As a result of the phytocoenological investigation, the presence of two associations - *Erysimo-Ramondietum nathaliae* Jovanović-Dunjić 1952 and *Potentillo apenninae–Saxifragetum aizoon* R. Jovanović-Dunjić 1955 - was confirmed. Additionally, stands dominated by *Micromeria cristata* subsp. *cristata* and *Silene flavescens* were recorded on south-facing cliffs at altitudes between 1,439 and 1,521 m a.s.l., while at lower elevations (1,362-1,456 m a.s.l), stands dominated by *Silene flavescens* and *Asplenium ruta-muraria* were found on slopes ranging from 60° to 90°, on all exposures except west-facing ones. These stands, rich in endemic and relict species, occur in habitats recognized and protected under the NATURA 2000 network (8210 - limestone rocky slopes with chasmophytic vegetation), which also support protected and strictly protected taxa. Although these habitats are relatively well-preserved, a certain degree of disturbance occurs along hiking trails due to recreational activities. The results of this study provide a strong foundation for conservation efforts aimed at protecting chasmophytic species, their phytocoenoses, and their habitats.

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Contribution of Professor Siniša Stanković in research and proposals for the protection of the Ohrid Lake between the two World Wars

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Siniša Stanković (1892-1974), an academic, professor at the University of Belgrade and one of the most recognized Serbian, Yugoslav, and world limnologists and ecologists in his research on freshwater ecosystems, was particularly concerned with the study of Lake Ohrid, its composition, plant nutrient capacity, but also with measures for its practical protection and natural conservation (of the lake itself, as well as the wider coastal zone), proposals of new methods of researches and scientific promotion within the European and world framework. The paper will also mention Prof. Stankovic's involvement in the formation of the unique Hydrobiological Station in Ohrid, whose establishment in 1935 in then Vardar banovina (province) of the Kingdom of Yugoslavia (on the border with Greece and Albania) laid down the foundations for modern biological studies of Lake Ohrid as a world natural value and the first efforts at its professional ecological protection.

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Overwiev of the ferns (Pteridophyta) of the Zasavica Special Nature Reserve

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In the 2012 SRP Zasavica protection study, 6 types of ferns are listed (*Athyrium filix-femina* (L.) Roth., *Azolla filiculoides* Lam., *Dryopteris carthusiana* (Vill.) H. P. Fuchs., *D. filix-mas* (L.) Schott., *Salvinia natans* (L.) All., *Thelypteris palustris* Schott). Then in 2014 the seventh species of *Polystichum setiferum*

(Forssk.) T. Moore ex Woyn., 1913 ferns in the reserve, was found in the forest at the location of Duge njive. Of the total number, two species are aquatic, one of which is *Azolla filiculoides* Lam. non-native and potentially invasive in Serbia, found in 2015. Rare ferns are *Athyrium filix-femina* and *Polystichum setiferum* with one to two finds in the reserve. Zasavica as a swamp-peat complex is the habitat of the rare glacial relict species *Thelypteris palustris* Schott, which in the coastal zone forms a priority type of Natura 2000 habitat 7230 - alkaline lowland peat, the relic community *Thelyptero-Phragmito-Salicetum cinereae* M. Jank. 1994. Species of the genera *Athyrium, Dryopteris* and *Polystichum* inhabit forests of occasionally flooded *Genisto elatae-quercetum* Hov. 1938. subass. *leucoio-fraxinetum* Glav. 1959 to those outside the groundwater on alluvial beds *Rusco aculeate-Tilio-Quercetum* Erdeši 1955. The species *A. filix-femina* and *D. carthusiana* are protected and *Th. palustris* is a strictly protected species in Serbia.

Endangered and protected plant species in the high mountain belt of Suva Planina Mt.: Current state and perspectives

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Despite notable floristic diversity, the pekas of Suva Planina Mt. have not been thoroughly studied regarding the presence of plant taxa of importance for protection. In 2024, an inventory of protected/endangered plant taxa was conducted across the peaks of Sokolov Kamen, Trem, Mosor, Golaš, Pasarelo, and the Valožje plateau. As a result, sixteen taxa listed in the Regional IUCN Red List were documented. Among these, *Androsace lactea* subsp. *lactea*, *Edraianthus serbicus*, *Pinus mugo* subsp. *mugo*, and *Pyrola minor* subsp. *minor* were assessed as endangered to vulnerable, five as vulnerable, three as vulnerable to near threatened, and four as near threatened to least concern. Four taxa are listed in CITES (*Anacamptis morio*, *Epipactis helleborine* subsp. *helleborine*, *Gymnadenia conopsea* subsp. *conopsea*, *Himantoglossum calcaratum* subsp. *rumelicum*), whereas 10 taxa are strictly protected and 35 are protected under national legislation. Nonetheless, this area is anticipated to exhibit a greater diversity of taxa of conservation concern. Although the monitored subpopulations of endangered and protected taxa are mostly

well-preserved, several identified conservation threats, such as recreational activities and tourism, livestock grazing, habitat degradation, and the spreading of invasive species, may negatively impact their distribution, size, and density. Hence, active conservation measures (e.g. ongoing monitoring, identification of priority taxa for conservation, management of invasive taxa) are recommended to preserve the floristic richness of the Suva Planina Mt.

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Priority species, floristic hotspots and their networking: An approach to the long-term conservation of Lalinac Salt Marsh

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The Natural Monument "Lalinac Salt Marsh" is located in C Serbia, near Niš and the municipality of Merošina. It represents a protected natural area of local but floristically great importance. It was designated as protected area in 2015 to preserve salt marsh fragments, the one of the most sensitive and endangered habitat types in Serbia. Between 2019 and 2021, comprehensive floristic research was conducted in phases, focusing on the protected area and its surroundings. The main objectives were to determine the spatial distribution and population parameters of priority plant species, and to establish a network of biologically diverse surfaces and ecological corridors. These corridors aim to mitigate the effects of habitat fragmentation caused by human activities, maintaining floristic diversity and connectivity between important salt marsh fragments. Our research identified 270 plant species and subspecies and highlighted 49 spatial fragments with high floristic diversity. This number included 49 areas, 14 within the protected area, 11 partially overlap, and 24 outside or near the boundaries. A total number of 10 priority plant species was

monitored. The research emphasizes the rich floristic diversity of the protected area and points out the importance of redefining its boundaries and species management to ensure long-term conservation.

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Floristic values of Mali Bosut Nature Park

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Part of the Bosut River in the municipality of Šid was declared the Mali Bosut Nature Park in 2024, with a total area of 282 ha, in II and III degrees of protection. The conservation study has 131 plant taxa. According to new research and data from earlier research by another author, a total of 309 taxa were recorded. Of the total number, 17 taxa are protected (*Achillea milleifolium agg., Althaea officinalis, Asperula odorata, Crataegus laevigata, C. monogina, Cyperus glomeratus, Fragaria vesca, Geranium robertianum, Hypericum perfoliatum, Iris pseudoacorus, Pulmonaria officinalis, Teucrium chamaedrys, Trapa natans; Utricularia vulgaris, Sternbergia colchiciflora, Dryopteris carthusiana, Arum orientale*); 2 taxa are strictly protected (*Nuphar lutea, Nymphaea alba*); 30 taxa are allochthonous (*Abutihlon theopgasti, Amaranthus crispus, A. retroflexus, Celtis occidentalis, Chenopodium album, Erigeron annuus, Euphorbia maculata, Hibiscus trionum, Morus alba, M. nigra, Oxalis stricta, Panicum capillare, P. crus-gali, Phytolaca americana, Portulaca oleracea, Prunus cerasifera, Sorghum halepense* and *Xanthium strumarium*) of which 13 taxa (*Acer negundo, Ailanthus latissimus, Ambrosia artemisifolia, Amorpha fruticosa, Asclepias syriaca, Aster lanceolatus, Azola filculoides, Echinocystis lobada, Fraxinus pennsylvanica, Robinia pseudoacacia, Solidago serotinia* and *E.canadensis*) have an invasive character, one taxon each is tertiary (*T. natans*) and glacial relicts (*S. colchiciflora*) and one taxon (*Galanthus nivalis*) is on CITES lists.

Results of floristic research of Majevac in the territory of the Municipality of Lopare, Bosnia and Herzegovina

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The Spatial Plan of the Republic of Srpska plans to declare the Majevica Nature Park on the territory of Bijeljina, Ugljevik, Lopare and Zvornik, category VI to the IUCN, until 2025. The paper includes an inventory of the flora of the territory of Lopare in the period 2005-2009, 2024 and spring of 2025. A total of 360 taxa were recorded, 30 taxa are non-native, and 18 taxa are invasive. According to Šilić, (1992-1995) there are 6 vulnerable taxa in the flora of Majevica (*Ilex aquifolium, Telekia speciosa, Ruscus aculeatus, Convalaria majalis, Galanthus nivalis, Stenbergia lutea*) and one endangered taxon (*Ruscus hypoglossum*). Two taxa (*Ruscus aculeatus* and *Galanthus nivalis*) belong to the Habitat Directive, 3 taxa (*Neottia nidus - avis, Galanthus nivalis* and *Epipactis helleborine*) are on the CITES list, 51 taxa with a low degree of protection (LC) are present on the European Red List of vascular plants. In the period 1950-1990 *Larix europaea, Pseudotsuga taxifolia, Sequvoiadendron giganteum, Pinus strobus, P. nigra, P. sylvestris, Abies alba, Picea abies, Betula verrucosa, Castanea sativa*, etc. trees were planted in the forests of Majevica. Two species (*Paeonia officinalis* and *Stenbergia lutea*) are planted around the cottages, but they do not grow natively on Majevica.

POSTER PRESENTATIONS

Pioneering approaches in e*x situ* propagation and conservation physiology of the rare moss *Podperaea krylovii* (Amblystegiaceae)

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Podperaea krylovii is a rare moss with insufficient biological and ecological data, as well as a limited number of recorded occurrences, underscoring the importance of its conservation. It inhabits various environments but appears to be rather rare and localized in nature, emphasising the importance of *ex situ* conservation. This study aimed to investigate the optimal type of *in vitro* culture medium to obtain sufficient biomass for the successful transfer to *ex vitro* cultivation. Three different types of media (with explants positioned upright and prostrate) were tested for the growth of *P. krylovii*. KNOP medium with prostrate explants showed the highest index of multiplication (number of newly formed shoots) and was best suited for biomass production. BCD medium promoted the development of secondary protonema, while the MS/2 medium showed the weakest growth. After optimization and obtaining sufficient biomass, the plantlets were transferred under controlled xenic conditions into Magenta vessels filled with distilled water on white terrazzo marble gravel chippings. Acclimation lasted for four weeks. Due to its limited distribution and vulnerability to habitat changes, *ex*

situ conservation and further studies are very important for the survival of this unique moss species.

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Optimization of *in vitro* propagation of the rare and threatened moss *Cynodontium tenellum* (Schimp.) Limpr. (Rhabdoweissiaceae)

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Bryophytes are at high risk of extinction due to rapid environmental changes, and effective conservation requires understanding their biology prior to implementation and decision on protection measures. In this context, we established the axenic *in vitro* culture of the moss *Cynodontium tenellum* as a measure of *ex-situ* propagation and optimized methods for its massive propagation. Although the overall European population is classified as Least Concern (LC), this species can be rare and locally threatened in many European countries. In Serbia, it is classified as Near Threatened (NT). In this study, three types of solid growth media were tested: KNOP, MS/2, and Benecke, each varying in macro- and micronutrient ratios, especially nitrogen. After six weeks of experimentation, morphological parameters such as the number of newly formed shoots (index of multiplication) and diameter of secondary protonema patches were measured, as well as photosynthetic pigment content. The results showed that MS/2 and Benecke media were both suitable for massive propagation of leafy gametophores and secondary protonema since the developed gametophores had satisfactory size, morphology, and photosynthetic pigment concentrations. However, the minimal KNOP medium, commonly used for axenic propagation of many bryophyte species, was more effective for protonemal development in *C. tenellum*.

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Cytokinins differentially improved shoot multiplication and secoiridoid contents of *Gentiana dinarica* Beck., an endangered medicinal plant

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Gentiana dinarica Beck. (Gentianaceae) is an endangered medicinal plant native to the Dinaric Alps, found and collected in Serbia on Mount Tara. It is valued for its high content of bioactive secoiridoids: gentiopicrin, sweroside, and swertiamarin. For conservation and research purposes, it was introduced *in vitro*. The effects of individual cytokinins 6-benzyladenine (6-BA), thidiazuron (TDZ), meta-topoline (*m*T), forchlorfenuron (CPPU), and kinetin (KIN) in increasing concentrations (0-15 µM) on shoot proliferation and secoiridoid contents were investigated. Shoot explants cultured on MS medium with 10 µM CPPU, 15 µM TDZ or 15 µM *m*T, produced the highest number of adventitious shoots (3.93, 3.56, and 3.33, respectively). The HPLC analysis revealed a significantly increased content of gentiopicrin and sweroside in shoots cultivated on 15 µM *m*T or 15 µM 6-BA compared to the control. When shoots were grown on MS with 15 µM *m*T, 78% spontaneous rooting was also achieved. Considering the satisfactory results of shoot proliferation, rooting potential and increase in secoiridoid contents, 15 µM *m*T was selected as optimal for *in vitro* conservation and further research on the metabolism and production of specialized metabolites of this endangered plant with great medicinal and pharmacological potential.

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First IUCN Red List assessment of rare and endemic plant species in North Macedonia

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The study presents the first structured application of the IUCN methodology for assessing the conservation status of rare and endemic plants in North Macedonia. A total of 31 plant species were evaluated based on fieldwork, herbarium records, and spatial data to determine their extent of occurrence, area of occupancy, population trends, and threats. Until recently, North Macedonia lacked an official National Red List of plants. A Preliminary Red List from 2019 identified 480 plant taxa for future evaluation. The current assessment classified five species as Critically Endangered, nine as Endangered, and eight as Vulnerable, primarily based on restricted distribution and small population size. Major threats include habitat loss, climate change, overexploitation, and invasive species. This study provides essential data to guide national conservation planning and contributes to the regional and global efforts to preserve plant biodiversity.

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New insights into the flora of Baljevski vrhovi - a conservation aspect

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Despite extensive research, the flora of the Stara Planina foothills, including the Baljevski vrhovi, remains insufficiently studied and critically evaluated. Located above Gornji Krivodol, Baljev Do, Kamenica, and Senokos, this area features mosaic vegetation and dry carbonate meadows. These habitats, recognised as a priority for conservation in Serbia, have led to the area's designation as a regime II protection area. This study presents floristic research in the Baljevski vrhovi, focusing on inventorying vascular flora, the spatial distribution of taxa protected under national and international legislation, and estimating threats to taxa. Overall,

95 taxa, classified within 75 genera and 36 families, were recorded. Two taxa (*Orchis purpurea* subsp. *purpurea*, *Spiranthes spiralis*) were assessed as endangered to vulnerable, according to the Regional IUCN Red List criteria. Additionally, three taxa are listed in CITES, five are strictly protected, and 14 are protected under national legislation. However, significantly higher values of floristic diversity are expected in this area, primarily in endemism and species of conservation importance. The primary identified conservation threat was the presence of *Pinus sylvestris*, which in the studied locality shows an invasive character, causing habitat succession and reduction of open grasslands, leading to the loss of habitats for protected plant taxa.

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15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Niš 23th-25th May, 2025

Genetics, Selection and Biotechnology

POSTER PRESENTATIONS

Seed viability and *in vitro* plants regeneration of the endangered species *Astragalus corniculatus* M. Bieb. (Fabaceae) from Bulgarian natural populations

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Astragalus corniculatus M. Bieb. (Fabaceae) is a species with conservation status "endangered" in the Red Book of the Republic of Bulgaria, protected by the Biological Diversity Act. The study aimed to establish a protocol for *in vitro* propagation of the species to obtain plants intended for future population reinforcement. Seeds were collected in June 2024 from two Bulgarian populations near the villages of Sovata and Gorna Studena, Veliko Tarnovo district. Most of the pods (86.6% and 65.2% for Sovata and Gorna Studena localities, respectively) were empty. Seed viability, assessed by tetrazolium test (20 seeds per population) was low: 30.76% for Sovata and 15.38% for Gorna Studena population. Seeds from both localities (2 replicates of 25 seeds each) were treated with ice and hot water to stimulate their germination, and after surface sterilization they were put on MS medium. The initiation of *in vitro* cultures was severely hampered by the low seeds germination: 2.9% for Sovata and 6% for Gorna Studena populations. Seedlings were sub-cultured, and the first *in vitro* plants were regenerated for a month. After the second sub-cultivation, a total of 45 spontaneously rooted *in vitro* plants were obtained (an average of 15 plants per seed for 4 months).

Acknowledgement: This work was partially supported by the Bulgarian Ministry of Education and Science under the National Research Programme "Young scientists and postdoctoral students-2", 2024.

Hydroponic propagation and organic cultivation of selected *Thymus* species

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Three *Thymus* species were selected as promising for mass cultivation because of their valuable essential oil composition: *Thymus pannonicus*, *T. zygioides*, and *T. longedentatus*. A protocol for accelerated vegetative propagation of these species was created applying hydroponic technology, thus preserving their desired characteristics. Thyme cuttings were rooted on a Flood and Drain hydroponic system with perlite as substrate, using a balanced nutrient solution. The rooting and survival rates of the cuttings were significantly higher compared to the control propagation in soil and the resulting plants flowered after 3 to 6 weeks. The study deals with the establishment of an organic pilot plantation in the Botanical Garden of the Bulgarian Academy of Sciences using hydroponically propagated thyme plants as starting material. Sustainable cultivation practices, such as compost fertilization, biodegradable mulching, and automated irrigation, ensure ecological and high-quality production. The plantation is also designed as an educational and demonstration site for innovative thyme growing technologies and for presenting end products such as three varieties of thyme tea and planting material. In conclusion, hydroponic propagation is a highly effective method to accelerate the propagation of target *Thymus* species, with the potential to be applied as a first step towards their sustainable large-scale cultivation.

Acknowledgments: This study is supported by the National Recovery and Resilience Plan of the Republic of Bulgaria, under project N PVU-66, 16.12.2024 /BG-RRP-2.017-0015-C01/.

A first *in vitro* regeneration protocol for *Micromeria myrtifolia* Boiss. & Hohen. from seedling explants

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Micromeria myrtifolia Boiss. & Hohen. is an aromatic, perennial plant from the Lamiaceae family, recognized for its numerous medicinal properties. It is mainly distributed in the eastern Mediterranean region, inhabiting open, rocky, and limestone slopes. The purpose of this study was to establish the *in vitro* culture of *M. myrtifolia* using seeds and then to examine the influence of mineral salts and carbon sources (sucrose and glucose) on the process of *in vitro* regeneration of the plant from the nodal segments. Based on the results, the full-strength Murashige and Skoog (MS) basal medium, as well as the medium supplemented with 3% sucrose, showed the best outcomes across the analyzed parameters, including the regeneration percentage, number of axillary shoots per explant, and the fresh and dry weights of regenerated explants. However, the highest average shoot length was observed in explants grown on medium containing 1% glucose. Further investigations will be conducted to examine the effects of other carbohydrates and various plant growth regulators that may influence the *in vitro* growth and development of this species.

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Influence of various factors of the cultivation media on the growth of the endemic species *Brassica jordanoffii* O.E. Schulz

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Brassica jordanoffii O.E. Schulz (Brassicaceae) is a Bulgarian local endemic species, distributed in the marble zone of the Pirin Mountain at altitudes from 2100 to 2500 m. The species is included in the Red Data Book of Bulgaria as "vulnerable" and is protected under the national Biodiversity Act. The aim of the study was to investigate the effects of medium strength, phosphorus level, type of gelling agent, and supplementation with activated charcoal (AC). Shoots were grown on B5, double-strength B5 (2B5), or 2B5 supplemented with phosphorus (2B5P), with or without AC, and gelled with either agar or Gelrite in the case of 2B5P media. After one month of cultivation, the numbers of roots, leaves, and shoots were recorded. The data was analyzed using a Generalized Linear Model (GLM) with a negative binomial distribution. Only root number showed a statistically significant model, with activated charcoal (AC) having a significant effect; medium strength and the interaction between factors were not significant. In the second experiment, both AC and the gelling agent significantly affected root number, and the gelling agent also influenced the number of shoots. The number of leaves was only slightly affected by the different factors.

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15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Niš 23th-25th May, 2025

Phytochemistry and Phytotherapy

ORAL PRESENTATIONS

Optimization of maceration conditions for stems and leaves of *Tagetes patula* L.

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The study aimed to optimize the effect of photoselective nets and maceration conditions on yield, antioxidant activity, total phenolic (TPC), and total flavonoid content (TFC) in macerates obtained from stems and leaves of marigold (*Tagetes patula* L.) by using custom design. The following parameters were varied: categorical variable – the nets color (red, blue, pearl) and an uncovered (control); continuous variables – ethanol concentration (20% v/v, 58% v/v, and 96% v/v); solvomodule (1:10 m/v, 1:25 m/v, and 1:40 m/v); and extraction time (6 h, 63 h, and 120 h). The following optimal conditions were obtained: control sample, an ethanol concentration of 46,81% v/v, a solvomodule of 1:10 m/v, and an extraction time of 120 h. Under these optimal conditions, with a confidence interval of 95%, the population values for TEM, EC_{50} value, TFC, and TPC should be in the range of 15.63-17.76 mg/ml; 12.1-239.49 μg/ml; 20.75-81.64 mg QE/g of dry extract; and 54.15-100.88 mg GAE/g of dry extract, respectively. To check the adequacy of the model used, maceration was done under optimal conditions. The experimentally obtained values were in the predicted range: 17.69 mg/ml (TEM), 154 μg/ml (EC_{50} value), 38.27 mg QE/g d.e. (TFC), and 70.66 mg GAE/g.s.e (TPC).

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The essential oil property of *Origanum vulgare* subsp. *gracile* and the biological activities and usage areas of some taxa belonging to the genus *Origanum* L.

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The aim of this study is to analyze the essential oil components of *Origanum vulgare* subsp. *gracile*. In addition, the biological activities and usage areas of some plants belonging to the genus *Origanum* L. were also investigated. *Origanum vulgare* subsp. *gracile* collected from the Çelikhan region of Adıyaman was subjected to hydrodistillation to obtain essential oil and analyzed using the GC-MS technique. Furthermore, a literature review was conducted on the biological activities and usage areas of *Origanum* taxa. From 100 g of plant sample, 0.5 ml of essential oil was obtained, indicating that the plant is rich in essential oil. Thirty-three different components were identified in the obtained essential oil, with the major components determined as thymol (24.60%), carvacrol (15.45%), and γ-terpinene (8.38%). Conclusion: In this study, the chemotypes of *Origanum vulgare* subsp. *gracile* were identified as thymol, carvacrol, and γ-terpinene. The obtained results were discussed in terms of biological activity and potential usage areas.

Spectroscopical analyses, cytotoxic and insecticidal effects of *Artemisia campestris* subsp. *variabilis* (Ten.) Greuter essential oil and its main components

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Plants of *Artemisia* L. genus are known for several biological effects, but comprehensive studies on their cytotoxic and insecticidal activities are still limited. This study examines the properties of the essential oil (EO) extracted by *Artemisia campestris* L. subsp. *variabilis* (ACV), collected in Sicily, Italy. The focus was on the insecticidal activity of ACV, with the aim of evaluating the phytosanitary potential of two isolated natural alkynes such as capillene and 2,4-pentadiynylbenzene. The EO was studied by GC-MS and 2D-NMR tecniques revealing that it was rich in alkyne compounds (59.04%), with capillene the predominant component (40.03%). The HSQC study not only highlighted the clear presence of alkyne derivatives and *β*-pinene, but confirmed the identification carried out by GC and GC-MS. At the same time, the promising insecticidal efficacy of ACV against *Spodoptera littoralis* (Boisd.) larvae was found. Finally, ACV showed remarkable cytotoxic activity against all cell lines tested with IC_{50} values ranging between 7.55 µg/mL and 23.05 µg/mL. This study demonstrated that ACV may be a suitable candidate for the development of botanical insecticides and antiproliferative

drugs, as ACV was found not only to be effective against *S. littoralis* larvae, but also relatively friendly to some non-target organisms.

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Chemical composition and antioxidant activity of *Geranium robertianum* L. leaves hydrolate

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Geranium robertianum L. has been traditionally used in folk medicine for different therapeutic purposes. While its extracts are well-studied, research on its essential oil and hydrolate, a distillation by-product, is still scarce. This study determined the chemical composition and antioxidant activity of the *G. robertianum* leaves hydrolate (the aqueous phase of the suspension, which remains in the flask after distillation of essential oil), which is a by-product during hydrodistillation. The hydrolate was separated after essential oil isolation from fresh leaves of *G. robertianum* grown in South Sebia. The chemical composition of hydrolate was determined by UHPLC-DAD-MS/MS analysis. The antioxidant potential of hydrolate was estimated by using the DPPH and FRAP assays. Twenty-one components were detected in the hydrolate, of which seventeen were identified, mainly phenolic acids and flavonoids. The hydrolate showed strong antioxidant activity obtained by the DPPH test (EC_{50} value of 0.004 mg/ml) and FRAP test (40.10 mmol Fe^{2+}/g hydrolate). The antioxidant activity is most likely a result of the presence of phenolic compounds in the hydrolate. The obtained results are particularly significant, considering that the hydrolate is a by-product of hydrodistillation, and based on the obtained results, it represents a source of highly valuable bioactive components with good antioxidant activity.

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Antioxidant and antimicrobial activities of essential oils from the Sicilian (Italy) accession of *Pimpinella peregrina* L.

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The genus *Pimpinella* L. (Apiaceae) is widely distributed across the Northern Hemisphere. *Pimpinella peregrina* L., native to the Mediterranean region and extending to Central Asia, has been underexplored in terms of its chemical composition. In this study the essential oils from the flowers and stems of a Sicilian accession of *P. peregrina* were analysed using gas chromatography-mass spectrometry (GC-MS). The essential oil from the flowers (Ppf) was found to be rich in sesquiterpene hydrocarbons (75.06%), with *α*-bergamotene as the main component (67.85%). In the essential oil from the stems (Pps), substantial amounts of *α*-bergamotene (41.90%) and *α*-bisabolol (15.08%) were detected. Both essential oils were tested to evaluate their antimicrobial and antioxidant activities. Among these, Ppf not only showed greater results against *B. subtilis*, with a MIC value of 0.25 mg/mL, indicating potential therapeutic applications, but also a promising antioxidant activity probably due to *α*-bergamotene and oxygenated monoterpenes. Futures studies could explore the essential oil's efficacy in developing natural food preservatives or treatments for respiratory infections caused by *B. subtilis*. In summary, the chemical profile of Sicilian *P. peregrina* represents a valuable source of bioactive compounds with noteworthy antimicrobial and antioxidant properties, warranting further investigation for therapeutic and agricultural applications.

Essential oil characteristics of *Mentha longifolia* subsp. *typhoides* var. *calliantha* and the biological activities and usage areas of some taxa belonging to the genus *Mentha* L.

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The aim of this study is to extract and analyze the essential oil content of *Mentha longifolia* subsp. *typhoides* var. *calliantha*. Additionally, the biological activities and usage of some plant species belonging to the genus *Mentha* L. were also investigated. The *Mentha longifolia* subsp. *typhoides* var. *calliantha* plant was collected from the Çelikhan region of Adıyaman. Essential oil was extracted using the water distillation method and analyzed by GC-MS technique. Furthermore, a literature review was conducted on the biological activities and usage areas of *Mentha* taxa. From 100 g of plant material, 0.4 ml of essential oil was obtained, indicating that this plant is rich in essential oil. Twenty-five different essential oil components were identified in the extracted oil, with the major constituents being menthol (10.71%), spathulenol (8.64%), and germacrene D (8.44%). In this study, the chemotypes of *Mentha longifolia* subsp. *typhoides* var. *calliantha* were identified as menthol, spathulenol, and germacrene D. The findings were discussed in terms of biological activity and potential areas of use.

The reducing power of black pepper (*Piper nigrum* L.) essential oil and hydrolate

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Given the lack of available literature on the antioxidant activity of essential oil (BPFEO) and hydrolate of black pepper fruit related to the reducing ability of Fe^{3+} to Fe^{2+}, the aim of this study was to investigate these properties. The BPFEO was obtained by Clevenger-type hydrodistillation (hydromodule 1:10 m/v, 240 minutes), and the hydrolate was collected after the hydrodistillation process. The chemical composition of BPFEO and hydrolate was determined by GC/MS and GC/FID, as well as HS-SPME methods, respectively. The reducing power of BPFEO and hydrolate was determined by the method of Oyaize. The reducing power of BPFEO and hydrolate was expressed as gallic acid equivalents per gram of essential oil/dry hydrolate. Fifty-five and twelve compounds were identified from BPFEO and hydrolate, respectively. The most abundant compounds in BPFEO were sesquiterpene hydrocarbons (56.5%), while oxygenated monoterpenes (93.2%) dominated in the hydrolate. Both samples showed the reducing power, with hydrolate showing better antioxidant activity (29.66 mg GAE/g d.h.) than BPFEO (7.26 mg GAE/g EO). The ascorbic acid, used as a reference standard, showed the best reduction power (176.93 mg GAE/g). Despite the relatively low reducing power of the tested samples, BPFEO and hydrolate can be used as natural sources of important bioactive compounds.

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POSTER PRESENTATIONS

Traditional use of medicinal plants for respiratory tract therapy in the urban ecosystem of Niš

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According to the Institute of Public Health, respiratory diseases were the leading health problems in the district of Niš from 2016 to 2022. The aim of this study was to document and preserve the ethnopharmacological knowledge of the population of Niš (Pantelej, Duvanište, Palilula, Vrežina, Trošarina, Medijana and Ledena Stena) about respiratory diseases. Data were collected through semi-structured, anonymous interviews with 49 participants (35 women, 14 men) who shared their insights on the traditional use of medicinal plants against respiratory disorders. The most commonly treated respiratory conditions were: sore throat (33.82%, 23 reports), cough (27.94%, 19 reports), and bronchitis (20.59%, 14 reports). The study also found that place of residence and gender influenced the selection of plant species. The most frequently mentioned plant families were Lamiaceae (47.06%, 32 reports) and Asteraceae (33.82%, 23 reports). The most commonly used species were *Matricaria chamomilla* (29.41%, 20 reports), *Thymus serpyllum* (16.17%, 11 reports), and *Salvia officinalis* (14.71%, 10 reports). The European Union herbal monographs list recognized *M. chamomilla* and *S. officinalis* for treating mouth and throat disorders, but *T. serpyllum* lacks an official monograph. Despite the availability of modern health services, medicinal plant use remains widespread in the urban ecosystem of Niš.

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Chemical profile of extracted volatile compounds of *Ocimum basilicum* L. hydrosol

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During the hydrodistillation of essential oils, the vapor condenses on contact with cold surfaces and separates into two phases: essential oil and hydrosol. However, some compounds of the essential oil remain in the hydrosol and give it different organoleptic properties, flavor and biological activity. The aim of this study was to evaluate chemical profile of the extracted volatiles of *Ocimum basilicum* hydrosol obtained from aerial part of the plant. After the isolation of the hydrosol by industrial hydrodistillation, volatile compounds were isolated from the hydrosol using liquid-liquid extraction with diethyl ether. Study was performed using gas chromatography/mass spectrometry (GC/MS) and gas chromatography/flame ionization detection (GC/FID). Qualitative and quantitative analyses of the extracted volatiles from the hydrosol showed that monoterpene hydrocarbons were the predominant class of identified compounds (95.3%). According to the analysis, linalool (60.2%), linalyl acetate (21%), and methyl chavicol (14.4%) were the most abundant volatiles extracted from the hydrosol. A wide range of biological activities is associated with the rich chemical composition of the hydrosols. Hydrosols produced during the industrial extraction of essential oils are recognized as effective cosmetic ingredients and are often used as beverages in Mediterranean folk medicine. The production of hydrosols is simple and inexpensive, and an increasing number of studies highlight the potential health benefits of these by-products of hydrodistillation.

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Anti-inflammatory and spasmolytic activity of sweet basil hydrosol

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Hydrosols have been traditionally used in Persian folk medicine as beverages in order to treat a variety of ailments. The aim of this study was to evaluate the anti-inflammatory and spasmolytic activity of the hydrosol obtained from the aerial parts of *Ocimum basilicum* L. (Lamiaceae) through industrial hydrodistillation by the company Promontis.The percentage of inhibition of protein denaturation in a 5% w/v aqueous solution of bovine serum albumin (BSA) at a volume of 4 µL was 65.93±0.006%, which was lower than the standard value for diclofenac (95.6±0.001%), indicating a considerable anti-inflammatory effect of *O. basilicum* hydrosol. The effect of different volumes (10-1000 µL) of hydrosol on spontaneous rat fundus contractions was evaluated *in vitro* in an isolated tissue bath model. Exposure of isolated rat stomach fundus strips to increasing concentrations of hydrosol led to an increase in tonus by 30-40%, depending on the volume. Although hydrosols are easily produced as by-products in the essential oil industry, many remain insufficiently studied. The obtained results highlight the potential of hydrosols as valuable natural products, particularly in the development of functional beverages for gastrointestinal disorders.

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Antioxidant and hypoglycemic properties of *Rosa micrantha* Borrer ex Sm. extracts

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Wild roses have been valued in traditional medicine for their nutritional and pharmacological benefits. They contain various biologically active compounds, such as phenolics and vitamins. This study assessed the antioxidative potential and α-glycosidase inhibitory activity of ethanolic extracts obtained from *Rosa micrantha* Borrer ex Sm. leaves, and aggregate fruit (including both achenes and hypanthium). Plant material was collected from wild populations in Petnica (Serbia). Extracts from leaves, achenes, and hypanthium were prepared using ultrasound-assisted extraction. The results revealed a high *in vitro* antioxidant activity of leaf extracts (DPPH IC_{50}=0.09 mg/mL; ABTS IC_{50}=0.23 mg/mL), while those from hypanthium and achenes showed significantly lower radical scavenging potential. Additionally, leaves expressed several times higher in vitro α-glucosidase inhibitory activity (IC_{50}=0.74 mg/mL) than both achenes (IC_{50}=4.02 mg/mL) and hypanthiums (IC_{50}=6.41 mg/mL). Antioxidant activity and α-glucosidase inhibition of *R. micrantha* extracts support using wild-growing roses in traditional medicine. This study suggested that *R. micrantha* leaf extract was in the range with referent substances (ascorbic acid and acarbose) and could be considered as a source of natural antioxidants and a hypoglycemic agent for application in food, cosmetic and pharmaceutical industries.

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The cytotoxic effects on tumour cell lines of *Thymus zygis* subsp. *gracilis* essential oil and its principal constituents

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Thymus zygis subsp. *gracilis* is an aromatic plant endemic to Morocco and Spain where it is used in the folk medicine. In this work, the essential oil (EO)

composition of wild Moroccan accessions has been investigated by GC-MS. The chromatogram showed the occurrence of oxygenated monoterpenes, with thymol (29.55%), carvacrol (10.64%), and linalool (7.20%) as the most abundant components; monoterpene hydrocarbons (15.42%), and sesquiterpene hydrocarbons (12.61%) were less abundant with *p*-cymene (10.64%) and *β*-caryophyllene (8.34%) as the most representatives. The EO and its main constituents have been tested for their possible cytotoxic activity against three human tumor cell lines (MDA-MB 231, A375, and CaCo2), with corresponding IC_{50} values of 31.10, 27.97, and 33.32 µg/mL, respectively. Carvacrol and *β*-caryophyllene were the most active constituents. The results demonstrate a good cytotoxic activity against several tumors and suggest that *T. zygis* subsp. *gracilis* EO could be regarded as a natural bioactive source.

Total phenolic content and antiradical activity of wild cyclamen (*Cyclamen purpurascens* Mill.) tuber extract from Southeast Serbia

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This study aimed to determine the total phenolic content and antiradical activity of the ethanolic extract of the wild cyclamen (*Cyclamen purpurascens* Mill.) tuber from southeastern Serbia (Predejane, 42.83°N 22.14°E). Ultrasound-assisted extraction was performed using 50% (v/v) ethanol under the following conditions: the liquid-to-solid ratio of 10 mL/g, extraction temperature of 30 °C, and extraction time of 35 min. The total phenolic content of 0.645 g GAE per 100 g dry matter indicated a significant presence of these important compounds. Additionally, the antiradical activity of the extract was determined according to the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay, which showed a high half-maximal inhibitory concentration of DPPH radicals of 3.62 mg/mL. A high total phenolic content does not always indicate high antiradical activity, as effectiveness depends on the type and structure of the phenolic compounds, as well as their interactions with other compounds in the extract. Further studies will focus on identifying the bioactive compounds present in the extract and determining the underlying reasons for the weaker antioxidant activity. Safe use of this extract as an active ingredient in pharmaceutical and cosmetic formulations also requires analysis of heavy metals and toxic compounds.

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Total phenolic content and radical scavenging properties of *Dictamnus albus* L. extracts

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Aerial parts of *Dictamnus albus* L. (Rutaceae), commonly known as the "burning bush" for its oils that ignite under certain conditions, have traditionally been used in treating skin, urinary, and digestive ailments thanks to their anti-inflammatory and antimicrobial properties. This study evaluated the phenolic content and antioxidant potential of aqueous, ethanolic, and methanolic extracts from *D. albus* leaves prepared via ultrasound-assisted extraction. Methanol was the most effective for extracting phenolics (30.16 mg GAE/g dw), closely followed by ethanol (28.65 mg GAE/g dw), while ethanol outperformed methanol in flavonoid extraction (26.19 vs. 18.81 mg QuE/g dw). Aqueous extracts yielded the lowest phenolic (26.90 mg GAE/g dw) and flavonoid content (14.08 mg QuE/g dw). In antioxidant assays, ethanolic extracts showed the most potent activity in the DPPH assay (IC_{50}=2.98 mg/mL), while aqueous extracts expressed the highest potential in the ABTS assay (IC_{50}=1.54 mg/mL). These findings highlight the importance of solvent choice in optimizing the extraction of bioactive compounds. Ethanol, in particular, demonstrated a balance of efficiency and bioactivity, suggesting its potential as a versatile solvent for various applications in natural product development. Furthermore, the results suggest *D. albus* is a promising natural antioxidant source for pharmaceutical and nutraceutical applications.

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The effect of *Ajuga laxmannii* (L.) Benth. essential oil and its constituents on the inhibition of lipid peroxidation

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Ajuga laxmannii has a significant importance being used in traditional medicine for its antimicrobial, anticancer, anti-inflammatory, and anti-rheumatic properties. As proven, some of these conditions may be related to oxidative stress. Since oxidative stress and lipid peroxidation (LP) play key roles in the development of various disorders and diseases, the search for new antioxidants remains a prominent area of research. To the best of our knowledge, no investigation about LP on essential oils (EOs) isolated from *Ajuga* plants has been reported. Purpose of this study was to characterize antioxidant activity of EO isolated from the above-ground parts of *A. laxmannii* by hydrodistillation, and coumarin (1) and linalool (2) as its main components, on the LP process. The results of *A. laxmannii* EO (IC_{50}=0.303±0.051 mg/cm^3), and pure components 1 (IC_{50}=0.078±0.005 mg/cm^3) and 2 (IC_{50}=0.025±0.002 mg/cm^3) on the peroxidation of the model phospholipid mixture have showed that all samples had direct antioxidant properties and are proved to be relatively good scavengers of radicals that are induced in the LP process. None of the compounds had an LP inhibition effect comparable to the antioxidant standards trolox (IC_{50}=0.005±0.001 mg/cm^3), and quercetin (IC_{50}=0.007±0.002 mg/cm^3).

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Antioxidative effects of naturally occurring hydroxychalcones: a lipid peroxidation study

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Lipid peroxidation (LP) is a chain reaction that leads to the oxidative destruction of polyunsaturated fatty acids and this process is considered as one of the mechanisms in pathogenesis of many inflammation related diseases. Generally considered safe, compounds from natural sources are an attractive source for exploring antioxidative potential. In the present study we have examined *in vitro* antioxidative potential of three naturally occurring hydroxychalcones on LP process. Chalcone derivatives, previously reported to be isolated from various plant sources: 4′-hydroxychalcone (1), 4′-hydroxy-4-methoxychalcone (2), and 4′-hydroxy-3,4-dimethoxychalcone (3), were synthesized and characterized by using nuclear magnetic resonance spectroscopy (NMR) experiments. Thiobarbituric acid-malondialdehyde (TBA-MDA) assay was used to assay the LP inhibition of pure compounds 1-3, using trolox and quercetin as reference standards. At tested concentration range (2000-0.1 μM) all compounds exerted comparable antioxidative effects (IC_{50}=111±17.8 μM (1), 126±11.8 μM (2), 109±7.03 μM (3)), suggesting the importance of phenolic moiety in the chalcone structure for lipoperoxyl radicals scavenging activity. However, all derivatives were weaker LP inhibitors compared to trolox and quercetin (IC_{50}=22±6 μM and 23±6 μM, respectively). The results provided evidence that the hydroxychalcones might be a potential source of natural antioxidative agents.

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Balkan medicinal plants with traditional use in the treatment of eczema and psoriasis

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Eczema and psoriasis are chronic inflammatory skin disorders characterized by redness, itching, and scaling. Plants from the Balkan Peninsula have long been used as herbal remedies to relieve these conditions, due to their anti-inflammatory, antimicrobial, and skin-regenerating properties. This study aimed to compile ethnobotanical knowledge through an extensive literature review of plants traditionally used to treat these skin disorders, resulting in a database of plant species, covering taxonomy, distribution, habitat, utilized plant parts, applications, and bioactivity for each condition. A total of 29 plant species from 18 families have been reported for eczema and 27 species from 19 families for psoriasis, with frequently mentioned species including *Taraxacum officinale* Weber and *Viola tricolor* L. respectively. Moreover, these two species are also reported to be used for the treatment of both conditions, similar to *Chelidonium majus* L. and *Trifolium pratense* L. Commonly used plant parts for remedies include herba, flowers, fruits, stems, leaves, roots, resin, bark, and seeds, where the inflorescences of *Carduus nutans* L. and the roots of *Inula helenium* L. stand out. The traditional preparations used to treat these skin conditions include balms, tinctures, teas, creams, gels, lotions, salves, poultices, extracts, and fresh plant juice, often applied topically.

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Ethnobotanical survey of usage of the *Artemisia* L. (Asteraceae) plants from southeastern Serbia

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The ethnobotanical survey was carried out in 25 urban and rural localities in southeastern Serbia from June to November 2023 with the aim to collect data about traditional usage of *Artemisia* species. Group of 144 local inhabitans was interviewed using semi-structured interview. Data for six out of 11 *Artemisia* species (nine autochthonous and two allochthonous) has been collected. The most used plant part was herba, while infusion or tincture were the most used preparation methods. The results have shown that *Artemisia* species were used for digestive system disorders (*A. absinthium, A. annua*, *A. vulgaris* and *A. ludoviciana*), as a spice (*A. absinthium* and *A. ludoviciana*), for alcoholic beverage (*A. absinthium, A. alba* and *A. ludoviciana*), as decorative (*A. absinthium, A. abrotanum, A. alba, A. ludoviciana*), in ethnoveterinary (*A. absinthium, A. vulgaris*) and as broom (*A. absinthium* and *A. vulgaris*). Differences in usage between sex (men mentioned usage for bees protection against diseases, while women mentioned ethnocultural use) were noticed. The use of *A. vulgaris* in children's play and *A. annua* as a natural room freshener represent a novelties for Serbian ethnobotany.

Could the traditional medicinal plants *Gentiana lutea* and *Achillea millefolium* be useful to combat *Listeria monocytogenes* biofilm?

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Listeria monocytogenes is an important foodborne pathogen, causative agent of listeriosis. Considering the growing trend of antimicrobial resistance of *L. monocytogenes* against antibiotics, sanitizers and disinfectants, searching for effective antibacterial alternatives seems to be of utmost importance. Yellow gentian (*Gentiana lutea*) and yarrow (*Achillea millefolium*), both collected on Tara Mountain, Serbia, were selected for this study in accordance with their traditional use against gastrointestinal disorders. The objective of the study was to determine antilisterial, i.e. antibacterial and antibiofilm effect of 50% aqueous-ethanolic extracts of yellow gentian root (GLR) and leaf (GLL), and methanol extract of yarrow herb (AMM), all being chemically characterized. Antibacterial effect was weak for GLR and GLL (MIC 10 mg/mL) and moderate for AMM (MIC 1.25 mg/mL). Remarkable biofilm formation reduction (up to 82.2%, 90% and 73%), could be ascribed to the suppression of swimming motility (45.9%, 58.3% and 42%), both parameters for GLR, GLL and AMM, respectively. In the case of yellow gentian, antibiofilm effect is additionally attributed to the reduction of exopolysaccharides production (up to 61% detected for GLR). The results of this study, showing notable antibacterial and antibiofilm effect against *L. monocytogenes*, encourage future investigations of the *G. lutea* and *A. millefolium* antimicrobial potential.

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Effect of foliar application of salicylic acid on the antioxidant capacity of Greek basil (*Ocimum basilicum* var. *minimum*)

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Salicylic acid acts as a biochemical signal, stimulating antioxidant mechanisms and improving plant growth and adaptation to abiotic stress conditions. *Ocimum basilicum* var. *minimum* is an important source of natural antioxidants and essential oils. Improving the growth of this species is important for increasing its yield and efficiency in industrial and pharmaceutical production. The accumulation of secondary metabolites such as phenolic compounds, flavonoids and anthocyanins plays an important role in the growth process, as well as in protecting plants from stress. One of the most important effects of salicylic acid are to stimulate production

of antioxidants. The aim of this study was to examine the potential of foliar application of salicylic acid at concentrations of 0.29 mM, 1 mM and 1.7 mM on the content of total phenols, flavonoids, anthocyanins and antioxidant capacity of basil seedlings grown under optimal conditions. Foliar application of salicylic acid at concentrations of 0.29 mM and 1 mM increased the accumulation of total phenolic compounds, indicating its ability to stimulate the synthesis of these antioxidant components, while the concentration of 1.7 mM decreased the phenolic content, which may be a result of the toxic effect of the higher concentration. Although the applied concentrations did not lead to an increase in the concentrations of flavonoids and anthocyanins, a significant increase in antioxidant activity, expressed through the neutralization of DPPH radicals, indicates that salicylic acid could improve adaptation capacity of basil seedlings on environmental conditions.

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Extract of *Gentiana asclepiadea* L. in microencapsulated and unencapsulated forms for the treatment of gastrointestinal spasms

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Underground parts of *Gentiana asclepiadea* L. (Gentianaceae) are traditionally used in southeastern Serbia to treat gastrointestinal disorders, including abdominal pain and cramps. The primary bioactive compounds in *G. asclepiadea* are secoiridoids, which are characterized by limited stability. This study aimed to evaluate the spasmolytic activity of the extract from the underground parts of *G.*

asclepiadea, as well as the activity of the same extract microencapsulated with whey protein via spray drying. The spasmolytic effect was assessed using isolated rat ileum, followed by an investigation of the underlying mechanism through contractions modified by acetylcholine, $CaCl_2$, $BaCl_2$, KCl, histamine, N(ω)-nitro-L-arginine methyl ester, and glibenclamide. Using HPLC-DAD analysis, significant quantities of secoiridoids (gentiopicroside and swertiamarin), flavones (isoorientin and isovitexin), and xanthones (isogentisine) were successfully quantified in the extracts. The results indicate that the extract exerts its spasmolytic effect primarily through Ca^{2+} channel blockade and K^+ channel activation, with no significant involvement of the nitric oxide pathway. Although slightly less active, the microencapsulated extract retained the bioactivity profile of the unencapsulated form. Overall, the results support the traditional use of *G. asclepiadea* for certain gastrointestinal disorders and suggest that the microencapsulated extract may be valuable in the development of pharmaceutical and nutritional formulations.

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Anatomical characterization of the aerial parts of *Capsella bursa-pastoris* (L.) Medik (Brassicaceae)

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Contemporary studies on the composition and biological activity of the aerial parts of *Capsella bursa-pastoris* (Brassicaceae) support the traditional confidence in this medicinal plant, widely used in folk medicine, particularly for the treatment of various types of bleeding. *Bursae pastoris herba* is listed within Community herbal monographs of European medicines agency (EMA), but it is not official in any modern Pharmacopoeia. Due to the increasing interest in this species, commonly harvested from wild populations, there is a growing need for the evaluation of its pharmacognostic attributes as a medicinal raw material. The aim of this study was to contribute to the characterization of *C. bursa-pastoris* herb by conducting a comparative anatomical analysis of five samples collected from natural habitats in Serbia. Anatomical features of stems, leaves, and fruits were examined in detail.

Among the most prominent microanatomical traits, potentially useful as diagnostic markers of the herbal drug, are branched unicellular trichomes covered with warty cuticular outgrowths on the surface of stems and leaves, a papillose epidermis of the petals, and a striated endocarp of the silicle.

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Analysis of milky sap content of dandelion (*Taraxacum officinale* F. H. Wigg.) using Raman spectroscopy

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Milky sap of common dandelion (*Taraxacum officinale* F. H. Wigg., Asteraceae), widely used as natural food or medicine, is a rich source of biologically active compounds such as glycosides, alkaloids (*β*-carbolines, taraxacin-A and taraxacin-B and a phenylpropanoid, taraxafolin), proteins, polyphenols, tannins, flavonoids, etc. Raman spectroscopy was applied to rapidly identify the content of the dandelion sap collected from flowering stem. Raman spectra were recorded in the 100–1800 cm^{-1} spectral range using XploRA Raman Horiba Jobin Yvon spectrometer at a laser wavelength of 785 nm. The spectra were processed using Spectragryph v 1.2.13 software. Higher intensity bands indicate alkaloids, such as 1623 cm^{-1} assigned to C=C stretching vibration, 1535 cm^{-1} indicated C=O symmetric stretching, while bands at 1336 and 1039 cm^{-1} indicated C–N and N–CH_3 stretching of amines. The Raman spectra of sap content display the characteristic bands at 1703 cm^{-1} (C=O stretching), 1591 cm^{-1} (C=C and C=N stretching of alkaloids), 1256 cm^{-1} (C-N of amine), and 874 cm^{-1} (C-H bending of aromatic rings). The region up to 850 cm^{-1} hints at amino acids, e.g. bands at 823 cm^{-1}, 541 cm^{-1} (ν(S-S) trans-gauche-trans) and 663 cm^{-1} from C-S stretching mode of cystine.

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Nutrient composition of indigenous pear cultivars and a commercial variety (Williams Bartlett) cultivated in Serbia

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The chemical composition of pear fruit is influenced by variety, ripening stage, environmental conditions and agrotechnical practises. In this study, the following parameters were analysed: pH, fruit acidity, moisture content, ash, cellulose, pectin, lipids and mineral elements (Na, Ca, Mg, Fe, Mn, Zn, Cu). The analysis included six indigenous pear varieties Vidovača, Karamanka, Ilinjača, Ječmenjača, Lubeničarka and Arapka, as well as the commercially grown Williams Bartlett from Serbia. Standard chemical analytical methods were used, whereby the fruit was previously frozen at -18°C and thawed before the analysis. The analyzed values of the fruit were as follows: pH from 4.3 to 5.1; moisture content from 80.38% to 85.84%; cellulose content from 0.98% to 2.3%; pectin content from 0.09% to 0.28%; protein content from 0.36% to 2.19%; and ash content from 1.45% to 6.8%. Karamanka had the highest concentrations of Na (0.94 mg/L), Mg (70.50 mg/L) and Zn (0.11 mg/L), Ječmenjača had the highest K content (99.1 mg/L), while Lubeničarka had the highest levels of Fe (0.39 mg/L) and Mn (0.09 mg/L). Vidovača was characterized by high Ca content (77.4 mg/L). The results suggest that all pear varieties analyzed are nutritionally valuable and suitable for consumption.

New esters from the essential oil of *Pelargonium graveolens* (Geraniaceae)

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Essential oils from *Pelargonium* species are prized in the perfume industry for their rich profiles of natural aroma compounds. Given the importance of esters as key aroma-active volatiles, the ester composition of a commercial *Pelargonium graveolens* essential oil was thoroughly investigated. Preparative chromatographic separation of *P. graveolens* essential oil enabled the discovery of several esters with potential olfactory interest that were missed in direct GC-MS analysis of the whole oil. GC-MS analysis of the chromatographic fraction identified over 240 constituents, including two tentatively identified compounds: a (*Z*)-hex-3-en-1-yl ester of an isomeric hexanoic acid, and a phenethyl ester of an isomeric heptanoic acid, based on their mass spectral fragmentation patterns. Due to the similarity of mass fragmentation patterns in the MS spectra and values of retention indices among the isomeric esters, we synthesized a library of all possible isomeric esters, comprising 10 compounds (including 4 entirely new). All esters from the library were spectrally characterized by NMR, IR, and/or MS techniques. GC-MS co-injection of the essential oil fraction sample with the synthesized standards confirmed that the analyzed fraction contained (*Z*)-hex-3-en-1-yl 3-methylpentanoate and phenethyl 5-methylhexanoate. The first compound represents a new natural product, while phenethyl 5-methylhexanoate has a restricted occurrence in the Plant Kingdom.

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Chemical composition of tea tree (*Melaleuca alternifolia*) (Maiden & Betche) Cheel essential oil

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Essential oil extracted from *Melaleuca alternifolia* (Myrtaceae), commonly known as tea tree oil, is extensively utilized in pharmaceutical and cosmetic formulations due to its well-documented antibacterial, antiviral, and anti-inflammatory activities, which contribute to its efficacy in treating acne, dandruff, and oral microbial infections. Comprehensive analysis of a commercially available *M. alternifolia* essential oil sample, employing gas chromatography-mass spectrometry (GC-MS), preparative chromatographic separation, and targeted chemical transformations, led to the identification of over 100 essential oil constituents. The essential oil was predominantly composed of oxygenated monoterpenes (64.2%) and monoterpene hydrocarbons (24.6%). The major constituents were *p*-cymene (19.5%), 1,8-cineole (19.8%), terpinen-4-ol (35.8%), and *α*-terpineol (3.4%). These findings are consistent with previous studies that reported similar major components, terpinen-4-ol, *α*-terpinene, *p*-cymene, terpinolene, and 1,8-cineole, among a smaller set of identified compounds (ranging from 7 to 16 constituents). Notably, the present analysis revealed the presence of numerous volatile compounds, more than one hundred, not previously described in tea tree oil, including a series of polyoxygenated monoterpenoids. These structurally complex molecules are of particular interest due to their relatively rare occurrence in the Plant Kingdom.

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Shoot cultures as a promising system for cannabinoid production in cannabis (*Cannabis sativa* L.) cultivars

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The main objective of this study was to establish an efficient protocol for shoot induction of cannabis (*Cannabis sativa* L.) in controlled *in vitro* conditions. For this purpose, nodal segments were isolated from 1-month-old plants of two commercial cannabis cultivars, Orange Creampop (OC) and Collieman Kush (CK). Nodal segments were successfully sterilized with 1% NaOCl and cultivated on DKW medium in the presence of cytokinin N^6-benzyladenine (0.2 mg·L^{-1} BA). Shoot cultures were evaluated for cannabinoid content after 30 days of cultivation. The analytical results revealed that Δ^9-tetrahydrocannabinol (Δ^9-THC) and Δ^9-tetrahydrocannabinolic acid (Δ^9-THCA) were the predominant cannabinoids identified in shoots. Shoot cultures of cultivar OC exhibited higher levels of Δ^9-THC (4.23±1.67 mg·g^{-1}) and Δ^9-THCA (66.57±24.83 mg·g^{-1}) compared to cultivar CK with Δ^9-THC (1.84±0.85 mg·g^{-1}) and Δ^9-THCA (44.45±11.95 mg·g^{-1}). It is important to note that the OC shoot cultures showed a wide range of total Δ^9-THC production (30.48-104.95 mg·g^{-1}) compared to CK shoots (27.67-66.64 mg·g^{-1}). These findings highlighted the potential of shoot cultures as a promising system for cultivar selection with high Δ^9-THC production.

Cannabinoid production in shoot cultures of cannabis (*Cannabis sativa* L.) cultivars

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This study aimed to develop an efficient protocol for micropropagation of cannabis (*Cannabis sativa* L.) in aseptic *in vitro* conditions using two commercial cultivars, Garlic Budder (GB) and Golden Sands (GS). Nodal segments isolated from 1-month-old plants were surface sterilized with 1% NaOCl and cultured on a DKW medium supplemented with various concentrations of N^6-benzyladenine (0.1-0.5 mg·L^{-1} BA). Results showed that the DKW medium supplemented with 0.2 mg·L^{-1} BA was the most effective for shoot proliferation. The cannabinoid analysis was carried out in shoot cultures after 30 days of cultivation. Shoot cultures of both cultivars exhibited a capacity for accumulation of Δ^9-tetrahydrocannabinol (Δ^9-THC) and Δ^9-tetrahydrocannabinolic acid (Δ^9-THCA) as two main cannabinoids. *In vitro* shoots of cultivar GB produced Δ^9-THC (3.27±0.60 mg·g^{-1}) and Δ^9-THCA (56.66±10.67 mg·g^{-1}), while GS shoots accumulated Δ^9-THC (1.64±0.64 mg·g^{-1}) and Δ^9-THCA (43.76±10.41 mg·g^{-1}). Total Δ^9-THC production varied in both cultivars, ranging from 38.73 to 68.10 mg·g^{-1} in GB shoots and from 21.38 to 57.80 mg·g^{-1} in GS shoots. These results demonstrated that cannabis shoot cultures represent an efficient experimental model for cannabinoid production.

Evaluation of total phenolic content, flavonoid content, and antioxidant activity of aqueous extracts from *Lithospermum officinale* L.

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Lithospermum officinale L. has been used in traditional medicine for the treatment of various ailments, including kidney problems, urinary tract inflammations, skin diseases, and rheumatic disorders. Although *L. officinale* has been utilized for centuries, its biological and chemical properties remain insufficiently explored, presenting both a challenge and an opportunity for modern scientific research. This study aimed to evaluate the total phenolic content (TPC),

flavonoid content (TFC), and antioxidant activity (AOA) of aqueous extracts from the roots, stems, and leaves of *L. officinale*. TPC, TFC, and AOA were determined using the Folin-Ciocalteu, $AlCl_3$, and DPPH methods, respectively. The results revealed that TPC values ranged from 4.44 to 10.38 mg GA/g, TFC values ranged from 2.71 to 3.61 mg RU/g, and AOA values were between 512.01 and 557.36 mg/mL. These findings provide insights into the phenolic and flavonoid content, as well as the antioxidant potential of *L. officinale*, contributing to a better understanding of its biological properties. Given the use of this plant as a medicinal remedy, further research is recommended. Future studies should focus on employing alternative solvents for extraction to better assess its therapeutic potential.

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Propylene glycol as extraction solvent in herbal extracts for topical use-safety/irritation considerations

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Propylene glycol (PG) is widely used in dermopharmacy and cosmetic formulations as a humectant, viscosity-lowering agent or solvent. We aimed to investigate the skin irritation potential of PG as an extraction solvent using *in vivo*/*in vitro* methods and *Alchemila vulgaris* as an example of extracted plant material. *In vitro*, the viability and cytotoxicity of *A. vulgaris* extract in PG (concentration range 0.3125 to 50 mg/ml) were tested in the L929 mouse fibroblast cell line. The *in vivo* skin safety of the same extract (dissolved in water, 10% m/m) was evaluated by measuring skin parameters (TEWL, erythema index and pH) before (baseline values) and 60 minutes after the end of the 24-hour occlusion treatment. 12 healthy volunteers without known allergies signed a written informed consent to participate in the study (approved by the local ethics committee). Only the highest concentrations showed cytotoxicity *in vitro*. At the same time, no significant cytotoxic effects were observed at concentrations below 250 μg/ml, which corresponds to the usual concentrations of herbal extracts for topical application. No statistically significant change in biophysical skin parameters was observed, indicating that no skin irritation is to be expected. Overall, these results indicate a satisfactory safety profile of PG and PG herbal extract.

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Co-treatments alters RBCs, haemoglobin and hematocrit levels in STZ-induced diabetic rats

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Glycosylation of hemoglobin and erythrocyte membranes, one of the side effects of increased glucose levels in diabetes, contributes to the severity of this disease. However, standard antidiabetic therapy doesn't directly improve the condition. The aim of this study was to examine the effect of co-treatment with standard pharmaceuticals, i.e., insulin and metformin, and the polyherbal mixture (PM) decoction made from the leaves of *Vaccinium myrtillus* L. and *Rubus fruticosus* L., aerial parts of *Geum urbanum* L., rhizomes of *Potentilla erecta* L., and pods of *Phaseolus vulgaris* L. on the levels of RBCs, hemoglobin, and hematocrit in STZ-induced diabetic animal model. After two weeks of treatment, the animals were euthanized, and blood was collected. Results from flow cytometry showed an increase in all the parameters in untreated diabetic controls (DC) compared to untreated non-diabetic controls (NDC). Diabetic animals treated with PM had levels of all the parameters similar to those observed in the NDC group, while other treatments, except for insulin, showed a tendency to increase these parameters, though not as much as in the DC group. We can conclude that the polyherbal mixture had protective effects against these hematological disturbances, which are commonly observed in diabetics.

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Sennae folium decoction: A toxicological investigation into cytotoxic and genotoxic properties

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Cassia angustifolia Vahl., Fabaceae leaves (Sennae folium) is one of the most widely utilized medicinal remedy worldwide. Findings from numerous studies on its biological activities have often been contradictory - particularly regarding its potential toxicity. Considering these inconsistencies, the present study aimed to further elucidate the biological properties of a Sennae folium decoction, with a specific focus on its cytotoxic and genotoxic effects. Six concentrations of the tested extract (250, 500, 750, 1000, 1250, and 1500 μg/ml) were evaluated using a range of methodological approaches. HPLC analysis identified the presence of several key constituents, including 8-glucosyl rhein, sennosides A, B, C, and D, as well as rhein. The DPPH assay indicated minimal antioxidant activity. RBCs hemolytic assay, *Allium cepa* test and lipid peroxidation evaluation confirmed the high cytotoxicity of the tested decoct when used in the highest tested concentration, similar to the one observed in positive controls, cells treated with H_2O_2. However, the genotoxicity assessment showed that the genotoxic properties of even the high concentrations were much lower than the ones seen in the positive controls ($p<0.001$). These findings suggest that the observed toxicity is primarily attributable to disruptions at the cellular membrane level, rather than genotoxic mechanisms.

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Polyherbal mixture and angiogenesis: Observations from chick yolk sac membrane assay

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The herbal mixture made from the aerial parts of common centaury (*Centaurium erythraea* Rafin., Gentianaceae), roots of common chicory (*Cichorium intybus* L., Asteraceae), and rhizomes of tormentil (*Potentilla erecta* (L.) Räuschel, Rosaceae) is frequently used as an antidiabetic remedy in traditional medicine. However, its effect on forming new blood vessels is left unknown. Thus, this study aimed to evaluate the effects of both the herbal mixture and its individual ingredients on angiogenesis. Five low concentrations (0.5, 1, 1.5, 2.5, and 5 mg/ml) of each extract were tested using the chick yolk sac membrane assay, with eggs treated with PBS serving as the control group. The results showed that although none of the extracts caused statistically significant changes in the formation of new blood vessels compared to the control group, only the chicory extract exhibited a tendency to decrease their development, while the other extracts slightly upregulated this process in a concentration-dependent manner. We might conclude that the synergistic effects of the medicinal plants that constitute this herbal mixture may be responsible for enhancing angiogenesis when used as a polyherbal formulation. However, more comprehensive studies are necessary to confirm these findings.

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A-amylase inhibition activity of the polyherbal mixture extract and standard antidiabetic drugs co-treatments

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As a continuation of our research on the hypoglycaemic properties of the Polyherbal Mixture Extract (PME) composed of blackberry (*Rubus fruticosus* L., Rosaceae) and bilberry (*Vaccinium myrtillus* L., Ericaceae) leaves, tormentil (*Potentilla erecta* (L.) Räuschel, Rosaceae rhyzomes, St. Benedict's herb (*Geum urbanum* L., Rosaceae) aerial parts and kidney bean (*Phaseolus vulgaris* L., Fabaceae) pods, this study aimed to evaluate and compare the antidiabetic effects of the PME in combination with commonly used antidiabetic pharmaceuticals. The antidiabetic effects of nine treatments, i.e., the PME, insulin glargine, metformin, glimepiride, and dapagliflozin, as well as their co-treatment combinations (PME + insulin, PME + metformin, PME + glimepiride, and PME + dapagliflozin), were assessed using the α-amylase inhibition assay. Five concentrations of each treatment (10, 25, 50, 75, and 100 μg/ml) were tested. Results indicated that all tested formulations, except for insulin, significantly inhibited α-amylase activity in a concentration-dependent manner. Synergistic effects of the co-treatments resulted in higher antidiabetic activity than the individual treatments. The highest antidiabetic activity was observed with the combination of the PME and dapagliflozin ($p<0.001$) and by PME + dapagliflozin. These findings suggest that these combinational therapies might be valuable candidates for future use in diabetes therapy.

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Chemical profile of *Myrrhoides nodosa* (L.) Cannon headspace volatiles obtained from different plant parts

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Myrrhoides nodosa (L.) Cannon is an accepted name of the species which have many other names including *Chaerophyllum nodosum* (L.) Crantz. The present study was carried out in order to determine the difference in the chemical composition of the headspace (HS) volatiles of *M. nodosa* obtained from fresh aerial parts and roots using HS-GC-MS. The plant was harvested in flowering phase in June 2014 (Perućac, Tara Mt., Serbia) and the voucher specimen was deposited in the Herbarium Moesiacum Niš under the acquisition number 11946. The fresh plant was divided into parts, and they were analyzed separately. The number of identified compounds in HS1 (aerial parts) and HS2 (root) samples were 32 and 30 (respectively) representing 95.2% and 99.0% of total. In both samples, the most dominant components were monoterpene hydrocarbons with the share 45.7% (HS1) and 80.7% (HS2). In aerial parts, the sesquiterpene hydrocarbons were also found as important class with the share of 33.7%. Germacrene D was the major constituent of the aerial parts representing 22.3% and followed by α-pinene with the share of 16.0% of the total volatiles. The most abundant constituents of fresh root volatiles were α-pinene (39.8%) and β-phellandrene (32.7%). β-phellandrene and (*Z*)-3-hexen-1-ol were detected in notable amounts with a contribution of 11.4% and 10.5% (respectively) in HS1 while in HS2 the only compound with significant share was *p*-cymene with a share of 10.4%.

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Antibacterial potential of *Achillea coarctata* Poir. essential oils in the treatment of *Salmonella abony*

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The species that belong to *Achillea* L. genus have wide use in Serbian folk medicine. The aim of this study was to determine the potential use of essential oil obtained from aerial parts of *Achillea coarctata* Poir. as antibacterial agens in the treatment of infections caused by *Salmonella abony*. The fresh aerial parts of the plant (flowering stage) were collected at four different locations in Serbia (Rujan mountain, Pčinja valley, Pirot and Preševo valley) and the voucher specimens were deposited in the Herbarium Moesiacum Niš (HMN), Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš. Essential oils were hydrodistillated immediately after harvest. *In vitro* antibacterial activity was evaluated against Gram-negative bacteria strain *S. abony* ATCC 6017 by using the disk diffusion assay. Sterile filter paper disks (9 mm in diameter) were impregnated with 3 mg of the essential oil. Chloramphenicol (30 μg) and streptomycin (10 μg) were used as positive reference standards to determine the sensitivity of the tested microbial species while disks containing hexane was used as the negative control. All the tested samples exhibited bacteriostatic activity against *S. abony*. Samples from Rujan, Preševo and Pčinja valley demonstrated similar antibacterial activity with inhibition zone diameter of 25 mm, 24 mm and 22 mm, respectively, while the essential oil obtained from *Achillea* collected in Pirot and Preševo valley exerted bacteriostatic effects with inhibition zone of 18 mm.

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Surface wax constituents of *Helleborus odorus* Waldst. & Kit. ex Willd.: A source of structurally diverse lipophilic compounds

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Helleborus odorus Waldst. & Kit. ex Willd. (Ranunculaceae) is a perennial herb native to the southern Balkan Peninsula, with a historical use in traditional medicine for its cardiotonic, analgesic, and emetic properties. Hellebrin, a highly toxic cardiac glycoside with potent biological activity, has been isolated from several *Helleborus* species and is considered one of their most pharmacologically significant constituents. Despite its known bioactivity, the chemical composition of its epicuticular waxes remains poorly studied. In this work, surface waxes from *H. odorus* flowers were obtained by washing with chloroform and analyzed by GC-MS. The washings were dominated by behenol (60%), along with notable amounts of long-chain aldehydes and *n*-alkanes. Fractionation by dry-flash chromatography and detailed GC-MS analysis of selected fractions led to the detection of esters of long-chain alcohols (behenol, 1-tetracosanol, 1-hexacosanol, and 1-octacosanol) and unsaturated C_5 acids (tiglic, angelic, and senecio acids). Comparison of retention indices with literature data enabled a tentative identification of several compounds, while several others may represent new natural compounds. These findings contribute to the phytochemical profiling of *H. odorus* and underscore the chemical diversity of its surface waxes.

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Volatile constituents of *Bupleurum affine* Sadler and *Bupleurum prealtum* L.

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The genus *Bupleurum* (Apiaceae) includes over 240 species widely distributed across Europe and Asia, many of which have been used for centuries in traditional medicine, particularly in Chinese herbal formulations. Among them, *Bupleurum praealtum* and *Bupleurum affine* are annual species native to the Balkan Peninsula, yet their essential oil compositions remain largely unexplored. In this study, we analyzed the essential oils of these two species, obtained by hydrodistillation. GC-MS analysis led to the identification of 230 constituents, revealing notable differences between the oils. The oil of *B. praealtum* was rich in sesquiterpenes, including germacrene D (24.0%), (*E*)-phytol (14.2%), and bicyclogermacrene (11.4%), while *B. affine* oil was dominated by undecane (21.0%). Perillyl 2-methylbutanoate was identified in *B. affine* for the first time as a natural product and confirmed via synthesis, co-injection, and a detailed NMR spin simulation of its ^{1}H NMR was performed. These results highlight the phytochemical diversity of the genus and suggest potential ecological or biosynthetic divergence between species. This work contributes to the chemotaxonomic understanding of *Bupleurum* subsection Juncea and represents the first report on the chemical composition of *B. affine* essential oil.

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Variability of needle terpenes of *Pinus heldreichii* Christ (Pinaceae)

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This paper reviews recent studies on the variability of needle terpene composition in the relict and subendemic Balkan species *Pinus heldreichii* Christ. Having on mind the species' relatively limited geographic range, studies conducted

on material from the Balkan Peninsula have shown a largely uniform composition of needle terpenes. Specifically, limonene and germacrene D were generally the dominant terpenes found in both nonpolar needle extracts and needle essential oils. Other compounds commonly present in notable amounts included α-pinene, (E)-caryophyllene, and δ-3-carene. In contrast, the needle essential oil of *P. heldreichii* from southern Italy (Calabria) exhibited a slightly different chemical composition. Namely, this oil was dominated by α-pinene and β-pinene, with limonene as the third most abundant component, whereas germacrene D was present at a level below 1%. These findings may support the hypothesis of the existence of at least two distinct chemotypes of *P. heldreichii*: one characteristic of the Balkan region and another specific to Italy.

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Where have the angelates gone? A closer look at *Doronicum hungaricum* Rchb.f. metabolites

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Many plant species, particularly those within the Asteraceae family, are known to contain esters of angelic and tiglic acids. Angelates are generally less chemically stable and may undergo isomerization into tiglates under the influence of heat, light, or other factors. In previous phytochemical investigation of *Doronicum hungaricum* Rchb.f. (Asteraceae, Senecioneae), several new natural compounds were isolated and identified, including angelates of 10-acetoxy-8,9-epoxythymol and related derivatives. In this work, we analysed the diethyl ether extract of an aqueous phase left over after the hydrodistilation of the roots of *D. hungaricum*, collected near mountain of Sokolovica (Republic of Serbia). In contrast to the findings of Bohlmann et al., GC-MS and subsequently NMR analysis revealed the presence of the corresponding tiglates instead of the expected angelates. It can be assumed that isomerization may have occurred during the hydrodistilation process. Alternatively, tiglates might be genuine constituents of the roots. These observations raise important questions about the thermal stability and chemical behavior of angelate

esters, as well as the potential impact of extraction techniques on artefact formation. Further investigation is needed to clarify these observations and assess their implications for natural product research.

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New 2-methoxycuminyl esters from the essential oil of *Doronicum columnae* Ten.

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The genus *Doronicum* L. (Asteraceae) includes 26 species, primarily found in Europe and southwest Asia. Despite the biological activity of some terpenoids from *Doronicum* species, the genus remains underexplored in terms of its phytochemical and pharmacological properties. In this study, we focused on *Doronicum columnae* Ten., a perennial species, and investigated the chemical composition of its root essential oil. GC-MS analysis revealed the presence of 3-methoxycuminyl esters and related compounds with similar mass spectra and retention indices, suggesting they are esters of a 3-methoxycuminol regioisomer, specifically 2-methoxycuminol. It is logical to expect that an essential oil that contains biosynthetically related compounds (e.g., thymol and carvacrol along with their ethers and esters) could also contain, alongside 3-methoxycuminyl esters, the regioisomeric 2-methoxycuminyl esters as well. To confirm the stated hypothesis, we synthesized these compounds using a two-step approach: the synthesis of 2-methoxycuminol and the subsequent preparation of its esters (2-methoxycuminyl isobutyrate, 2-methylbutyrate, and isovalerate). All prepared compounds were structurally characterized by MS, IR, UV-Vis, and NMR. GC co-injection experiments definitively confirmed that all synthesized 2-methoxycuminyl esters were present in the essential oil of *D. columnae*, representing both new natural products and new chemical entities.

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Variability of needle headspace volatiles in natural populations of *Abies alba* Mill. from North Macedonia

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The present study investigated the variability of needle headspace (HS) volatiles in two natural *Abies alba* Mill. populations from North Macedonia (Bistra and Mavrovo) and examined their relationships with two previously studied *A. alba* populations (Šar planina and Nidže) from the same region. The major HS volatiles in the Bistra and Mavrovo populations were *β*-pinene and camphene. Canonical discriminant analysis revealed a clear separation of the the populations into two groups: the first comprising the Šar planina and Nidže populations and the second consisting of the Bistra and Mavrovo populations. The observed variability between populations likely reflects adaptive responses to specific ecological conditions, since terpene biosynthesis is regulated by genes with different expression influenced by various environmental factors. Evaluating the variability of needle volatiles in *A. alba* provides significant insight into its current genetic diversity, which is crucial for understanding the species' potential for adaptation to rapid climate change and for its conservation on the Balkan Peninsula.

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Phytochemical characterization and antioxidant potential of methanol extracts of two *Stachys* species

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In this study, phytochemical profile and antioxidant activity of dry methanol extracts from aerial flowering parts of two species from the *Stachys* subsect. *Rectae* R. Bhattacharjee were analysed. *Stachys angustifolia* M. Bieb. is a Pontic plant that inhabits steppe and steppe-like grass communities in Ukraine, Romania and the E. Balkans. *Stachys goulimyi* Rech. f. is an stenoendemic ultramafic orophyte from Mt Vourinos in N.W. Greece. Plants were collected from natural habitats in Bulgaria (Melnik, Rožen) and Greece, respectively. Air-dried, powdered plant material was successively extracted with chloroform and methanol. The resulting dry methanol extracts were analyzed using liquid chromatography coupled to mass spectrometry (LC-MS), revealing a complex composition of phenolic acids, phenylethanoid, flavonoid (primarily isoscutellareine and hypolaetine derivatives), and iridoid glycosides. Results demonstrated significant differences among species, with extract of *S. goulimyi* being particularly rich in flavonoids (56.62%) and extract of *S. angustifolia* being devoid of any phenylethanoid glycosides. Main compound in both extracts was isoscutellarein-7-*O*-[6'''-acetylallosyl(1®2)]-glucopyranoside (41.07 and 8.87%, respectively). Antioxidant activity was evaluated using spectrophotometric DPPH and FRAP assays, and correlated with phenolic composition. Obtained results provide new insights into phytochemical diversity and bioactive potential of underexplored *Stachys* taxa, supporting their relevance for further pharmacological and phytochemical studies.

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Antimicrobial activity of silver nanoparticles biosynthesized by aqueous extract of blackberry leaves

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The application of plants extracts in the biosynthesis of nanoparticles represents the future of technology in the process of faster nanoparticle production. Plants have been shown to possess several cellular structures and physiological processes that prevent metal toxicity. Silver nanoparticles (AgNPs) were synthesized at room and boiling temperatures using an aqueous extract of blackberry leaves, obtained by reflux extraction. The formed nanoparticles were subjected to antimicrobial activity testing using the minimum inhibitory concentration (MIC) and minimum bacterial concentration (MBC) by the microdilution method on the microorganisms *Bacillus subtilis* ATCC 6633, *Staphylococcus aureus* ATCC 25923, *Proteus vulgaris* ATCC 8427, *Pseudomonas aeruginosa* ATCC 27853, *Escherichia coli* ATCC 25922, *Candida albicans* ATCC 2091, *Klebsiella pneumoniae* ATCC 700603. Compared to the extract, the synthesized nanoparticles showed higher antimicrobial activity, as a result of a synergistic effect of biomolecules from the extract and silver in the formed AgNPs. AgNPs synthesized at boiling temperature showed the highest antimicrobial activity against all microbes. This suggests that high temperature induces more effective reduction of silver ions by the bioactive compounds, resulting in the formation of nanoparticles with higher antimicrobial activity. These results point to further studies of AgNPs for their usage in cosmetic preparations.

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Essential oil variability in *Achillea lingulata* Waldst. & Kit. (Asteraceae)

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Achillea lingulata Waldst. & Kit. (*Achillea* section *Anthemoideae sensu lato*) is a species native to the high mountainous regions of the Balkan Peninsula and Ukraine, typically found in grassy areas, pine forests, and calcium-deficient terrain. This review aims to summarize current knowledge on the variability of essential oil from the aerial parts of *A. lingulata* across different populations and ecological conditions. In most studies, monoterpenes were the dominant class of compounds, with borneol (20.3-40.7%) being the most abundant. Other compounds commonly found in high concentrations included α-pinene, α/β-thujone, γ-palmitolactone, and *trans*-verbenol. However, the essential oil of *A. lingulata* from Stara planina Mt. exhibited a distinct chemical composition, with a predominance of sesquiterpenes, particularly τ-cadinol (22.5%) and caryophyllene oxide (16.6%), while borneol was present at a level below 10%. Understanding this variability is important for providing valuable taxonomic insights within the genus *Achillea*, supporting chemotype identification and species differentiation. In addition, this knowledge is important for evaluating the pharmacological potential of *A. lingulata* and its industrial applications.

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Methyl ketones from the essential oil of *Humulus lupulus* L.: Potential contributors to the aroma and flavor profile of beer

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Humulus lupulus L., a perennial species belonging to the Cannabaceae family, is a rich source of bioactive compounds primarily found in the essential oil of its female cones. This oil contains terpenoids known for their antibacterial, antifungal, and various biological properties. In this work, a chromatographic fraction of the essential oil of the cones of *H. lupulus* (female inflorescence) was isolated using preparative column chromatography and analyzed by gas chromatography–mass spectrometry (GC-MS). The analysis revealed the presence of saturated methyl ketones - both linear and branched (iso-type) - within the C_9–C_{15} range. Unsaturated linear methyl ketones featuring a single double bond were also identified in the C_{11}–C_{16} range. The positions of the double bonds (between carbons 5 and 7) were determined based on the interpretation of mass spectra of the corresponding DMDS-adducts. This represents the first identification of both saturated and unsaturated methyl ketones in *H. lupulus* essential oil. Previously, such compounds had only been reported from the essential oil of *Ruta angustifolia* Pers. and in the secretion of the scent glands of Opiliones. These findings expand the known chemical profile of hop essential oil and suggest that these newly identified volatile compounds may contribute to the unique aroma and flavor of beer.

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Anthocyanin composition and antioxidant activity of four black currant (*Ribes nigrum* L.) juices

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Black currant (*Ribes nigrum* L.) is a valuable source of various bioactive constituents particularly anthocyanins, flavonols and ascorbic acid. These compounds contribute to the antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and antiproliferative properties of black currants, among other effects. This paper aims to identify and quantify the anthocyanins present in the juices made

of four black currant varieties berries - Titania, Ben Nevis, Ben Lomond, and Silmu, while also evaluating their antioxidant effects. Anthocyanins were determined using high performance liquid chromatography (HPLC). Antioxidative activity was evaluated by DPPH method. The results showed that the dominant anthocyanins were delphinidin-3-*O*-rutinoside and cyanidin-3-*O*-rutinoside. The highest anthocyanins content was found in Silmu juice (≈77.04 mg/100 g) and the lowest in Titania juice (≈20.46 mg/100 g). The strongest scavenging of free radicals was exhibited by Silmu (IC_{50}=2.35±0.12 mg/ml) and the weakest by Titania juice (IC_{50}=4.13±0.25 mg/ml). Determination of anthocyanins content and antioxidative activity in black currants juices showed that Silmu juice expressed the best results. The findings of this study can assist in selecting high-quality varieties and highlight the advantages of incorporating them into the daily food intake. The knowledge gained could be utilized to help prevent diseases related to oxidative stress.

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Could γ-costyl esters serve as chemotaxonomic markers of *Achillea atrata*?

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Comprehensive analyses of the diethyl ether (Et_2O) extract from the aerial parts of *Achillea atrata* L., collected in the Alpine regions of Switzerland (Mt. Säntis, 2501 m above sea level), were conducted using gas chromatography (GC), gas chromatography–mass spectrometry (GC–MS), and nuclear magnetic resonance (NMR) spectroscopy. More than 70 constituents were identified, with nonacosane (12.7%), α-linolenic acid (10.1%), and pentacosane (5.4%) as the major components. Notably, a series of previously unreported esters of the sesquiterpene alcohol γ-costol were detected. Among them, γ-costyl 2-methylbutanoate and γ-costyl 3-methylbutanoate were the most abundant (11.4% of the extract). Additional esters—acetate, propanoate, 2-methylpropanoate, butyrate, and 3-phenylpropionate - were also identified (total content of γ-costyl esters: 15.6%). All these esters were

identified for the first time in nature and structurally elucidated using a combination of 1D (^{1}H and ^{13}C) and 2D (HSQC, HMBC, NOESY, and COSY) NMR spectroscopy, along with retention index prediction. Furthermore, the rare sesquiterpene alcohol 4-amorphen-11-ol (5.3%) was isolated and fully characterized by NMR; this is the first report of its occurrence in the genus *Achillea*.

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Anti-inflammatory and cytotoxic effects of marrubiin: Evidence from *in vitro* and *in vivo* models

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Marrubiin is a diterpene with a long history of a wide range of biological activities. In this study, the anti-inflammatory effects of marrubiin were investigated using several *in vitro* and *in vivo* assays. Marrubiin inhibited carrageenan-induced peritoneal inflammation by preventing inflammatory cell infiltration and peritoneal mast cell degranulation. The anti-inflammatory activity was further demonstrated by monitoring a set of biochemical parameters, showing that the peritoneal fluid of animals treated with marrubiin had lower levels of proteins and lower myeloperoxidase activity compared with the fluid of animals that were not treated. Marrubiin exerted the most pronounced cytotoxic activity towards peripheral mononuclear cells, being the main contributors to peritoneal inflammation. Additionally, a moderate lipoxygenase inhibition activity of marrubiin was observed.

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The rosmarinic and caffeic acid contents of methanol basil leaves extracts (*Ocimum basilicum* L.)

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Basil (*Ocimum basilicum* L.) is a medicinal herb valued for its therapeutic properties in traditional and modern herbal medicine, primarily for supporting digestive health. It contains essential oil and polyphenolic compounds, such as phenolic acids, which exhibit numerous pharmacological properties. The study aimed to determine the content of rosmarinic and caffeic acids in methanol extracts of basil leaves using high performance liquid chromatography (HPLC). Dried leaves, sourced from the "Yumis" food company, were extracted by absolute, 80% or 60% methanol, using single-stage maceration, digestion or ultrasound-assisted method. The highest content of rosmarinic acid was measured in the 60% methanol extract prepared using the digestion method (70.98±3.25 μg/mg), while the lowest was found in the methanol extract prepared with 60% methanol using the single-stage maceration (49.27±0.66 μg/mg). The highest content of caffeic acid was measured in the ethanol extract prepared with 60% methanol using the digestion method (2.29±0.04 μg/mg), whereas the lowest content was measured in the methanol extract prepared with absolute methanol using the ultrasound method (1.70±0.05 μg/mg). The results of the research show that the basil leaves methanol extracts contain high amounts of these two polyphenols, therefore significant pharmacological activities of the extracts are expected in further studies.

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Spasmolytic effects of hydroethanolic extract of *Salvia sclarea* L. on isolated rat trachea

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Many plant species from the Lamiaceae family are traditionally used in the treatment of respiratory diseases due to their spasmolytic effects, and numerous experimental studies have shown that their extracts exhibit bronchodilator effects on isolated tracheal preparations. This study is aimed to investigate the effects of the hydroethanolic extract of *Salvia sclarea* L. on carbachol- and KCl- induced contractions of rat tracheal smooth muscle. The extract was prepared from the above-ground parts of *S. sclarea* collected in Malča, Niš, Serbia, using 60% ethanol and ultrasound-assisted extraction. Previous chemical characterization of the extracts revealed a high content of phenolic compounds, with rosmarinic acid identified as the predominant component. The relaxant effects of the extract on tracheal smooth muscle were moderate, and dose-dependent. The maximum concentration of the extract (1.5 mg/ml) inhibited contractions by 17.46±0.87% in carbachol-induced model, with an EC_{50} value of 4.65±0.15 mg/ml. In the KCl-induced model, the same concentration of the extract reduced contractions by 8.57±0.21%, with an EC_{50} value of 15.39±0.31 mg/ml. Although the effects are moderate, these findings suggest that the *S. sclarea* extract may be a beneficial agent in treatment for respiratory diseases linked to bronchial spasms.

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Antifungal, anti-biofilm and synergistic potential of *Syzygium aromaticum* essential oil against otomycosis-associated *Candida* spp.

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Otomycosis is a superficial fungal infection of the external auditory canal, most commonly caused by *Candida* species. The aim of this study was to evaluate the antifungal activity of *Syzigium aromaticum* essential oil (EO) using microdilution method. Additionally, the biofilm-forming ability of the tested strains and the anti-biofilm potential of clove EO were assessed using the crystal violet (CV) method. The synergistic interaction between EO and nystatin was also examined through a checkerboard assay. The results demonstrated a high antifungal potential of clove oil, inhibiting the growth of the tested strains at concentrations ranging from 0.31 to 1.25 mg/ml. *Syzigium aromaticum* EO also inhibited biofilm formation in all tested strains, with reduction levels ranging from 34.84% to 84.12%. Its combination with nystatin showed mostly additive or indifferent effects; however, a synergistic interaction was observed against two of the tested strains. These findings highlight the promising antifungal and anti-biofilm potential of *S. aromaticum* EO, suggesting its possible application as a complementary agent in the treatment of otomycosis caused by *Candida* spp. While synergism effects with nystatin were observed in a limited number of strains, the overall results indicate its potential for further investigation.

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Concentration of heavy metals in the leaves of rosemary (*Salvia rosmarinus* Spenn., Lamiaceae) cultivated in urban habitats of Belgrade

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Rosemary (*Salvia rosmarinus* Spenn., Lamiaceae) is widely cultivated as an ornamental plant in urban areas. Due to essential oil, carnosic and rosmarinic acid, its leaves have antioxidant, anti-inflammatory and antimicrobial properties. Rosemary leaves are traditionally used as a bath additive for mild muscle and joint pain and peripheral circulatory disorders, as well as in herbal teas for dyspepsia and mild gastrointestinal spasms. Rosemary is also a common culinary spice. Given the potential health adverse effects of heavy metals accumulated from environmental pollution and pesticide residues, this study analyzed Hg, Pb and Cd concentrations in rosemary leaf samples from seven locations in central and peripheral Belgrade and in two commercial samples. The dried leaves were subjected to microwave mineralization with nitric acid, and metal concentrations were measured by ICP-OES. All samples contained heavy metals below the limits for herbal products according to national and European regulations. The highest levels of Hg and Pb were found in a commercial sample from Morocco, while Cd was most abundant in samples from Zemun. The lowest metal levels were found in a sample from the Faculty of Pharmacy's garden in the outskirts of Belgrade.

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Evaluation of antifungal and anti-biofilm activities of *Syzygium aromaticum* essential oil and its synergistic potential with nystatin against otomycosis-associated *Aspergillus* spp.

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Otomycosis represents a superficial fungal infection affecting the external auditory canal, with *Aspergillus* species being among the most common causative agents. This study aimed to investigate the antifungal activity of *Syzygium aromaticum* essential oil (EO) using the broth microdilution method. Additionally, the ability of the tested strains to form biofilms, as well as the potential of clove EO to inhibit this process, was examined using the crystal violet assay. The potential interaction between clove EO and nystatin was also assessed using the checkerboard method. Clove oil exhibited notable antifungal activity, with inhibitory concentrations ranging from 0.31 to 0.625 mg/ml. Furthermore, the EO significantly reduced biofilm formation with inhibition percentages varying from 55.37% to 88.98%. When combined with nystatin, the EO demonstrated only additive or indifferent interactions, with no synergistic effects observed. These results point to the promising antifungal and anti-biofilm properties of *S. aromaticum* EO and suggest its potential role as a supportive agent in the treatment of otomycosis caused by *Aspergillus* spp. Further studies are needed to explore its clinical applicability.

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Ethanol extract of wild mushroom *Morchella conica* as a source of phenolic compounds: correlation with antioxidant activity and implications for potential functional application

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In recent natural product research, mushrooms have emerged as promising sources of bioactive compounds. This study examined the wild-growing mushroom *Morchella conica* to evaluate the phenolic profile of its ethanol extract and the correlation between identified phenolics and antioxidant activity. High-performance liquid chromatography (HPLC) was used to identify and quantify phenolic compounds, while antioxidant activity was measured spectrophotometrically using FRAP (Ferric Reducing Antioxidant Power) and DPPH (2,2-diphenyl-1-picrylhydrazyl) assays. Among the detected phenolics, gallic acid (0.0580 mg/g), protocatechuic acid (0.0106 mg/g), and catechin (0.5335 mg/g) were the most abundant. Mean antioxidant values were 19.23±0.03 mg AAE/g for FRAP and 77.35±1.89 μg/mL for DPPH IC_{50}. Pearson correlation analysis revealed a strong positive relationship between gallic acid content and FRAP activity (r=0.997), as well as catechin and DPPH IC_{50} values (r=0.943). These findings suggest that *Morchella conica* may serve as a natural source of phenolic antioxidants with potential for further functional application.

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Biological activity of sesquiterpenes lactones from *Centaurea* species

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Centaurea is a genus of flowering plants widely distributed in the Mediterranean region, belonging to Asteraceae family. Many of its species have been used for a long time in traditional medicine as herbal remedies for various purposes, it has been reported that the organic extracts of many *Centaurea* species displayed a high inhibitory activity on α-glucosidase, but the bioactive compounds responsible for this activity have not been identified yet. Thus, in order to deepen the potential use of *Centaurea* species to treat metabolic syndrome and identify the bioactive compounds, a screening of various sesquiterpenes lactones isolated from the chloroform extract of different *Centaurea* species aerial parts, including *C. drabifolia*, *C. kotschyi* and *C. sicula* has been carried out. As first step, the inhibitory activity of 19 sesquiterpene lactones against α-glucosidase was evaluated by a spectrophotometric assay. The results obtained showed how some compounds exhibited IC_{50} values in a range from 39.8 to 224.8 μg/mL. The sesquiterpene melitensin resulted the most active compound with an IC_{50} of 39.8 μg/mL, comparable to that observed for acarbose (IC_{50}=27.9 μg/mL), the antidiabetic compound used as reference compound. Compounds rhizantholide A, kandavanolide, kotschyol A and 11-epi-11,13-dihydroartemisiifolin showed IC_{50} values lower than 50 μg/mL. Successively, molecular docking experiments were carried out to assess the possibility for selected compounds to form complexes with the α-glucosidase active site.

15th Symposium on the Flora of Southeastern Serbia and Neighboring Regions

Niš 23th-25th May, 2025

Agriculture, Forestry and Landscape Architecture

INTRODUCTORY LECTURE

Potential of the climbing rose 'Casino' in urban environments: Towards to climate change

Ocokoljić, M.[1], Petrov, Đ.[1], Galečić, N.[1], Skočajić, D.[1], Čukanović, J.[2], Kolarov, R.[2], Đorđević, S.[2]

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The aim of this study was to analyse the impact of air temperature on the phenological flowering pattern of the 'Casino' cultivar at the age of 30, located in the garden of St. George's temple in Banovo Brdo, Belgrade. Daily phenological observations were conducted to evaluate damage caused by low temperatures and to define the phenological flowering pattern during the globally warmest year on record, 2024. Frost damage was not recorded, except for the interruption of flowering in December, without the shedding of open flowers and buds. It was observed that flowering began in January and, without interruption but with varying abundance, lasted until mid-December. The shortening of the abundant flowering interval correlated with high temperatures. The significance of the observed genotype was confirmed by a 100% rooting success rate of semi-hardwood cuttings taken in June and the complete opening of a single flower on all new plants in December of the same year, in a greenhouse. Based on the results, the identified genotype of the 'Casino' cultivar stands out for future breeding programmes, as no climbing rose taxa with yellow flowers and periodic flowering have been synthesised so far. The sustainability and the impact of high temperatures on the duration and abundance of flowering are evident, suggesting broader application possibilities, though without assurance of the stability of the flowering phenophase in the coming years. The conducted research highlights the genotype of the 'Casino' cultivar as a climbing rose with exceptional ornamental, ecological, and landscape attributes.

Acknowledgements: The authors are grateful to the Ministry of Science, Technological Development and Innovation of the Republic of Serbia for financial support of the University of Belgrade - Faculty of Forestry the scientific research work in 2025, the registration number 451-03-137/2025-03/200169.

ORAL PRESENTATIONS

Trachelospermum jasminoides (Lindl.) Lem. in pergola design: An experimental study in Belgrade

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The paper analyzes the potential application of Star Jasmine, a climbing plant from the subtropical biome, in pergola design in Belgrade, considering the growing interest in the phenomenon of urban heat islands as a result of increased urbanization, improper planning, and design. In order to understand this phenomenon, the integration of meteorological components into the design process and the appropriate selection of plants in landscape design is encouraged. Therefore, comprehensive analyses of climatic parameters, phenological, and morphological characteristics during the period from 2015 to 2024 confirmed the adaptability of the species on a pergola in a private garden in the Čukarica district of Belgrade. It is particularly notable that Star Jasmine, at the age of two, tolerated severe frosts in a protected position from the dominant cold northwestern and southeastern winds. The morphometric characteristics of the leaves were within the expected range, while the dimensions of the flowers exceeded the values cited in the literature for Star Jasmine in the Northern Hemisphere. For the first time, the number of flowers in the inflorescences and the number of pistils in the flowers were determined. The obtained results are significant considering that Star Jasmine is an evergreen species with a fine texture, has a long flowering phenophase, and that there are only few woody climbing plants with such characteristics in Belgrade. Further research is necessary to define guidelines for pergola design, in the context of climate change. In urban environments ornamental climbing plants provide year-round value and require minimal maintenance.

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of Belgrade - Faculty of Forestry the scientific research work in 2025, the registration number 451-03-137/2025-03/200169.

The phases of degradation in oak forests of the western part of the National park 'Fruška Gora' - a challenge for sustainable forest management

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The forests of the National park 'Fruška Gora' have been under the negative anthropogenic influence before, but also after official protection in 1960. Coppice forests on over 80% of the area and the share of *Tilia* species of over 40% are indicators characterizing the degradation in the National park. Natural forests were composed of oaks (*Quercus robur* L., *Q. cerris* L. and *Q. pubescens* Willd.) with *Tilia* spp. and other admixed species and have undergone extensive clear cutting, and more recently inadequate application of natural regeneration systems. The expansion of invasive neophytes - managed *Robinia pseudoacacia* L. and spontaneously colonized *Ailanthus altissima* (Mill./Swingle) marked the initiation of the final phase of degradation as these exotic species supress *Tilia* spp. that are often the last remaining native species. The expansion of *A. altissima* has been the most intensive factor of diversity degradation of the natural forest stands, and a challenge to the established sustainable forest management concept in the National park. To stop this expansion, there is a need to adjust the management plans to include not only the tending operations in the colonized stands, but also to characterize the conditions in the neighboring stands.

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Indigofera heterantha Wall. ex Brandis – a new exotic species in Serbia

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The paper describes the differential characteristics of *Indigofera heterantha* Wall. ex Brandis, in a location in Belgrade, for which, to our knowledge, there is no prior experience or data available in Serbia. The collected data on the quantitative properties of leaves, inflorescences, flowers, and fruits were processed through biometric analysis. Since the Indigo Himalayan is located in close proximity, an integrative approach using phenological patterns and climatic predictors allowed for comparison and drawing conclusions about this yet unrecorded exotic species in the flora of Serbia. During the warmest year of 2024, new growth and leafing were observed in September and October, and the flowering phenophase was extended until November. Based on the results, the Indigo Himalayan stands out as an adaptive, fast-growing shrub species in the altered moderately continental climate conditions of Serbia, confirming that alien species tolerate these fluctuations. Therefore, it is proposed that indigenous and sustainable alien plants should be used in the design of urban semi-natural and new open spaces. This study serves as a starting point for further research aimed at better understanding the state of diversity in urban dendroflora and the role of Indigo Himalayan in landscape design. Species diversity plays a key role in providing ecosystem services and stability, and urban environments can support a high diversity of shrub dendroflora.

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POSTER PRESENTATIONS

Can ethanolic extracts of liverwort *Metzgeria furcata* suppress weed *Abutilon theophrasti*?

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Liverworts are a group of bryophytes with distinct morphology and chemical composition compared to mosses and hornworts. Their oil bodies contain lipophilic secondary metabolites, many of which are unique to liverworts. Some of these metabolites exhibit allelopathic effects, influencing the growth and development of other plants. This study aimed to investigate the effects of different concentrations of ethanolic extracts (10^{-4}, 10^{-3}, $8x10^{-3}$, and 10^{-2} mg/ml) of the liverwort *Metzgeria furcata* on the seed germination and seedling development of the weed *Abutilon theoprhasti*, a species considered damaging to agricultural crops such as corn and soybean. All tested concentrations of *M. furcata* extract did not affect *A. theophrasti* seed germination after seven and ten days. However, higher extract concentrations ($8x10^{-3}$ and 10^{-2} mg/ml) reduced hypocotyl length and chlorophyll content in *A. theophrasti* seedlings after ten days. The results clearly indicate that investigated *M. furcata* extracts inhibit seedling growth in the early stages of development, but do not have a significant impact on seed germination. This suggests their potential as weed growth suppressants to improve crop yields. However, further investigation is needed to explore the chemical profile of *M. furcata* and the effects of its individual components on crops.

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Allelopathic interactions between liverworts and radish (*Raphanus sativus*): Investigating growth and germination responses

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Liverworts are a diverse group of bryophytes known for producing various secondary metabolites, some of which exhibit allelopathic properties. These compounds may influence other plant species by promoting or inhibiting their growth and development. Understanding liverwort allelopathic features, particularly its effects on crop species like radish, can provide meaningful insights into plant interactions and potential agricultural green applications. The allelopathic effects of various ethanolic extract concentrations (10^{-4}, 10^{-3}, 2×10^{-3}, 4×10^{-3}, and 8×10^{-3} mg/mL) from three liverwort species were assessed by examining seed germination percentage and hypocotyl length of radish (*Raphanus sativus*) seedlings. The ethanolic extracts were obtained from *Bazzania trilobata*, *Metzgeria furcata*, and *Plagiochila asplenioides*, and the measurements were taken at two time points i.e. three and five days after the start of germination assays. The highest applied extract concentration (8×10^{-3} mg/mL) of all three species significantly reduced the germination percentage and hypocotyl length in radish after five days of treatment. Interestingly, after three days of treatment, no significant effects on radish seed germination percentage were observed for any liverwort extracts at any of the applied concentrations. However, the highest applied concentration of *M. furcata* extract significantly reduced the hypocotyl length of radish seedlings even after three days of exposure.

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Pigment content in sunflower and maize treated with sodium cholate, elicitor substance from manure

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Content of chlorophyll a and b and carotenoids in plants can increase or decrease due to different types of stress. As carotenoids are known to be powerful antioxidants, we tested the effect of sodium cholate as priming substance, component of manure, as potential biopesticide. On dry leaves of sunflower and maize treated with sodium cholate (20, 40, 60 and 80 mg/L) and sampled for seven days, the content of the mentioned pigments was measured spectrophotometrically. Higher concentrations of cholate led to a significant change in pigment content of both plants. Interestingly, sodium cholate had the opposite effect on sunflower than on maize. In maize, after a five-day treatment with 60 mg/L cholate, the content of chlorophyll a (4.13 mg/g vs. control 5.76 mg/g) and chlorophyll b was statistically significantly reduced, as was the content of carotenoids by treatment with 80 mg/L cholate. In sunflower, on the other hand, the content of chlorophyll b was significantly increased by treatment with 60 mg/L cholate after three, five and seven days, as well as with 80 mg/L after one (3.85 mg/g vs. control 2.41 mg/g) and three days of treatment.

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Improvement of carrot seed germination by *Bacillus* spp. isolates

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Carrots (*Daucus carota* L.) are horticultural plants that are cultivated on large agricultural areas for human consumption. Recently, various plant growth-promoting (PGP) bacteria have been used to improve the germination of seeds of different plant species. In this study, we investigated the impact of different *Bacillus* isolates on the germination of carrot seeds with the aim to identify beneficial bacteria that could enhance seedling emergence, by using the filter paper method. The carrot seeds were treated with four different PGP *Bacillus* isolates (BHC 4.7, BHC 5.1, BHC 5.6 and BHC 7.6), while the untreated seeds were used as the control treatment. After 14 days of incubation at room temperature, the number of germinated/ungerminated seeds was determined and the relative seed germination index (RSGI%) was calculated. The highest RSGI value was recorded for carrot seeds treated with BHC 4.7 (108.04%), while similar results were also recorded for the BHC 7.6 treatment (104.44%). In addition, BHC 5.1 and BHC 5.6 treatments had no effect on improving carrot seed germination. Our results show that the use of various bacterial isolates such as BHC 4.7 and BHC 7.6 can be a natural alternative to chemical treatments to improve carrot seed germination.

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Assessment and management of soil fertility for vineyard establishment (*Vitis vinifera* L.)

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For the purpose of establishing vineyards, 12 soil samples were analyzed, taken from the settlements of Milutovac (2) and Medveđa (10), in the vicinity of Trstenik. Soil samples were collected at two depths: 30 and 60 cm. The examined soils are classified as vertisols and eroded loamy soils. The values of active acidity range from 5.59 to 7.94, while the substitutional acidity values range from 4.86 to 7.16. All soil samples fall into the category of slightly calcareous soils, with carbonate values ranging from 0.62% to 1.66%. The humus content varies widely, from low to highly humic soils (0.21% to 4.86%). Most of the examined soil samples belong to the group of nitrogen-deficient soils, with a total nitrogen content ranging from 0.044% to 0.208%. The content of readily available phosphorus varies from less than 5.00 to 21.15 mg/100 g, with only one sample being optimally supplied with phosphorus, while the rest are low in phosphorus. The values of readily available potassium range from 5.80 to more than 40.00 mg/100 g. Along with a detailed chemical analysis, appropriate ameliorative measures were proposed to ensure the successful establishment of vineyards and maximize yields.

Acknowledgements: The authors acknowledge the financial support of the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Grant No. 451-03-137/2025-03/200383).

Agrochemical soil analysis for the establishment of strawberry (*Fragaria* x *ananassa* Duch) plantations in the Trstenik region

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To grow strawberries in plantations, a detailed analysis of the terrain was made in the area of Trstenik. Thirty-two soil samples taken in the settlements

Milutovac (10), Stopanja (12) and Medveđa (10) were analysed. The analyzed soils are vertisols, eroded cambisols, and cambisols. Active pH values range from 5.77 to 7.88, and substitutional pH values from 4.90 to 7.25. Most of the samples belong to the group of weakly carbonated soils, with carbonate values ranging from 0.98 to 2.30%. The humus content ranges from 2.27 to 4.29%. All samples of the tested soils belong to the group of soils moderately supplied with nitrogen, and the percentage content of total nitrogen is in the interval from 0.098 to 0.213%. The content of easily available phosphorus varies widely from less than 5.00 to more than 40.00 mg/100 g, with the most samples being poorly supplied with phosphorus. Values of easily available potassium vary from 7.30 to more than 40.00 mg/100 g. Along with a detailed chemical analysis, adequate ameliorative measures were proposed for the successful establishment of strawberry plantations and gaining the highest possible yields.

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Phenological phases of leafing and leaf fall in stands of sessile oak (*Quercus petraea* Matt. Liebl.) and pedunculate oak (*Quercus robur* L.) during 2024

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In forest ecosystems in the territory of Vojvodina, the phenological phases of leafing and leaf fall have been monitored for many years at Bioindication Points Level II. This paper will present the phenological phases for 2024. Monitoring was conducted in a stand of sessile oak (*Quercus petraea* Matt. Liebl.) on Fruška Gora at an altitude of 485 m and in a stand of pedunculate oak (*Quercus robur* L.) near Odžaci at 87 m. For sessile oak, the beginning of the leafing phase was observed on March 28, and the end on April 12 (16 days), while for pedunculate oak, the beginning of the leafing phase was observed on March 21 and the end on April 10 (21 days). The phenological phase of leaf discoloration and fall for sessile oak began on October 16 and ended on November 27 (43 days), while for pedunculate oak, the beginning was observed on September 18 and the end on November 27 (72 days). From the above, it can be concluded that in 2024, sessile oak had a later start and

end of the leafing phase, which was shorter by 5 days compared to pedunculate oak. The phenological phase of leaf fall started earlier for pedunculate oak and ended at the same time as for sessile oak but lasted 29 days longer. The different timings of phenological phases depend on air temperature and altitude, as well as the microclimatic conditions of the stands.

Acknowledgements: This work was carried out within the program for monitoring the impact of transboundary air pollution in forest ecosystems in the territory of AP Vojvodina in 2024 – funded by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia.

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