Book of Abstracts

8th Balkan Botanical Congress

4-8 July 2022

The National and Kapodistrian University of Athens, Main Building
Athens, Greece

www.bbc2022.org

Hymenonema laconicum
Boiss. & Heldr.
(Asteraceae)

ORGANISERS

Section of Ecology & Systematics and Section of Botany, Department of Biology
HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

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Section of Pharmacognosy and Chemistry of Natural Products, Department of Pharmacy
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Hymenonema laconicum
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(Asteraceae)

Welcome Letter

Dear colleagues,

On behalf of the Organising Committee of the BBC 2022, we have the pleasure and honour of inviting you to the **8th Balkan Botanical Congress,** which will be held for the first time in **Athens, Greece,** on **July 4-8, 2022.**

This year, the organisation of the congress is undertaken by the **Section of Ecology & Systematics and Section of Botany, Department of Biology** of the **National and Kapodistrian University of Athens** together with the **Hellenic Botanical Society.** Different Botanical Institutions from Greek Universities and Public Research Bodies serve as co-organisers. Our aim is to meet and connect with all scientists involved in the research of plant life of the Balkan Peninsula, after a long period of social distancing. Therefore, we are working towards a face-to-face Congress, with due respect to all prevention and control measures of the covid-19 pandemic.

This educative, scientific meeting puts an emphasis on the uniqueness of the Balkan Botany. The rich flora and diverse vegetation serve as a stable ground for research and experimentation and sustains conservation. We hope that the **8th Balkan Botanical Congress** will provide an excellent opportunity to present the latest results and share research experience. In addition, it is the ideal meeting place to network and interact, to develop new or strengthen existing collaborations with colleagues from different countries of the Balkan Region and beyond.

The congress scientific program will include invited lectures, oral and poster presentations, covering various research fields, such as Plant Anatomy and Physiology, Plant Systematics, Plant Molecular Biology and Genetics, Floristics, Vegetation and Phytogeography, Conservation Botany and Plant Invasions, Phytochemistry, Plant Resources and Utilization, Agronomy and Forestry, Botanical Collections and Botanic Gardens, History and Ethnobotany and Cryptogamic Botany.

Athens, the historic capital city of Greece, sets the ideal scenery for **the congress, which will be hosted in the central domains of the National and Kapodistrian University of Athens,** the oldest in Greece. The university offers contemporary venues of international standards and high-level services.

We are confident that we will deliver an inspiring and memorable event and are looking forward to welcoming you to the **8th Balkan Botanical Congress** in Athens in 2022!

On behalf of the Organizing Committee,

Theophanis Constantinidis
Section of Ecology & Systematics
National and Kapodistrian
University of Athens

Ioannis-Dimosthenis Adamakis
Section of Botany
National and Kapodistrian
University of Athens

Panayotis Dimopoulos
Hellenic Botanical Society

Organisers

The National and Kapodistrian University of Athens

The National and Kapodistrian University of Athens is the oldest state institution of higher learning in Greece, and among the largest universities in Europe. It was officially founded on April 14th, 1837, and is the first University not only of Greece but both the Balkan peninsula and the Eastern Mediterranean region. The **8th Balkan Botanical Congress** will be co-organised by the Section of Ecology and Systematics and Section of Botany Department of Biology.

The Hellenic Botanical Society

The Hellenic Botanical Society (HBS) was founded in 1980 and is based in Athens (Faculty of Biology, National and Kapodistrian University of Athens). The logo of the Society depicts the head of Theophrastus (371-286 BC), ancient Greek philosopher and founder of Botany. The Society has approximately 210 members and has organised a significant number of Scientific Symposia and Congresses from 1980 till today in various Greek cities. According to its statute, the objectives of the Hellenic Botanical Society are:

- the advancement of all sectors of botanical science
- the advancement of botanical research in Greece
- the protection of the Greek flora
- the advancement of the achievements in Greek botanical research

co-Organisers

Section of Pharmacognosy and Chemistry of Natural Products, Department of Pharmacy, National & Kapodistrian University of Athens.

The main objectives of the Department of Pharmacy are to promote education and research into the pharmaceutical sciences and technology, and to that end it continually promotes improvements/changes in the curriculum in line with the changes in the nature/demands of the pharmaceutical profession.

Institute of Plant Breeding and Genetic Resources - ELGO-DEMETER

The Institute of Plant Breeding and Genetic Resources (IPB&GR) is part of the Hellenic Agricultural Organization-Demeter (ELGO-DEMETER) supervised by the Ministry of Agriculture. Its main research targets include the preservation, evaluation, and exploitation of genetic resources and the development of new cultivars with improved yield, quality, and adaptation. Its research aims to produce and transfer knowledge for the development of integrated crop production and solve modern agricultural problems. Furthermore, it conducts research in the areas of crop protection and sustainable agriculture, driven by the need of reducing production costs and protecting the environment.

Interbalkan Environment Center

i-BEC is a non-profit and mission oriented international organisation and a public-private network that links local communities and countries in the wider Balkan area, with EU and UN agencies. i-BEC supports and co-develops with Aristotle University of Thessaloniki state of the art technologies and innovative research, for sustainable management of natural resources and environmental protection. i-BEC promotes a collaborative approach to sustainable management and protection of natural resources that fosters harmonious socio-economic development in Greece, the broader Balkan region and beyond.

Thematic Topics

- Agronomy and Forestry
- Botanic Gardens and Botanical Collections
- Conservation Botany and Plant Invasions
- Cryptogamic Botany
- Floristics and Phytogeography
- Palynology and Paleobotany
- Phytochemistry and Plant Natural Compounds
- Plant Anatomy and Development
- Plant History and Ethnobotany
- Plant Molecular Biology and Genetics
- Plant Physiology and Ecophysiology
- Plant Resources and Utilization
- Plant Taxonomy, Biosystematics and Evolution
- Vegetation Science and Plant Ecology

Scientific Committee

Ioannis - Dimosthenis Adamakis – Department of Biology, National & Kapodistrian University of Athens, Greece

Evgenios Agathokleous – Department of Ecology, Nanjing University of Information Science & Technology, China

Emilia Apostolova – Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences, Sofia, Bulgaria

Gülriz Bayçu – Department of Biology, University of Istanbul, Turkey

Sandro Bogdanović – Department of Agricultural Botany, University of Zagreb, Croatia

Nicolaos Christodoulakis – Department of Biology, National & Kapodistrian University of Athens, Greece

Theophanis Constantinidis – Department of Biology, National & Kapodistrian University of Athens, Greece

Panayotis Dimopoulos – Biology Department, University of Patras, Greece

Anelia Dobrikova – Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences, Sofia, Bulgaria

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Maria Halabalaki – Department of Pharmacy, National & Kapodistrian University of Athens, Greece

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Eleni Maloupa – Hellenic Agricultural Organization - DEMETER, Thessaloniki, Greece

Vlado Matevski – Macedonian Academy of Sciences and Arts, Skopje, North Macedonia

Sofia Mitakou – Department of Pharmacy, National & Kapodistrian University of Athens, Greece

Sinisa Ozimec – Faculty of Agriculture, University of Osijek, Croatia

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Maria Panitsa – Biology Department, University of Patras, Greece

Emmanuel Panteris – School of Biology, Aristotle University of Thessaloniki, Greece

Aristotelis C. Papageorgiou – Department of Molecular Biology and Genetics, Democritus University of Thrace, Greece

Ivana Rešetnik – Department of Biology, University of Zagreb, Croatia

Marko S. Sabovljević – Faculty of Biology, Institute of Botany and Botanical Garden, University of Belgrade, Serbia

Ivanka Semerdjieva – Department of Botany and Agrometeorology, Agricultural University of Plovdiv, Bulgaria

Krzysztof Sitko – Institute of Biology, Biotechnology and Environmental Protection, University of Silesia in Katowice, Poland

Eleni Skaltsa – Department of Pharmacy, National & Kapodistrian University of Athens, Greece

Panayiotis Trigas – Faculty of Crop Science, Agricultural University of Athens, Greece

Spyros Tsiftsis – Department of Forest and Natural Environment Sciences, International Hellenic University, Greece

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Olga Tzakou – Department of Pharmacy, National & Kapodistrian University of Athens, Greece

Vladimir Vladimirov – Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria

Georgios Zalidis – Interbalkan Environment Center, Thessaloniki, Greece

Lana Zorić – Department of Biology and Ecology, University of Novi Sad, Serbia

Invited Speakers

Evgenios Agathokleous

PhD, Environmental Resources
Full Professor
Department of Ecology
School of Applied Meteorology
Nanjing University of Information Science & Technology
Nanjing, Jiangsu, China

Panayotis Dion. Dimopoulos

PhD on Flora and Vegetation Ecology
Professor in Botany and Ecology,
University of Patras, Greece
Chair of the Hellenic Botanical Society

Dr Krzysztof Sitko

Professor (Assistant)
Institute of Biology, Biotechnology and Environmental Protection
University of Silesia in Katowice, Poland

Opening Speech

Michalis Moustakas

Professor Emeritus

Will give a short historical review since the conference returns after 25 years to the country that started it. Mr Moustakas was part of the organizing committee of the 1st Balkan Botanical Conference in 1997 in Thessaloniki, Greece

Awards

Best Oral and Poster Presentation Awards

The BBC2022 awards will honour one Oral and one Poster presentation, which will be selected among the submissions of the Congress participants, by the members of the Organising and Scientific Committee. Each award will consist of a certificate and a prize of 250€ donated by the **Journal of Biological Research-Thessaloniki (JBRT).**

The Journal of Biological Research – Thessaloniki (auth.gr) is an international scientific journal which has been published since 2004. The Editorial Board members of JBRT originated from more than 10 countries around the world and cover all the major fields of Biology. JBRT has published more than 350 articles (research papers, reviews, commentaries, etc) after peer review. JBRT is indexed in major bibliographic databases such as WoS (Web of Science, ISI Thomson), SCOPUS (Elsevier), CAS (Chemical Abstracts Service), DOAJ (Directory of Open Access journals) and PubMed (NCBI). It has been included in Journal Citation Reports since 2007 and its impact factor has been increased ever since (IF = 2.364 for 2018). From September 1st, 2021, JBRT is published through the OJS platform provided by the Aristotle University of Thessaloniki (AUTH).

For more details, please, visit JBRT homepage at http://ejournals.lib.auth.gr/jbiolres

Programme

Monday 04.07.2022

13.30-14.30 **Registrations / Poster placement**

MAIN HALL

14.30-16.30 **Opening Session**

14.30-15.00 **Welcome addresses**

15.00-15.40 **Opening Speech**
Balkan Botanical Congresses: a 25 years history
Moustakas M.

15.40-16.15 **Invited Lecture**
Flora of Greece: current state of the total and endemic species diversity
Dimopoulos P.

16.30-17.00 **Coffee break**

MAIN HALL

17.00-17.40 **Session 1: Agronomy & Forestry, Conservation Botany and Plant Invasions**

17.00-17.20 **The importance of long-living trees in dendrochronological research: case studies from Greece**
Christopoulou A., Gmińska-Nowak B., Özarslan Y., Moody J., Ważny T.

17.20-17.40 **Alien invasive plant species of Greece in the implementation of EU regulation 1143/2014.**
Arianoutsou M., Bazos I., Christopoulou A., Galanidis A., Kokkoris Y., Zikos A.

Tuesday 05.07.2022

AMPHITHEATRE "ALKIS ARGYRIADIS"

09.30-10.05 **Invited Lecture**
Breathing toxins without mask filtering: frontiers in the research of ozone effects on plant ecosystems
Agathocleous E.

AMPHITHEATRE "ALKIS ARGYRIADIS"

10.05-11.25 **Session 2: Plant Anatomy & Development, Plant Molecular Biology and Genetics**

10.05-10.25 **Wood anatomy as a starting point for dendroarchaeological research: case studies from Greece**
Gmińska-Nowak B., Christopoulou A., Moody J., Ważny T.

10.25-10.45 **The morphogenesis of epidermal cells in *Sargassum* sp. blades: wavy anticlinal cell contours in brown algae**
Panteris E., Stamatakis S., Pappas D.

10.45-11.05 **Integrated genetic diversity, transcriptome and volatile metabolic profile of *Origanum vulgare* subsp. *hirtum* wild populations**
Mylona P., Zafeiriou I., Ntoanidou S., Sarrou I.

11.25-12.00 **Coffee break**

AMPHITHEATRE "ALKIS ARGYRIADIS"

12.00-13.05 **Session 3: Palynology and Paleobotany, Vegetation Science and Plant Ecology**

12.05-12.25 **Late glacial- Holocene vegetation and climate development in Mount Grammos (GR1320002, NW Greece) inferred from pollen and *Pediastrum* assemblages**
Panajiotidis S., Mavridou A., Syropoulou E.

12.25-12.45	**Vegetation variability through successive Quaternary climatic cycles in a typical Mediterranean setting (Corinth Gulf, Greece)** Kouli K., Kafetzidou A., Fatourou A., Panagiotopoulos K.
12.45-13.05	**Topoclimatic observations regarding conservation of climate microrefugia in the Opuvani do doline, maritime Mediterranean Dinarides of Montenegro** Cikovac P., Küfmann C.
13.05-14.30	**Lunch break**
	POSTER AREA
14.30-18.00	**Poster presentations** **Presentation of posters on:** **Agronomy & Forestry, Botanic Gardens & Botanical Collections, Palynology & Paleobotany, Phytochemistry & Plant Natural Compounds, Plant Anatomy & Development, Vegetation Science & Plant Ecology**
16.00-16.30	**Coffee break**
18.30-19.30	**Welcome Reception**

Wednesday 06.07.2022

Congress excursions

Thursday 07.07.2022

AMPHITHEATRE "ALKIS ARGYRIADIS"

09.30-10.05	**Invited Lecture** **Hyperaccumulation of Cd and Zn phenomenon on example of *Arabidopsis helleri* and *Arabidopsis arenosa*** Sitko K., Szopiński M., Gieroń Ż., Rusinowski S., Rostański A., Małkowski E.

AMPHITHEATRE "ALKIS ARGYRIADIS"

10.05-11.05	**Session 4: Plant Physiology and Ecophysiology, Plant Resources and Utilization**
10.05-10.25	**Bisphenol A toxicity on plants: an overview** Adamakis I.D., Panteris E., Sperdouli I., Malea P., Moustakas M., Eleftheriou E.P.
10.25-10.45	**Hyperaccumulator plant species from the Balkan Peninsula** Jakovljević K., Bani A., Pavlova D., Konstantinou M., Dimitrakopoulos P.G., Mišljenović T., Tomović G., van der Ent A., Morel J.L., Reeves R.D., Baker A.J.M., Echevarria G.
10.45-11.05	**Bioaccumulation of potentially toxic elements in *Noccaea kovatsii* and *N. praecox* (Brassicaceae) from different geological substrates and their physiological responses to Ni** Mišljenović T., Tomović G., Rakić T., Mišić D., Jakovljević K.
11.05-11.45	**Coffee break**

AMPHITHEATRE "ALKIS ARGYRIADIS"

11.45-12.25	**Session 4: Plant Physiology and Ecophysiology, Plant Resources and Utilization**
11.45-12.05	**New insights into the effects of cyanobacterial bioactive compounds on plant cells: an overview** Pappas D., Adamakis I.-D., Giannoutsou E., Gkelis S., Panteris E.
12. 05-12.25	**Secondary metabolites production of *in vitro* root liquid cultures of *Primula veris* subsp. *veris*** Sarropoulou V., Sarrou E., Marten S., Maloupa E., Grigoriadou K.

12.30-14.00	**Lunch break**
	POSTER AREA
14.00-18.00	**Poster presentations** **Presentation of posters on:** **Conservation Botany and Plant Invasions, Cryptogamic Botany, Floristics & Phytogeography, Plant Physiology and Ecophysiology, Plant Resources and Utilization, Plant Taxonomy, Biosystematics and Evolution**
16.00-16.30	**Coffee break**
20.00-23.00	**Congress Dinner**

Friday 08.07.2022

	AMPHITHEATRE "ALKIS ARGYRIADIS"
10.00-11.20	**Session 5: Botanic Gardens and Botanical Collections, Plant Taxonomy, Biosystematics and Evolution**
10.00-10.20	**Dimitrios Zaganiaris and his legacy in Thessaloniki Aristotle University (TAU) Herbarium** Karousou R., Giourieva V., Hanlidou E., Gkelis S.
10.20-10.40	**A peek into the private life of a rare endemic: initial results of a pollination study on *Crocus balansae* J.Gay ex Maw** Ciftci A.
10.40-11.00	**Diversification of different species of *Euphorbia* subgen. *Esula* (Euphorbiaceae) from the Balkan Peninsula** Kirschner P., Faltner F., Đurović S., Temunović M., Schönswetter P., Frajman B.
11.00-11.20	***Festuca varia* complex under the scope: multigene phylogeny of fine-leaved Loliinae with focus on *F. bosniaca*** Mucko M., Lakušić D., Kuzmanović N., Bogdanović S., Ljubičić I., Rešetnik I.
11.20- 11.50	**Coffee break**
	AMPHITHEATRE "ALKIS ARGYRIADIS"
11.50-12.50	**Session 5: Botanic Gardens and Botanical Collections, Plant Taxonomy, Biosystematics and Evolution**
11.50-12.10	**Phylogeographic patterns in *Aurina saxatilis* (Brassicaceae) revealed with genomic RADseq data** Rešetnik I., Záveská E., Grgurev M., Bogdanović S., Bartolić P., Frajman B.
12.10-12.30	**Complex pattern of morphological and genome size variation in *Dianthus sylvestris* Wulfen s.l. (Caryophyllaceae)** Terlević A., Temunović M., Bogdanović S., Frajman B., Rešetnik I.
12.30-12.50	**Unravelling patterns of genomic variation of *Dianthus sylvestris* Wulfen s.l. in the Balkan Peninsula** Temunović M.[1*], Terlević Ana[2], Luqman H.[3], Bogdanović S.[4], Widmer A.[3], Fior S.[3], Rešetnik I.[2]
	AMPHITHEATRE "ALKIS ARGYRIADIS"
13.00-13.30	**Award announcement – Closing ceremony**

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Invited Speakers

Breathing toxins without mask filtering: frontiers in the research of ozone effects on plant ecosystems

Agathokleous E.*

Department of Ecology, School of Applied Meteorology, Nanjing University of Information Science & Technology (NUIST), Nanjing, China. – e-mail: nuist@nuist.edu.cn or globalscience@frontier.hokudai.ac.jp

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Keywords: air pollution, biodiversity, ozone, plant-soil-atmosphere continuum, pollination, species interactions

Ground-level ozone levels have dramatically increased all over the northern hemisphere since the preindustrial period. Its chemistry and physics are highly complex as ozone is a secondary air pollutant formed by the reaction of primary pollutants under sunlight, exhibits considerable long-range transboundary transport, is highly affected by weather conditions, and undergoes stratospheric inputs. Hence, its control is challenging, and ozone exposures are predicted to persist at high levels for many decades to come. However, as a trioxygenic molecule, ozone is highly-reactive oxidative gas, leading to the production of harmful chemical species in organisms, a cascade of oxidative stress responses, and eventually to negative health outcomes for plants and other organisms.

In this talk, an outline of frontiers in the research of ozone effects on plant ecosystems will be presented. First, it will be briefly summarized how ozone suppresses crop productivity, with special reference to East Asia as a current hotspot of ozone pollution, including estimated yield losses and translated economic impacts at regional scale. This will be followed up by a broad picture of the current knowledge regarding ecological implications of ozone pollution and its threat to terrestrial ecosystems. In doing so, empirical evidence suggesting alteration of plant communities by ozone pollution will be summarized. Building upon these, ozone effects on plant-insect interactions will be analyzed, considering how alterations in plant-insect interactions via changes in leaf qualitative status and atmospheric chemistry can lead to shifts in insect communities. Extending beyond herbivory, recent evidences hinting to the potential disruption of pollination by ozone pollution will be highlighted. Then, ozone impacts on plant-microbe interactions, also indicating altered plant-soil feedbacks, will be introduced while underlining changes in the composition and alpha diversity of soil microbial communities. Finally, using 2100 scenarios of global ozone exposures and endemism richness at global level, risks of ozone to biodiversity will be presented.

Flora of Greece: current state on the total and endemic species diversity

Dimopoulos P.*

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Keywords: plant diversity, endemism, range-restricted flora, hot-spot areas, Greece

The flora of Greece consists of 5845 species and 2004 subspecies (native and naturalized), which represent 6724 taxa and belong to 1089 genera and 184 families. The endemics and range-restricted plants of Greece include respectively 1495 and 2026 taxa (22.2% and 30.1% of the total nr of taxa in Greece), distributed in 1096 endemic and 1495 range-restricted species (18.8% and 25.6% of the total nr of Greek species) and 470 endemic and 640 range-restricted subspecies (23.4% and 31.9% of the total nr of subspecies) (analysis of the *Vascular Plants Checklist database* - version V, June 2022). When comparing the different floristic regions of Greece, we find that the most sp.+ssp.-rich region is North East (NE) (4402), followed by North Central (NC), Sterea Ellas (StE) and Peloponnisos (Pe), whereas the most species- and taxon-poor region is Kiklades (Kik) (2193). The endemic richness in absolute numbers and the rate of endemism are not uniformly distributed across the floristic regions; as a general pattern S Greece (Pe, KK, StE) and E Greece are richer in absolute numbers of endemics. The highest number of Greek endemic plants (species and subspecies) is observed in Pe (512), while the second and the third highest numbers are in the regions Kriti-Karpathos (424) and StE (389). The lowest numbers are in the regions North Aegean (69), Ion (93) and East Central (96). The ranking of the regions according to their total vascular plant diversity is quite similar across taxonomic levels (families, genera, species, subspecies, and taxa), but is very different to the ranking according to the diversity of endemic species and taxa. Taking total species and endemic species richness in relation to area size, as a measure of its plant diversity, Greece ranges among the highest in European and Mediterranean or Mediterranean-type climate areas. The results are discussed, interpreted and suggestions are made to determine national conservation responsibilities and to improve the effectiveness in endemics/range-restricted plant species conservation at national, regional and local scale.

Hyperaccumulation of Cd and Zn phenomenon on example of *Arabidopsis helleri* and *Arabidopsis arenosa*

Sitko K.[1,2]*, Szopiński M.[1], Gieroń Ż.[1], Rusinowski S.[2], Rostański A.[3], Małkowski E.[1]

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Keywords: ecophysiology, hyperaccumulation, Arabidopsis, heavy metals

Plants have evolved anatomical and physiological mechanisms for the effective and selective uptake, transport, and accumulation of metals in their tissues. Some plant species have developed strategies to cope with the toxic effects of the heavy metals (HM) present in excess in the environment as a result of human activity and/or natural processes. The hyperaccumulation of HM, which are manifested as the accumulation of unusually high concentrations of metals in plant shoots without any visible symptoms of toxicity, is an extreme example of these strategies. Currently, approximately 720 plant species have been reported that show HM hyperaccumulation. This number accounts for 0.2% of all known plant species.

Arabidopsis halleri is a hyperaccumulator of Cd and Zn, a pseudo-metallophyte, and a close relative species to *Arabidopsis thaliana*, which is a model plant. Very high levels of Cd and Zn accumulation in its shoots and its close genetic relatedness to *A. thaliana* has made *A. halleri* a model species for detailed studies of the HM hypertolerance and hyperaccumulation mechanisms. *Arabidopsis arenosa* is a pseudo-metallophyte, closely related to *Arabidopsis halleri*. *A. arenosa* occurs naturally in both diploid and tetraploid forms, in contrast to *A. halleri* in which only diploid forms were found. Moreover, *A. arenosa* similarly to *A. helleri*, often occupies HM contaminated sites.

Our research described that the two *Arabidopsis* species evolved different strategies of adaptation to extreme metallicolous environments that involve fine regulation of metal homeostasis, adjustment of the photosynthetic apparatus, and accumulation of flavonols and anthocyanins. In my Team's articles, we presented the ecophysiology of both species for the first time. Moreover, we have documented that *A. arenosa* is a new hyperaccumulator of Cd and Zn.

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Oral Presentations

The importance of long-living trees in dendrochronological research: case studies from Greece

Christopoulou A.[1]*, Gmińska-Nowak B.[1], Özarslan Y.[2], Moody J.[3], Ważny T.[1]

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Keywords: tree-rings, dendroarchaeology, Greece, long-living trees, historic timber, dating

Dendrochronology is the scientific method that uses tree-rings for dating past events. It has applications in different disciplines, including dendroarchaeology which studies historical and archaeological wood used for various purposes from a diverse set of contexts.

Within the framework of the Balkan-Aegean Dendrochronology Project: "Tree-Ring Research for the Study of SE-European and East Mediterranean Civilizations" we have collected and examined samples from numerous sites in the Balkans and the Aegean region with the scope to develop a set of continuous and absolute tree-ring chronologies as a solid foundation for the re-interpretation of historic chronologies and as a basis for studying both the environmental and cultural history of our study area. To achieve this goal, we have examined wood samples from long-living trees, historic buildings and archaeological sites.

In Greece, we have developed new chronologies from long-living trees for different species and regions, including Bosnian pine (*Pinus heldreichii*) and Black pine (*Pinus nigra*) from the Northern Pindus National Park, Cypress (*Cupressus sempervirens*) from Crete, Brutia pine (*Pinus brutia*) from the island of Symi and deciduous oaks (*Quercus* spp.) from several sites in the mainland and the islands. These newly developed chronologies, having more than 500 years in some cases, can be used to date historic timber, but also to reconstruct climate, landscape history and past disturbances such as fires.

The development of local reference chronologies is the first step for dating historic timber of local origin. The lack of such chronologies is why dendroarchaeological studies have remained relatively limited and rare despite the high dendrochronological potential of regions with historical and archaeological remains like Greece.

The study was funded by the National Science Center, Poland, project nr 2016/22/A/HS3/00285: "The Balkan-Aegean Dendrochronology Project. Tree ring research for the study of SE-European and East Mediterranean Civilizations".

Alien invasive plant species of Greece in the implementation of EU regulation 1143/2014.

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Keywords: pathways of introduction, risk assessments, monitoring, indicators

Biological invasions represent one of the most important threats to biodiversity, with invasive alien species (IAS) having severe negative consequences for the invaded environment. Within the European Union, prevention and management of the introduction and spread of IAS are monitored through the EU Regulation 1143/2014. All Member States are required to carry out a comprehensive analysis and prioritization of the pathways of introduction and spread of IAS of Union concern.

Within the research project entitled "Compilation of the national list of invasive alien species (IAS) of Greece and organization of a methodology for risk assessment" a national list of IAS has been prepared. To this end, alien species already present in Greece, and species with a high introduction risk in the near future, as these were defined through a Horizon Scanning procedure, have been evaluated and formed the national list of IAS. The list includes 126 species, out of which 32 are terrestrial plants, including six (6) species that are already in the Union Concern List.

The most common introduction pathway is their use as ornamental and in horticulture. Risk assessments have been performed for all 32 plant species, to detect those presenting the highest risk to the local biodiversity and ecosystem services. Fifteen plants were found to have major impacts, with 80% of them being recorded in the wild, while 40% of them are already established in Greece.

For the monitoring and management of IAS, a new framework of indicators has been developed based on available information. The proposed indicators can be applied at a national and/or local scale for monitoring the rate of new introductions, pathways, number and distribution of IAS, as well as to evaluate the effectiveness of policy and management interventions. The proposed indicators can also be used for the preparation of national reports.

Wood anatomy as a starting point for dendroarchaeological research: case studies from Greece

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Keywords: tree species identification, wood anatomy, tree-rings, dendroarchaeology, historic timber, Greece

Dendrochronology is the scientific method that uses tree-rings for dating past events. One of its possible applications is dendroarchaeology, in which tree-rings are used to study and date historical and archaeological wood from various contexts and functions. As the most accurate dating method, dendroarchaeology is used to determine the exact time when timber was felled, transported, processed, and used for construction.

A crucial piece of information for applying dendrochronological analysis to historical wood is an accurate identification of the tree species the object is made from. This information guides the selection of appropriate reference tree-ring chronologies of the same species or other species with similar growth responses to environmental conditions, which allows the object to be successfully cross-dated and absolutely dated. The identification of tree species also gives insights about the possible timber origin.

The basic information on tree species can be obtained during macroscopic observation of the cross section of historical wood. Precise identification, however, can only be made from anatomical studies requiring microscopic observation of cross, tangential and radial sections.

Within the framework of the Balkan-Aegean Dendrochronology Project: «Tree-Ring Research for the Study of SE-European and East Mediterranean Civilizations» we have collected and examined samples from numerous sites in the Balkans and the Aegean region.

In Greece, we analyzed objects made of different species: Bosnian pine (*Pinus heldreichii*) and Black pine (*Pinus nigra*) from Epirus; Brutia pine (*Pinus brutia*), cedar (*Cedrus libani*) and fir (*Abies alba*) from Symi island; juniper (*Juniperus* sp.) and olive (*Olea europea* L.) from Sikinos island; cypress (*Cupressus sempervirens*) from Crete, and deciduous oaks (*Quercus* spp.) from several sites in mainland and the islands, suggesting the use of both local and imported timber. The objects under study include historical buildings, doors, barrels, icons and archaeological charcoals.

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The morphogenesis of epidermal cells in *Sargassum* sp. blades: wavy anticlinal cell contours in brown algae

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Keywords: brown algae, cell morphogenesis, epidermal cell, F-actin, *Sargassum*

Waviness of anticlinal epidermal cell walls is widespread among land tracheophytes. Organization of cortical microtubules in bundles and radial systems, under anticlinal and periclinal walls of growing epidermal cells, respectively, imposes a local cell wall reinforcement by thickenings, the cellulose microfibrils of which are responsible for selective wall expansion that results in cell waviness. Besides cellulose microfibrils, the differential distribution of several pectin epitopes also contributes to the above mechanism.

Apart from tracheophytes, this feature has not been recorded yet in any algal species. Here, we report for the first time the presence of wavy anticlinal cell walls in blade epidermal cells of the brown alga *Sargassum* sp. Light and transmission electron microscopy observations revealed that this wavy pattern is restricted close to the external periclinal wall, while, at inner levels, the anticlinal walls become straight and uniformly thick. At the level of the external periclinal cell wall, local thickenings were found, interconnected as a unified pattern of cell wall reinforcement, allowing cell growth only in the areas between them. The resulting morphology of epidermal cells is closely similar to that found in several tracheophytes.

Since brown algae lack cortical microtubules, cellulose microfibril orientation is considered to be controlled by cortical F-actin cytoskeleton. Accordingly, F-actin organization was studied in *Sargassum* sp. blades by fluorescent phalloidin staining and imaging with confocal laser scanning microscopy. Observations revealed a reticulum of F-actin bundles coincident to the pattern of wall reinforcement at the external periclinal epidermal surface and adjacent anticlinal wall areas.

Our findings suggest that anticlinal epidermal cell wall waviness should not be considered as a feature that originated and evolved exclusively in tracheophytes. The analogy of cell wall patterning mechanisms, F-actin-dependent in brown algae *vs* microtubule-dependent in tracheophytes, is also underlined.

Integrated genetic diversity, transcriptome and volatile metabolic profile of *Origanum vulgare* subsp. *hirtum* wild populations

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Keywords: oregano, genetic diversity, molecular markers, genetic structure, transcriptome, GC-MS/FID analysis, terpenoids, carvacrol.

Oregano is a commonly used culinary aromatic herb, recognized for its essential oils' medicinal properties, and antimicrobial activity. Greece is a hot spot of species diversity including oregano, with a vast plethora of species and chemotypes. Conservation of species' diversity and genetic resources entails for thorough assessment of genetic diversity and metabolomic profiling. A germplasm collection of *Origanum vulgare* subsp. *hirtum* wild populations originated from Andros Island was used to assess morphological descriptors along with genetic diversity applying a set of specific molecular markers. The morphological characterization was conducted at the full flowering stage and revealed significant variation regarding plant height, number of nodes, internodal distance, leaf width and flower color traits.

Genetic analysis of the germplasm collection was employed using 18 polymorphic markers, revealed the presence of 100 alleles, with a PIC value ranging from 0.2 to 0.8. UPGMA analysis separated the populations in three distinct clusters, distinguishing two populations from the rest, with no apparent correlation to the collection site according to statistical analysis.

Furthermore to assess the volatile metabolic profile, a GS-MS/FID analysis was employed on terpenoids extracted from flowers derived from single plant from each population. Sixteen terpenoids was assessed in all samples. Principal component analysis of metabolomic fingerprinting clustered together all populations from Andros island and biplot analysis indicated the influence of each terpenoid compound on the distribution of the populations on the plot. All populations were classified as carvacrol chemotypes, due to the exceptionally high levels. Additionally, expression analysis of genes implicated in the terpenoid biosynthesis pathway using RT-PCR method, and heatmap analysis and dendrogram correlated the transcriptome profile to the terpenoid metabolites.

In conclusion results are discussed towards the development of a core collection representing both the genetic and metabolite diversity of natural populations to foster conservation and sustainable utilization of genetic resources.

Late glacial- Holocene vegetation and climate development in Mount Grammos (GR1320002, NW Greece) inferred from pollen and *Pediastrum* assemblages

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Keywords: Late Glacial, Holocene, Fagus, Abies, Quercus, Pediastrum

A core recovered from an ephemeral pond at an altitude of 1820 m a.s.l. offers new insights in the vegetation development of NW Greece as previous works recovered data from mid-altitude sites.

The pollen diagram covers a period of about 16 Ka BP spanning from Late Glacial to late Holocene. Climatic temperature/precipitation oscillations of Late Glacial are traced by excursions of *Pinus* pollen curve and to a lesser degree by fluctuations of *Quercus* and *Abies* pollen curves. Throughout the Late Glacial *Fagus* shows a continuous presence reaching values of 2%, and the same holds for elements of mixed deciduous woodlands like *Tilia*, *Fraxinus*, *Acer* and *Ostrya* with the latter two being the most prominent constituents. A possible formation of Tilio- Acerion could be inferred by the pollen values of *Acer* and *Tilia*.

Onset of Early Holocene is characterised by rapid expansion of mixed oak woodlands culminating at the middle of the period. At the same period conifer woodlands and especially *Abies* expand with the latter species forming the forest limits.

The expansion of *Fagus*, starting at around 5500 Ka BP, is the most significant event of the Middle-Late Holocene period. *Fagus* replaces *Abies* and forms the forest limits which surround the pond. The expansion of *Fagus* is favoured by climatic conditions which become humid as indicated by the rise of pollen of hygrophilous vegetation (e.g. Cyperaceae, *Ranunculus*, *Platanus*, *Alnus*)

Two *Pediastrum* assemblages were recorded at distinct time intervals respectively. The first (*Pediastrum orientale, P. integrum, P. boryanum var. boryanum, var. forcipatum, var. longicorne, var. brevicorne*) is indicative of the cold conditions during Late Glacial while the second one indicates the warm humid (*P. integrum, P. boryanum var. boryanum, var. forcipatum, var. longicorne, var. brevicorne, var. comutum, P. angulosum, και P. duplex var. duplex*) conditions on the onset of Middle Holocene.

Vegetation variability through successive Quaternary climatic cycles in a typical Mediterranean setting (Corinth Gulf, Greece)

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Keywords: vegetation history, glacial-interglacial cycles, relict species, Corinth Gulf

The vegetation response to the successive Quaternary climatic cycles has long been the interest of the scientific community as it contributes to the better understanding of current climate change and the impact on terrestrial ecosystems. A growing number of long continuous pollen evidence from various sites across the Mediterranean region feature the general trend of alternating forested/open landscape intervals in response to interglacial/glacial cycles and reveal the high complexity of the Quaternary vegetation development in response to latitudinal and longitudinal variability, as well as local conditions.

The study of a newly recovered pollen record from the Corinth Gulf (central Greece) during the International Ocean Discovery Program Exp. 381 aims to investigate the unique shifts in vegetation composition and succession of Mediterranean species in the southernmost tip of the Balkan peninsula at a millennial scale since the Middle Pleistocene. The high terrestrial pollen concentration during Interglacial intervals, as well as the low concentration during the Glacial ones, shows increase, or decrease respectively, in plant biomass and vegetation cover following the typical pattern observed in most southern Europe records. However, the glacial intervals retain surprisingly high percentages of both mesophilous and Mediterranean vegetation components, that has not been previously reported. Moreover, the Corinth record retain is the occurrence of several Neogene relict tree taxa implying their presence within the catchment until the Late Pleistocene. These findings confirm the refugial character of the Corinth Gulf area and allow comparison with other regional reference sites in the Balkan, Italian and Iberic Peninsulas.

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Topoclimatic observations regarding conservation of climate microrefugia in the Opuvani do doline, maritime Mediterranean Dinarides of Montenegro

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Keywords: microclimate, microrefugia, doline, cold-air pool, climate change, Dinarides

Naturally occurring refugia in topography-controlled cold-air pools (CAPs) are increasingly discussed for their potential to buffer some impacts of global warming. For this purpose, we assessed air temperatures in a recently detected doline refugia on Mt Orjen (Opuvani do, 1580 m, Csbx" – maritime mediterranean climate, SE-Dinarides, Montenegro) and compared them to decadal observations of the station with the lowest mean annual temperature (MAT) in Montenegro (Žabljak, 1450 m, Dfs"bx" – sub-continental boreal climate, MAT 2011-2020: 6,4°C).

We observed 15 days with frost in summer 2021 (Tmin: June -6.3°C, July -1.8°C, August -2.3°C). At Žabljak summer decades were frost free. In the sinkhole averaged mean summer quarter temperature in 2021 was 13,3°C, decadal average at Žabljak is 15,5°C. In the sinkhole averaged autumn quarter temperature in 2021 was 4,2°C, at Žabljak the decadal average is 7,3°C. In December 2020 the sinkhole had an average temperature of -2,3°C, in Žabljak decadal December average is -1,7°C. The sinkhole saw an absolute minimum temperature in January of -29,2°C, the decadal minimum at Žabljak is -23,9°C. Snow cover extended 2021 to 182 days with the last snowmelt on June 15th.

Our observations confirm that thermal conditions in topography-controlled CAPs facilitate habitat selection by frost-hardy (glacial) biota. Examined snow-bed and shrub heath communities in the climate microrefugia are composed of resilient and isolated cold-adapted arctic-alpine (*Dryas octopetala*, *Oxytropis dinarica*), alpine (*Salix retusa*, *Heliosperma pusillum*, *Plantago atrata, Viola zoysii*), Dinaric-Apennine (*Crepis aurea* ssp. *glabrescens*, *Scabiosa silenifolia*), Eurosiberian (*Allium schoenoprasum*, *Coeloglossum viride*, *Androsace villosa*), European-W-Asian (*Leontodon hispidus*) and SE-European taxa (*Saxifraga federici-augustii*, *Edraianthus serpyllifolius*).

In conclusion, CAPs offer suitable topoclimatic conservation areas for climate change resilient conservation. They buffer arctic-alpine plants and alpine organisms in cold microhabitats through cold-adaptive selection sieves, which are particularly important influence on edaphic indicators of frost action and snow cover microrelief variation.

Bisphenol A toxicity on plants: an overview

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Keywords: auxin transporters; F-actin; growth defects; microtubules; oxidative stress

Bisphenol A (2,2-bis(4-hydroxyphenyl)propane; BPA) is a chemical stabilizer used in the industrial manufacture of plastic materials. Upon plastic aging, BPA may leach to the environment inducing estrogenic, cytotoxic and genotoxic effects, raising concerns for human and wildlife health. While extensive research has been conducted about BPA effects on humans/animals, scientific data regarding the toxic effects of BPA on plants have been accumulating only in recent years.

Although plants can absorb and metabolize BPA, at the same time BPA may negatively affect their cellular/physiological status. During almost 10 years of research we have shown that experimentally applied BPA (at concentrations ranging at mg/L) decreased the growth of many important crops, such as pea and maize, and also of non-crop plants, such as the cephalonian fir and the model plant *Arabidopsis thaliana*. Interestingly, growth reduction has been found to occur also after application of environmentally relevant concentrations (μg/L) on both land plants and seagrasses. The observed BPA-derived growth defects have been linked to cytoskeletal derangement, auxin transfer imbalance, deterioration of the photosynthetic machinery, ROS production or triggering of the enzymatic/non enzymatic antioxidant machinery. In particular, both actin filaments and microtubules were prime subcellular targets, while all major organelles (mitochondria, plastids, Golgi) were variously affected. Also a spatiotemporal heterogeneity in the quantum yields of light energy partitioning at PSII on leaves treated with BPA was linked with temporal ROS increase, triggering phenolic substance accumulation and ROS scavenging enzyme activity.

It could therefore be concluded that BPA effects in plants are pleiotropic. However, experimental evidence showed that the BPA-derived ROS overproduction is a key factor of toxicity, not only causing oxidative damage, but also triggering retrograde signaling that offers tolerance against toxic BPA effects.

Hyperaccumulator plant species from the Balkan Peninsula

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Keywords: accumulation, heavy metals, nickel, Brassicaceae, Violaceae, Asteraceae

Hyperaccumulator plant species are those that can successfully grow and develop in metalliferous habitats and accumulate heavy metals in their above-ground tissues at concentrations up to 1000 fold higher than those observed in non-hyperaccumulator species. Although the distribution centres of hyperaccumulator plants are in the tropics, a significant number of species have been found in the Balkan Peninsula. Due to the size and abundance of ultramafic areas, which are the largest in Europe, the Balkan Peninsula is a significant source of metalliferous habitats suitable for hyperaccumulator species. To date, 36 taxa with the ability to hyperaccumulate one or more elements have been observed in this area. The largest number of taxa belongs to the family Brassicaceae (72.2%), especially to the genus *Odontarrhena* (13 taxa) and slightly less to the genera *Noccaea* (9 taxa) and *Bornmuellera* (4 taxa). Hyperaccumulation was also observed in 5 taxa of the genus *Viola*, predominantly inhabiting As-Sb-Tl-Au deposit in North Macedonia. Because of the dominance of ultramafics, rich in Fe, Mg, Ni, Cr, Co, nickel is the element that most frequently accumulates at concentrations above the notional hyperaccumulation threshold (with 29 taxa). In *Noccaea kovatsii* and *N. ochroleuca*, Ni is hyperaccumulated together with Zn or Pb. Multiple hyperaccumulation (As and Tl) is also observed in *Viola arsenica*, while the other three species of this genus take up Tl above the hyperaccumulation threshold. Hyperaccumulation of Ni has also been observed in *Centaurea thracica* (Asteraceae), with more than 1% Ni in leaves, making this species one of the very few hypernickelophores outside the Brassicaceae in temperate climates. To date, *Minuartia recurva* has been shown to be the only Cu hyperaccumulator in the study area. The hyperaccumulation of heavy metals is discussed in terms of the phylogenetic relationship of the hyperaccumulating plant species and their distribution.

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Bioaccumulation of potentially toxic elements in *Noccaea kovatsii* and *N. praecox* (Brassicaceae) from different geological substrates and their physiological responses to Ni

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Keywords: hyperaccumulation, heavy metals, ultramafics, metalophytes, Balkan Peninsula

Besides *Noccaea praecox* which is one of the well-known model systems in the studies of PTE accumulation and tolerance, high metal concentrations have also been observed in *N. kovatsii*. The potential of these two pseudometallophytes to hyperaccumulate PTE was studied at 29 ultramafic and non-ultramafic sites in the Balkan Peninsula. Their physiological responses to elevated concentratons of Ni were also studied. Selected populations of both species were exposed to a Ni gradient in the substrate (1000, 2000 i 4000 mg kg^{-1}) for 3 months under controlled conditions. Ni concentrations in plant tissues, biomass yield, concentrations of photosynthetic pigments, anthocyanins, proline, and phenolic compounds, as well as intensity of lipid peroxidation in response to Ni were analyzed.

Nickel hyperaccumulation was observed in all ultramafic accessions of both species, with the highest detected concentration of 11100 mg kg^{-1} in shoot samples of *N. praecox* from Mt. Tara. The accession of *N. kovatsii* from schist soil on Mt Kopaonik hyperaccumulated Zn (4920 mg kg^{-1}), with pronounced Cd accumulation as well. When *N. kovatsii* and *N. praecox* were exposed to the Ni concentration gradient, different levels of tolerance to Ni were observed in the studied populations of both species. The ultramafic populations of both species showed the highest level of tolerance. General patterns of physiological responses of populations with different level of Ni tolerance were observed, which is manifested through differences in plant biomass, accumulation of anthocyanins, proline and malondialdehyde. Constitutive differences in the content of analyzed phenolic compounds between populations with different degrees of Ni tolerance were not detected.

Despite the different degree of tolerance to Ni, hyperaccumulation of Ni was observed in all populations of the two cultivated species at all applied Ni concentrations in the substrate.

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New insights into the effects of cyanobacterial bioactive compounds on plant cells: an overview

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Keywords: *Arabidopsis thaliana*, cell wall, cyanobacteria, cytoskeleton, microcystins, *Oryza sativa*, stomata

Cyanobacteria produce a variety of secondary metabolites, which are widely studied for their bioactivity against other organisms. A group of well-established toxins (called cyanotoxins), such as microcystins (MCs), and their effects on plants, are of particular interest, as MCs are accessible to crops (e.g. through irrigation) and further affect yield productivity and consumer health. However, data regarding alterations induced by MCs, or other cyanobacterial bioactive compounds, at the cellular level of plants are still limited and, therefore, further investigation is needed.

Plant microtubules are already known to be severely affected by MCs. Using confocal laser scanning microscopy (CLSM) and transmission electron microscopy (TEM), major F-actin alterations were also shown to be induced in *Oryza sativa* (rice) root cells after treatment with either pure MC-LR or an aqueous cyanobacterial extract containing MCs, along with endoplasmic reticulum aggregations and problems in cell cycle progression. Interestingly, when treated with extracts from specific non-cyanotoxin-producing cyanobacterial strains, rice root cells also exhibited cytoskeletal disturbances. The bioactivity of these extracts was confirmed by standard enzymatic activity assays, suggesting that, apart from the known cyanotoxins, also other cyanobacterial compounds could target the plant cytoskeleton. Since microtubules were affected, plant cell wall composition in treated roots was expected to be altered. Intense presence of glucans and changes in pectin methyl-esterification patterns were observed, a finding also supported by altered pectin methylesterase activity. Apart from the roots, MC-LR was also found to affect stomatal ontogenesis and development in *Zea mays* leaves. In addition, new findings regarding the effects of cyanobacterial volatile organic compounds on root development in *Arabidopsis thaliana* were reported.

Our results highlight novel targets of MC toxicity, as well as cyanobacterial bioactive compounds not previously studied for bioactivity against plant cells.

Secondary metabolites production of in vitro root liquid cultures of *Primula veris* subsp. *veris*

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Keywords: *in vitro*, bioreactor, flanonoid glycosides, *Primula veris*, primulic acid I, primulic acid II, medicinal aromatic plants

Primula veris subsp. *veris* family Primulaceae, is a perennial medicinal plant that grows mainly in meadows at high altitude and its populations are often exploited predatorily. Its roots are rich in triterpenoid saponins, phenolic glycosides and flavonoids and their extracts are used in the treatment of diseases of the upper respiratory system and for the preparation of vitamin C concentrates.

The effect of temperature (10, 15, 22 °C) in combination with L-proline (100 mg/L) on biomass root production *in vitro* was studied. The highest temperature of 22 °C yielded the highest biomass production exhibiting a 4.8-fold increase compared to 15 °C and 10 °C.

The addition of four L-proline concentrations (0, 100, 250, 500 mg/L) as an abiotic elicitor at 22 °C on biomass and secondary metabolites' production was also recorded. Root segments, obtained of rooted plantlets *in vitro* and cultivated in liquid culture for 60 days in L-proline-free medium (rotary shaker 120 rpm, dark, 22 °C), were used as explants. The liquid medium used was MS supplemented with 5 μM NAA + 0.5 μM kinetin + 30 g/L sucrose + four L-proline concentrations. After 60 days of culture, the media containing L-proline resulted in approximately 5-fold increase of root biomass, without statistically differences between the concentrations, while the respective control gave a 3-fold increase. Total saponins content in combination with dry biomass production reached the maximum value of 183.4 mg oleanolic acid, 37.2 mg primulic acid I and 8.2 mg primulic acid II, while for flavonoids 47.0 mg primulaverin, 97.4 mg primeverin, under 100 mg/L L-proline. Total phenols content was also increased. All root cultures *in vitro* contained higher amounts of flavonoid glycosides (primulaverin, primeverin) and species-specific saponins (primulic acid I and primulic acid II) (2.4-3.3 mg/g DW) than the roots of plants grown in soil.

Dimitrios Zaganiaris and his legacy in Thessaloniki Aristotle University (TAU) Herbarium

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Keywords: Dimitrios Zaganiaris, TAU Herbarium, historical collections

Dimitrios Zaganiaris (1901-1940) was a renowned botanist, who highly contributed in the study of the Greek Flora. However, almost nothing was known for his life and work. After four years of research in several archives his full ergobiography is presented for the first time.

Regarding his collections, an unknown number of specimens has been destroyed during WWII, while the remaining material is kept only in TAU. In recent years 3,556 of his specimens, have been retrieved, nomenclaturally updated and georeferenced, while their annotation is in progress. His collections are divided into three subgroups (a) Herbarium Macedonicum comprised of 1,844 specimens from northern Greece and collected between 1936 and 1939 (b) Herbarium Laconicum consisting of 258 specimens collected from Laconia in 1932 and (c) The rest of his collections are labeled either as "Herbarium D. Zaganiaris", or as "Herbarium Universitae Thessalonicae" and include 1,454 specimens, either duplicata of his own collections, or specimens from various other parts of Greece collected by other collectors, mostly by B. Tuntas.

The annotation of Zaganiaris' specimens proved to be quite the challenge, since data on the specimens' labels are often lacking. Nevertheless, with our to-date work we have managed to fill in the missing data in many labels. Thus, around 1,570 taxa (1,370 from Herbarium Macedonicum and 200 from Herbarium Laconicum) can now be used as substantiating material for the taxa appearing in Zaganiaris' publications.

Upon completement of the annotation process, a checklist of Zaganiaris' collections will be uploaded to a database satisfying biodiversity information management requirements, thus making these valuable data about the Greek phytodiversity FAIR (Findable, Accessible, Interoperable, Reusable).

A peek into the private life of a rare endemic: initial results of a pollination study on *Crocus balansae* J.Gay ex Maw

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Keywords: pollination, conservation, reproduction, rare species, *Crocus*

Crocus balansae J. Gay is a stunning yellow crocus that exhibits wide variation in terms of perianth segment pattern. This species has a very limited distribution in Turkey, where it is found only around the provinces of Izmir and Manisa. It is among the most threatened crocus taxa because of anthropogenic pressure on its few populations, especially at the type locality. Furthermore, two of the three populations that we visited were found to be not *C. balansae*, but other closely related species. This preliminary field work shows that the distribution of this species may be much more limited than is currently known.

We observed the population at its type locality, Spil Mountain (Manisa), between 05-10 April 2022 on sunny or partly cloudy days. Two observation sessions were planned; one being in the morning (09:00 to 12:00) and other in the afternoon (13:00 to 16:00). The pollinators were collected in falcon tubes, pinned and dried for further identification. Results indicate that neither the genus nor number of visitors differ according to time of day. Three dominant pollinator genera visited *C. balansae*: *Andrena*, *Osmia* and *Anthophora*. The bees observed to spend the most time inside the flowers belonged to the genus *Andrena*. To our knowledge this is the first systemic study on pollinators in the genus *Crocus* and will serve as a stepping stone for further such work to be carried out in the future.

Diversification of different species of *Euphorbia* subgen. *Esula* (Euphorbiaceae) from the Balkan Peninsula

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Keywords: biogeography, endemic species, phylogenetic analyses, taxonomy

Euphorbia is one of the largest genera of flowering plants including more than 2150 species. Most species in Europe belong to *Euphorbia* subgen. *Esula* Pers., which is sister to three other subgenera. It comprises roughly 480 species and represents the most significant radiation of the genus in temperate areas of the Old World. Also the Balkan Peninsula, a hotspot of European biodiversity, is with 70 species one of *Euphorbia*-richest regions of Europe. I will present the outcomes of past and ongoing studies on diversification of different *Euphorbia* species from the Balkan Peninsula, based on DNA sequencing, including next generation RAD sequencing, AFLP fingerprinting, relative genome size measurements, chromosome number estimations and morphological analyses. More specifically, the diversification and evolution of *Euphorbia carniolica* and *E. epithymoides*, as well as a Greek narrow endemic *E. orphanidis* will be presented.

Festuca varia complex under the scope: multigene phylogeny of fine-leaved Loliinae with focus on *F. bosniaca*

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Keywords: phylogeny, *Festuca varia*, *Festuca bosniaca*

Festuca L. represents one of the largest known paraphyletic genera systematically anchored in subtribe Loliinae whose distribution has been proven globally. In this study, we focused on *F. varia* complex within fine-leaved fescues and with emphasis on *F. bosniaca* populations, in order to provide insights into its diversification according to ploidy level and geographical affiliation. We sampled a total of 612 individuals divided in 169 populations from various locations in north-western and south-eastern Balkan Peninsula, Apennines and the Alps and complemented with samples from 135 herbarium vouchers. Nuclear ITS and two plastid *trn*T-*trn*L and *trn*L-*trn*F regions were sequenced and phylogenetically analysed. The inferred phylogenies support the placement of *F. varia* complex in basal position within fine-leaved fescues and reveal several supported groups within the complex. *Festuca bosniaca* populations are divided into five major lineages showing a geographical pattern. Two established lineages largely correspond to the *F. bosniaca* subsp. *bosniaca*, and *F. bosniaca* subsp. *pirinensis*, while the other three require additional research. The relationships of different taxa in the complex remain, however, uncertain due to incongruences between nuclear and plastid trees. This study contributes to knowledge on *F. varia* complex and indicates that at this level the traditional morphologically based taxonomy is of limited use for recognizing and defining monophyletic groups.

Phylogeographic patterns in *Aurina saxatilis* (Brassicaceae) revealed with genomic RADseq data

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Keywords: *Aurinia saxatilis,* demographic modelling, glacial refugia, *ndhF,* RAD sequencing, species distribution modelling

Aurinia is an exclusively diploid genus comprising of seven species with the centre of origin and diversity in south-eastern Europe. *Aurinia saxatilis* is the most widely distributed species ranging from the central, eastern and southern Balkan Peninsula and adjacent shores of the western Asia Minor and the southern Apennine Peninsula, over the Carpathians to central Europe and growing on rocky grounds and dry soils. Due to its morphological variability it has been divided into three subspecies: typical *A. saxatilis* subsp. *saxatilis* is widespread in central and south-eastern Europe, subsp. *orientalis* is distributed in the Balkan Peninsula, the southern Carpathians and the western Anatolia, whereas subsp. *megalocarpa* is limited to the southern Apennine Peninsula and the Aegean region. The aim of this study was to provide insights into spatiotemporal diversification of the species by exploring its evolutionary dynamics and phylogeographic patterns using a combination of phylogenomic (RADseq), and phylogenetic (plastid *ndhF*) data as well as species distribution models. The inferred phylogenies retrieved three main geographically distinct lineages. The southern lineage is distributed throughout the Aegean area, southern Balkan Peninsula and southern Apennine Peninsula, and corresponds to the species main distribution area during the LGM. The eastern lineage extends from the eastern Balkan Peninsula over the Carpathians towards central Europe, while the central lineage occupies the central Balkan Peninsula. Molecular dating places diversification of all three lineages into the early to middle Pleistocene, indicating their long term independent evolutionary trajectories. Moreover, our data suggest an early divergence and stable in situ persistence of the southernmost populations, whereas the central Balkan and Carpathian populations experienced more complex range dynamics triggered by Pleistocene climatic oscillations. Finally, the extant genetic variation is congruent with the taxonomic separation of subsp. *saxatilis* and subsp. *orientalis*, whereas the taxonomic value of subsp. *megalocarpa* remains doubtful.

Complex pattern of morphological and genome size variation in *Dianthus sylvestris* Wulfen s.l. (Caryophyllaceae)

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Keywords: Balkan Peninsula, morphometrics, environmental niche, flow cytometry

Dianthus sylvestris includes ten subspecies, whose delimitation is challenging and taxonomically inconsistent. Its main diversity centres are the Balkan and the Apennine Peninsulas where the taxa grow in various habitats from the Mediterranean coast to the alpine belt. This study is focused on the Balkan populations where six subspecies occur. In total 162 populations were sampled across the Balkans: 97 were included in detailed morphometric analyses, for 162, including 28 populations from the Alps, relative genome size (RGS) analysed was estimated using flow cytometry, while all Balkan populations were used in the environmental niche analyses. The integrated results of these analyses represent a first step toward the revised taxonomic treatment for *D. sylvestris* on the Balkan Peninsula. The results reveal that morphological variation gradually changes with environment and geography and does not correspond to described subspecies. The results suggest two morphologically distinct entities, the north-western and the south-eastern groups of populations, distinct by the shape of epicalyx scales, calyx length and petal denticulation. The quantitative assessment of niche overlap, equivalency and similarity of *D. sylvestris* subspecies indicated, that niche similarity was more common than niche divergence. Longitude was a major geographic predictor associated with morphological variability, where the changes in cauline leaf length and shape of epicalyx scales reflected a gradual transition from the coastal Mediterranean to the alpine environment. RGS analyses revealed that the majority of populations is diploid ($2n=2x=30$), but also spatially restricted occurrence of tetraploid populations ($2n=4x=60$) disclosed polyploidization in the NW Balkans. The tetraploid populations are morphologically similar to their diploid counterparts occurring in the same area indicating their autopolyploid origin. The populations at the southern distribution margin in the Balkan Peninsula, as well as those in the central and western parts of the Alps, exhibit higher RGS, likely corresponding to discrete evolutionary lineages.

Unravelling patterns of genomic variation of *Dianthus sylvestris* Wulfen s.l. in the Balkan Peninsula

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Keywords: Balkan Peninsula, genetic structure, gene flow, phylogeography, habitat suitability

Contemporary patterns of genomic variation in plant species often reflect past demographic processes linked to climate events such as Pleistocene glaciations. *Dianthus sylvestris* s.l. comprises a number of taxa distributed across southern and south-eastern Europe. We here used RAD-seq SNP data to unravel genomic variation in 165 populations, including all six currently described subspecies occurring in the Balkan Peninsula. Population genetic structure using Bayesian clustering revealed a north-western (NW) and south-eastern (SE) group, while an alternative model-free approach identified five genetic groups. We detected significant isolation by distance (IBD) within our populations, though with a visible discontinuity, and additional genetic connectivity analyses confirmed a sharp break between the two main groups of populations from NW and SE, suggesting that these groups derive from separate evolutionary lineages. Migration analyses revealed highest rates of gene flow between two subgroups of the NW cluster, while lower rates of gene flow were inferred between three subgroups of the SE cluster. The SE group showed higher inbreeding values compared to the NW group. Species distribution modelling (SDM) pointed to suitable habitats during the last glacial maximum (LGM) along the whole eastern Adriatic coast with higher suitability predicted in the south of the Balkans compared to the north. Overall, patterns of genomic variation and SDM suggest that *D. sylvestris* in the Balkans survived the Pleistocene glaciations in two separate glacial refugia located along the eastern Adriatic coast, with secondary contact of the two lineages in the area of Montenegro where admixed populations occur.

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Poster Presentations

P01. Chemical characterization of traditional sweet chestnut and hybrid varieties

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Keywords: chestnuts, traditional varieties, hybrid varieties, chemical composition, nutritional value

The chemical composition of the kernel was studied in four traditional sweet chestnut and hybrid varieties produced on private estates in the Lovran surroundings, on the eastern slopes of Mount Učka, under the specific conditions of the sub-Mediterranean climate. The samples were analyzed for proximate constituents (moisture, crude fat, crude protein, ash and total carbohydrates), and macro- and micro-nutrients (K, Mg, Ca, Na, Mn, Fe, Zn and Cu). The studied traditional and hybrid varieties differed in the mass fraction of moisture, crude fat, crude protein, ash, total carbohydrates, K, Mg, Na, Mn, Fe and Cu. In addition, six out of 13 chemical traits were found to be significant among traditional sweet chestnut varieties, and seven out of 13 among hybrid varieties. In general, chestnuts of hybrid varieties were characterized by higher moisture, crude protein, potassium, magnesium, sodium, iron and copper contents than those of traditional sweet chestnut varieties. On the other hand, nuts of traditional sweet chestnut varieties were richer in total carbohydrates and crude fat. Overall, our results suggest that due to the aforementioned differences, these two groups of chestnut varieties have different practical applications.

P02. Influence of forest management systems on the morphological and chemical variation of wild sweet chestnut (*Castanea sativa* Mill.) populations

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Keywords: population diversity; population structure; morphometric analysis; chemical analysis; forest management; silviculture

In this study, morphometric methods and chemical analyses were used to quantify the extent of differences in phenotypic and nutritional traits between sweet chestnut (*Castanea sativa* Mill., Fagaceae) populations from different environmental conditions, where different management types are applied, high-forest and coppice. I order to do that, we collected samples from 160 trees originating from eight natural populations stretching from the Prealps in Italy to the western part of Bosnia and Herzegovina. In total, 31 nut and kernel morphometric and nutritional traits were studied, and various multivariate statistical analyses were used to study intra- and interpopulation variations. Both analyses, morphometric and chemical, revealed a similar pattern of diversity, with morphological and chemical variability not associated with geographic or environmental variables. Moreover, differences in morphological and chemical nut traits evaluated here corresponded mainly to management practices. Extensively managed coppice populations on average resulted in smaller nuts with higher water and magnesium (Mg) content. In contrast, high-forest stands grown from seeds were characterized by larger nuts with lower water and Mg content. However, it was noteworthy that the type of management did not affect the morphological and chemical nut diversity of the coppice populations and that they remained similar to those of the high-forest stands. Finally, we concluded that the differences between coppice and high-forest populations are due to several factors, including habitat changes resulting from the forms and intensities of management practices, physiological processes related to stem growth, and genetic diversity.

P03. New data on the genetic resources of *Ulmus* species in Bulgaria

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Keywords: Elm species, genetic diversity, conservation

Full inventory of the genetic resources of the Elm species (genus *Ulmus*) in Bulgaria was performed. New data on the distribution of *Ulmus* species in Bulgaria are presented, together with preliminary results of a study on their genetic diversity. New localities are reported for *Ulmus laevis* and *U. glabra* in six floristic regions of Bulgaria. Inaccuracies were detected in some forest management plans, where *U. minor* was erroneously considered as *U. laevis*. The most represented was the most tolerant species *U. minor*, while the other two species were shown to have more specific requirements to the environmental conditions and occupied smaller area. Allozyme gene markers were applied as a first step to characterize the genetic diversity of the species. All *Ulmus* species were characterized by high level of genetic diversity and several markers clearly distinguished the studied species. The results of the study could be useful for gene conservation purposes and for sustainable use of the genetic resources of *Ulmus* species.

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P04. The effect of the engagement with the cultivation of vegetables on the cognitive and psychomotor development of the students of the school of Special Vocational Education and Training (E.E.E.EK.) of Thira

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Keywords: students with special educational needs, autism, mental retardation, school garden, cognitive and psychomotor development, environmental education

The Special Laboratory of Vocational Education (E.E.E.EK.) of Thira is a school unit of secondary education, covering the compulsory element of secondary education and was founded in 2017. Students are taught both General Education courses (Modern Language, Mathematics, Gymnastics, etc.), as well as the Specialized Laboratory course of Agriculture-Food & Environment. In the context of the laboratory course we examined the effect of students' involvement with the vegetable cultivation on their cognitive and psychomotor development.

The research conducted, involved all school children [5 boys (aged 15-22) and 4 girls (aged 14-16)]. The specific students, according to the official opinion of the Educational and Counseling Centre of students with special educational needs and disabilities (KE.DA.SY.) of Syros, are located either in the autism spectrum, or present mental retardation. In September 2021, the students with the assistance of the teaching staff removed from the ground foreign plant residues, materials and weeds. Then they incorporated a peat substrate to improve the soil quality and installed an irrigation system. Finally, the following species were planted: lettuce, broccoli, cabbage, cauliflower and onion. About two months after their planting and the necessary cultivation work/care (fertilization, weeding, earthing, etc.), the students first harvested the lettuce plants and then the rest of the plant species.

The majority of students were able to identify these vegetables, while acquiring important knowledge about the cultivation management and care needed for their development. Throughout the cultivation of vegetables, the students' interest remained undiminished and on the one hand, positive emotions were recorded while on the other hand, there was an improvement in their motor skills. In conclusion, the involvement of students with special educational needs in the cultivation of vegetables had a positive effect on their cognitive and psychomotor development, while their already positive attitude towards the environment was further reinforced.

P05. Balkan Botanic Garden Kroussia, Greece: applied research and sustainable exploitation of Greek flora

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Keywords: botanic garden, aromatic/medicinal plants, conservation, endemic species, protection

The Balkan Botanic Garden of Kroussia (BBGK) was founded in 2001 and is located in two different areas, in the campus of the Institute of Plant Breeding and Genetic Resources in Thermi Thessaloniki and next to the village of Pontokerasia in the municipality of Kilkis. It is one of the youngest botanical gardens in Europe with rich flora that includes 1,072 native species of Balkan flora. Furthermore it is a member of the Botanic Gardens Conservation International (BGCI). The objectives of BBGK are preservation and conservation of valuable phytogenetic resources, the evaluation of selected clones, the production of high quality propagating material and their introduction in cultivation.

The research conducted in BBGK is multifaceted and is focused on the protection of endemic plant species and their sustainable exploitation. Species like *Helichrysum amorginum* L. and the wild roses (*Rosa canina* L.) are used for the production of high added value - cosmetic products. Some of the research subjects are harmonized with the principles of circular economy for the utilization of plant material residues. An example is the research for the production of high protein feeds - with insects produced in enriched plant residues substrates with Greek medicinal/aromatic plants. Advanced biotechnological techniques are also applied for the production of secondary metabolites *in vitro* from endemic plants. Traditional local varieties and small forest fruits are -subject of evaluation and utilization on a pilot basis.

P06. Occurrence verification of some plant species through TAUs' historical collections

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Keywords: TAU Herbarium, historic collection, D. Zaganiaris, occurrence, North Greece

The TAU Herbarium (Thessaloniki, Greece) dates to the early 1930s and holds more than 70,000 plant specimens mainly from Greece. Most of TAU's historical collections, all of which are consisted of c. 6,000 specimens, are represented by D. Zaganiaris' specimens and comprise a valuable source of taxonomic and phytodiversity data. These rare specimens are likely located only in TAU and until recently no data on their location was reported, hence several taxa are not included in the recent checklist of the Hellenic Flora. This work is part of a broader research effort regarding the study of Greek phytodiversity through the Zaganiaris' historical collections in the TAU Herbarium and the dissemination of the resulting knowledge. The aim of this study was to provide evidence for the presence of some taxa in North Greece, based on the historical specimens from TAU Herbarium.

As a result of the annotation of TAUs' Herbarium historical specimens, 114 taxa whose presence needs verification were detected. Most of the studied herbarium specimens originate from North Greece (e.g. Mt. Chortiatis, Mt. Cholomon, Litochoro) and a few from Peloponnesus (mainly from prefecture of Laconia). The examined taxa were nomenclaturally updated and georeferenced. Presumably, some of the taxa whose occurrence in North East Greece (NE) has been confirmed are *Biarum rhopalospadix* K. Koch. (Araceae) and *Erodium laciniatum* (Cav.) Willd. (Geraniaceae), both in the broader area of Thessaloniki.

P07. Thematic Botanic Garden based on customary observances of contemporary Jewish communities in Greece. The case of Romaniotes at Ioannina

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Keywords: Jewish communities, Romaniotes, Biblical Times Garden, traditional Jewish customs, contemporary living

Judaism is a religion originated in the Middle East over 3500 years ago, practiced in the worship of God within Synagogues, and based on its most important document the Torah. In Greece, most Jews are Romaniotes, Ashkenazi, and Sephardim. Romaniotes, known as the "Greek Jews", are the oldest group that inhabited Greece more than 2000 years, since 200-250 BC on the island of Rhodes. The second distinct Jewish population of Sephardim settled in Greece after their expulsion from the Iberian Peninsula (1492), mainly in the city of Thessaloniki which was called the "Mother of Israel". Focus is placed on Yevanic speaking Romaniotes Jews, that settled the city of Ioannina back at least to the 9th century. They culturally enriched, influenced, and shaped the city's history through the Byzantine and the Ottoman Empires until the community's near destruction from Holocaust in World War II.

Through a selected sociological approach, the study goal of the paper is fourfold: a) define traditional Jewish customs, b) liaise old customs with contemporary everyday living, c) establish the needs for observing traditional Jewish customs at a Biblical Times Garden setting by d) proposing a selection of proper plants within an appropriate garden design. Potential end users of the Jewish origins and typology Garden are considered to be everyday citizens, tourists, and schools / universities study groups. The results of this Garden can be widely accessible, combining education, meditation, spiritual awareness, physical health, and recreation, addressing multiple aspects of Biblical times through personal or group visits, educational displays and lectures.

P08. BioBlitz survey on invasive alien plants in the region of Pancharevo Lake, Bulgaria

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Keywords: Invasive alien plants, observations, apps, public participation

Citizen science has become a popular and complementary approach to monitor invasive alien species (IAS). New technologies, such as smartphone application software (apps) are increasingly used to reach and engage a wider audience in learning about and recording IAS. In the frame of the COST Action CA17122 *Increasing understanding of alien species through citizen science* (Alien CSI) BioBlitz surveys have been conducted at European level in the period 20-22 May 2022 (https://iasbioblitz.creaf.cat/). In Bulgaria the BioBlitz survey was conducted on 21 May 2022, in the region of Pancharevo Lake, Sofia Municipality. BioBlitz participants (national authorities, scientists, NGOs, students, general public) were invited to go out and by using the phone applications 'Invasive Alien Species in Europe' and 'iNaturalist' to take photos and record observations of alien species to collect data for the region.

The following alien plants have been recorded: *Ailanthus altissima*, *Amorpha fruticosa*, *Crataegus germanica*, *Elodea nuttallii*, *Laburnum anagyroides*, *Opuntia engelmannii*, *Parthenocissus quinquefolia*, *Platycladus orientalis*, *Robinia pseudoacacia*. Two of these are included in the List of invasive alien species of EU concern – *A. altissima* and *E. nuttallii*. *Robinia pseudoacacia* was most frequently recorded. The poster presents details about the initiative and the involvement of citizens in the monitoring of alien species.

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P09. *Colchicum atticum* (Colchicaceae) at the northern limit of its range – distribution and conservation

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Keywords: Bulgaria, *Colchicum*, conservation, distribution, threats

Colchicum atticum is an E Mediterranean element, distributed in the SE part of the Balkan Peninsula and Turkey. The territory of southern Bulgaria lies at the northern limit of its distribution and the species is therefore rarer and more vulnerable. In Bulgaria, the species is red listed as Critically Endangered [CR B2ab(ii,iv); C2a(i)]. The aim of this study was to summarize the knowledge on the distribution of *C. atticum* and to evaluate the state of its populations in Bulgaria.

In the period 2010-2017 we have studied all sites where *C. atticum* has been reported as well as other potential sites in S Bulgaria. We also investigated the herbarium materials of the species at SOM, SOA, and SO. The visiting period started from early December until March. At each site we counted the number of flowering individuals and recorded the area occupied by the species.

We recorded the species at eight sites. It is confined to the northern slopes of the Western Rhodopi Mts. and adjacent hilly territories with sporadic occurrences in the lowland nearby, and a single population at the foothills of Pirin Mt. The area of the populations varies between 0.08 and 87 ha, and the number of flowering individuals from three to over 1000.

Some of the populations are situated next to arable fields. The population at the foothills of Pirin Mt. is severely affected by overgrazing. These observations indicate that *C. atticum* has suffered population contraction mostly due to agriculture.

The detailed distribution data in this study indicate that *C. atticum* in Bulgaria is not so rare but is still threatened, meeting the IUCN criteria for EN B1b(iii,v)c(iv)+2b(iii,v)c(iv).

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P10. Designing an effective Plant Micro-Reserve Network within the protected areas of Chelmos-Vouraikos Management Unit (N Peloponnisos, Greece)

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Keywords: conservation, protection, endemism, extinction risk, monitoring

Chelmos-Vouraikos Management Unit supervises thirteen Special Areas of Conservation of the Natura 2000 Network in North Peloponnisos, hosting a huge number of threatened, rare and local/regional endemic plant species. The present study presents results of a project dealing with the development of a Plant Micro-Reserve (PMR) Network in the area, the first on the Greek mainland, based on previous efforts, experience and outcomes concerning PMRs.

The proposed PMR network will include micro-reserves that will be located on public land, within Chelmos-Vouraikos National Park and other Natura 2000 sites supervised by Chelmos-Vouraikos Management Unit. The designed micro-reserve network includes, among others, populations of some local endemic plants, restricted to extremely small areas, i.e. *Alchemilla aroanica* (Buser) Rothm., *Lonicera alpigera* L. subsp. *hellenica* (Boiss.) Kit Tan & Zielinski, *Polygala subuniflora* Boiss. & Heldr., *Silene conglomeratica* Melzh., *Valeriana crinii* Orph. ex Boiss. subsp. *crinii,* and *Veronica contandriopouli* Quézel. The populations of these rare taxa coexist with other important for conservation endemic taxa among which *Globularia stygia*, a species included in Annexes II, IV & V of the Directive 92/43/EE.

In the framework of this project, extinction risk assessment of these taxa showed that their populations will face serious decrease of their potential distribution and continuous monitoring of their populations is urgently needed. For this purpose, a detailed inventorying of the localities for the target species and their habitats is implemented, covering population, plant community and habitat type characteristics, their structure and functions and the current pressures and threats they face. Subsequently, monitoring plans will be elaborated including baseline reference data for every PMR, conservation targets will be identified, and the necessary conservation actions will be proposed.

P11. Ecosystem condition assessment of sand dune habitats in Evrotas (Greece) – Proposals for management measures and actions

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Keywords: Ecosystem condition, management measures and actions, restoration, sand dunes, Evrotas

The Natura 2000 Special Area of Conservation (SAC) "Ekvoloes Evrota, Periochi Vrontama & Thalassia Periochi Lakonikou Kolpou" (GR2540003) is located in the Southern Peloponnese, east of the town of Gytheio and is the innermost place of the Lakonikos Gulf. Coastal habitats are threatened by direct and indirect human activities that reduce the delivery of significant ecosystem services and deteriorate ecosystem condition. The extensive sand dunes of Evrotas are gradually reduced and degraded because of agricultural conversion and anthropogenic activities, that have been intensified during the last decades, and according to the results of the latest project for Dir. 92/43/EEC species and habitat monitoring, there is a need for a detailed evaluation of sand dune habitats, aiming to propose and implement management measures and actions to ensure, at least, good ecosystem condition. The current study focuses on (i) ecosystem condition assessment of sand dune habitats (2110, 2120, and 2190), (ii) the assessment of pressures and threats that affect sand dune habitats, and (iii) proposals of restoration measures and actions for the sand dune habitats.

P12. *Euphorbia serrata* L. (Euphorbiaceae) and *Clerodendrum bungei* Steud. (Lamiaceae), two new alien species of the Greek flora

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Keywords: allochthonous species, chorology, dispersal, plant introduction, population size

Allochthonous plants may pose threats to the indigenous species, alter ecosystem structure and affect both agriculture and the economy. During recent years much progress has been made on Greek alien plant taxa, ways of introduction, invasive potentials and impacts to the environment. In this study we report two new alien records for the Greek flora, *Euphorbia serrata* L. (Euphorbiaceae) and *Clerodendrum bungei* Steud. (Lamiaceae).

Euphorbia serrata is a perennial herbaceous species, native to the west and central Mediterranean countries. It is here recorded in two Attiki localities separated by ca. 3.6 km. The population of Spata, first recorded in 2019, consists of 10-15 individuals and is subjected to periodic pruning. The second population in Vravrona occupies the margins of an abandoned field and consists of at least 60 plants, each consisting of 3-12 stems. Only 80 flowering stems with ripe cyathia were recorded among 730 total stems counted in June 2020. The species propagates mostly vegetatively and occasionally by seed. The time of introduction is unclear but should not extend long to the past. We presume that *E. serrata* reached Attiki accidentally, either as a contaminant of cereal seed or through fodder.

Clerodendrum bungei is a perennial ornamental subshrub originating from China, Vietnam and Taiwan. It has been naturalized in the Americas and reported as a casual in Europe. Two populations are recorded: the one in Metochi village (central Evvia Island, less than 10 individuals) seems to be a recent garden escape. Nevertheless, no cultivated material was found in its neighbourhood. The second population was found along the riverbanks of Metaxochori village, NNE of Larissa (Thessaly), where it is well adapted to the damp, shady habitat. Total population number is unknown. Previous records from Ichalia (Thessaly) and Litochoro (Macedonia) presumably refer to cultivated material. This species may have invasive potential.

P13. Fixed coastal dunes with *Alyssum borzaeanum* Nyár. in the Danube Delta Biosphere Reserve (Romania) – floristic particularities, conservation status, future tendencies and vulnerabilities

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Keywords: fixed coastal dunes, *Alyssum borzaeanum,* Lupilor sandbank, Black Sea coast, Romania

Fixed coastal dunes with herbaceous vegetation - grey dunes (2130*) are one of the most threatened coastal habitats in Europe, assessed as Endangered in the European Red List of Habitats due to many pressures and threats, mainly anthropogenic. In Romania, grey dunes are colonised by more or less closed perennial grasslands, composed by herbaceous plants, mosses and lichens. Coastal grasslands with *Alyssum borzaeanum* are typical for the habitat 2130* on the western Black Sea coast and they have high conservation value mainly due to very limitted and fragmented distribution of the euxinic plant *Alyssum borzaeanum* in Romania, Northern Bulgaria, Ukraine and North-Western Turkey. Fixed coastal dunes with *Alyssum borzaeanum* have been observed in the Danube Delta Biosphere Reserve, on Lupilor and Saele (Istria) sandbanks and on the southern coast of Romania, in the protected area "Marine sand dunes of Agigea". On Lupilor sandbank (Wolves sandbank) there are the largest surfaces of dunes with *Alyssum borzaeanum* in Romania, out of the strictly protected area, on the sand strips formed over than 1500 years ago, which closed the ancient Halmyris Bay of the Black Sea (ancient coast of the Black Sea). Grasslands have particular structure and floristical composition on Lupilor sandbank because around the fixed dunes humid dune slacks with mesophytic plant communities there are (belong to the habitat 2190 according to the Annex I of the Directive 92/43/EEC). Floristic particularities, conservation status, future tendencies, vulnerabilitis of the fixed coastal dunes with *Alyssum borzaeanum* and proposals for improving of the conservation measures on Lupilor sandbank will be approached in the paper.

P14. Greek sea-lavenders: distribution and conservation status of eight *Limonium* species from the Aegean Islands and the mainland

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Keywords: GIS, IUCN, rare species, endemism, *Limonium*

Limonium Mill. (Plumbaginaceae) is a typical genus of predominantly coastal plants and one of the largest genera in the Mediterranean, which constitutes the center of its diversity. Greece hosts 85 *Limonium* species, with the majority of them being endemic and/or rare, although their conservation details are largely unknown.

In order to examine the distribution and conservation status of eight *Limonium* species, i.e., *L. athinense* Erben & Brullo, *L. atticum* Erben & Brullo, *L. corinthiacum* (Boiss. & Heldr.) Kuntze, *L. dolihiense* Erben & Brullo, *L. heraionense* Erben & Brullo, *L. ikaricum* Erben & Brullo, *L. kirikosicum* Erben & Brullo, *L. vravronense* Erben & Brullo occurring in the Aegean and the eastern coasts of the mainland, we recorded and assessed their populations on the field, while taxonomically evaluating them as well. In addition, we gathered distribution data from the literature and by studying specimens from the ATHU herbarium. The geographical coordinates of the populations were used to produce distribution maps through Google Earth Pro and QGIS 3.16. New locations were reported for all species, leading to the extension of their known distribution and changes of the local endemic status for three of them (*L. atticum*, *L. corinthiacum* and *L. dolihiense*). All species were evaluated against the IUCN criteria and assigned to IUCN categories as follows: *L. atticum* – **LC,** *L. corinthiacum* – **NT,** *L. dolihiense, L. heraionense, L. ikaricum* and *L. kirikosicum* – **VU,** *L. athinense* and *L. vravronense* – **EN.** Field observations indicated that habitat destruction and invasive species are the two major threats for sea-lavenders.

We stress the importance of extensive and detailed fieldwork to delimit the range size and population characters for these rare species, as well as the necessity for the implementation of science-based strategies regarding the conservation of Limonium species that are unique parts of the Greek flora.

P15. Natural localities of *Rhodiola rosea* in Bulgaria: their status and dynamics caused by anthropogenic pressure and climate change

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Keywords: Medicinal plant, conservation, climate change, diversity

Natural localities of *Rhodiola rosea*, a critically endangered species were studied in Rila and Pirin Mts. Full inventory of the floristic composition in the communities was performed, with analysis of geographic elements and biological types. Additionally, some population density parameters were scored. The results indicate that the localities of the species are characterized by high diversity, with presence of some rare and endemic species. Occurrence of anthropophyte species and not typical for the studied plant communities species was recorded in some of the localities. This was considered to reflect the influence of the anthropogenic pressure and changing climate. However, most localities were not affected by these negative factors, which indicates that the species is well adapted and its localities are properly conserved. The results of the study can be useful for the development of future conservation strategies and measures.

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P16. Recent deterioration of the population state of *Tozzia alpina* subsp. *carpathica* in Vitosha Mountain, Bulgaria

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Keywords: Bulgaria, climate change, endangered species, Habitats Directive

Tozzia alpina subsp. *carpathica* (Woł.) Pawł. (*Orobanchaceae*) is a taxon of high conservation concern. It is included in the Bern Convention, the EU Habitats Directive, the Biodiversity Act and the Red Data Book of the Republic of Bulgaria. It is a semi-parasitic, herbaceous, rhizomatous perennial, parasitizing on large-leaved, rhizomatous plant species. The world range of the subspecies covers the high mountains of Eastern Europe (the Carpathians, the Tatras, eastern parts of the Balkan Peninsula). In Bulgaria, it is found in the following floristic regions: Western and Central Balkan Range, Vitosha Region, Rila Mts, Western and Central Rhodopi Mts. Herbarium records and literature data suggest there have been over a dozen of localities on the territory of Vitosha Mountain. However, only about five localities have been confirmed in the past 10 years. The number of individuals in each locality varies from just a few to 150. Observations in several consecutive years show a significant fluctuation in the number of individuals in the localities. In some of the habitats there is a negative tendency to "sink" the water level in the streams, most likely as a result of unevenness and reduction of the total amount of precipitation. This leads to drainage of the stream banks, development of more mesophilic vegetation and accumulation of dead biomass that raises the level of the banks. Lack of any grazing may also favour this trend. Thus, the conditions become unsuitable for spills, the water is channelled and the speed of the water flow increases, which worsens the conditions for the development of the taxon. These changes are particularly pronounced in the Bistrishko Branishte Reserve. An Action Plan for protection of the species has been elaborated for a 10-year period (2022-2031).

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P17. Sustainable management of aromatic and medicinal plants at protected areas of North Peloponnisos (Greece)

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Keywords: conservation, overcollection, pressures, monitoring, conservation status

The Chelmos-Vouraikos Management Unit is responsible for *thirteen* Special Areas of Conservation of the Natura 2000 Network, at N Peloponnisos, Greece. These areas are characterized by a high plant species diversity, including several aromatic and medicinal plants. This communication presents the methodology and first results of a project that is taking place in the area that records, registers, assess and maps the populations of aromatic and medicinal plants and the pressures and threats they face. Eight taxa have been selected, viz., *Sideritis clandestina* subsp. *peloponnesiaca, S. raeseri* subsp. *raeseri, Salvia fruticosa, Origanum vulgare* subsp. *hirtum, O. vulgare* subsp. *viridulum*, *Hypericum perforatum, H. empetrifolium* and *H. tetrapterum,* with populations that must be monitored for their conservation and/or restoration under a sustainable management scheme.

Within the framework of this project a detailed assessment of the localities for these seven target plant taxa and their habitats is taking place, concerning their population characteristics, the plant communities and habitat types, their structure and functions and the current pressures and threats, aiming to create a reference, baseline database. Grazing and uncontrolled harvesting are among the main pressures affecting their populations. Subsequently, relevant monitoring plans will be developed including the baseline reference data for these aromatic and medicinal plants and the necessary conservation actions and measures will be accordingly proposed.

P18. The invasive alien species of *Heracleum* (Apiaceae) in the Bulgarian flora

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Keywords: alien species, Bulgaria, Heracleum mantegazzianum, Heracleum sosnowskyi, invasive species

The genus *Heracleum* (Apiaceae) is represented by two alien species in the Bulgarian flora – *H. mantegazzianum* and *H. sosnowskyi*. The native range of the species covers the Caucasus. Both taxa have been recently recorded in the Bulgarian flora and show invasive traits. The former has been found in Sofia floristic region (Sofia city), whereas the latter – in Sofia (Mirkovo village) and Western Rhodopi Mts (Borino village) floristic regions. Both species have been included in the List of invasive alien species of EU concern related to EU Regulation 1143/2014. The species have negative impact on the native biodiversity, e.g. they change the composition and structure of the invaded plant communities. Moreover, they pose serious threat to human health causing skin burns. Therefore, the taxa are of high interest for research. The present poster presents new data about the currently known occurrences of both species in Bulgaria: distribution ranges, population size, genome size, composition of invaded plant communities. The invasion potential of the species in the Bulgarian flora is discussed. Issues of raising public awareness and involvement of citizens in recording of species localities have been discussed too.

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P19. The invasive alien species of sand dune ecosystems in Elafonisos (Greece) – Management measures and actions

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Keywords: Invasive alien species, management measures and actions, restoration, dune ecosystems, Elafonisos island

The Natura 2000 Special Area for Conservation (SAC) of Neapolis and Elafonisos island (GR2540002) is located in the region of Laconia, lies just off the Southwest coast of Maleas Peninsula and belongs to the phytogeographical region of Peloponnese. The dune habitats and the endemic plant species that are found exclusively on the beaches of Elafonisos island, provide a high ecological, aesthetic, and cultural value. However, given the sensitivity of sand dunes, anthropogenic pressures that have increased over the last years and specifically the introduction of invasive alien species is considered one of the most important threats to ecosystem structural and functional characteristics. Consequently, the need for a detailed evaluation of dune habitats, aiming to ensure, at least, good ecosystem condition is emphasized.

Main objectives of the present study are to (a) record and assess the invasive alien species impact to the sand dune habitats and (b) propose and implement management measures and actions to ensure the long-term conservation and sustainability of sand dune habitats and specifically for the priority habitat type 2250*.

The most common invasive alien species recorded in the dunes of Elafonisos are *Carpobrotus edulis*, *Opuntia ficus-indica*, *Agave americana* and *Acacia saligna*, the presence of which seems to be related to 'escaping' from home gardens.

P20. The impacts of climate change on the conservation status of the Mediterranean Basin taxa: a preliminary meta-analysis

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Keywords: conservation, endemism, climate change, extinction risk, Mediterranean Basin

Climate has been changing since the 1800s mostly due to human activities, with global mean annual temperature increasing by 1.1°C. This will trigger modifications in temperature and precipitation patterns, highly impacting the biosphere by altering phenologies, biotic interactions, species' distributions and community composition. The Mediterranean Basin, a global biodiversity hotspot hosting ca. 24,000 plant taxa and exhibiting ca. 60% endemism mostly in its insular and montane regions, is also considered as an extinction hotspot due to human-induced climate change.

To survive, plant taxa could either adapt to the changing conditions of their current (Eltonian or Hutchinsonian realized) niche or shift to a more suitable area, tracking the climate change. Overall, studies show that most plant taxa – and especially those that are range-restricted – are currently shifting poleward and uphill. The issue is that there is a migration lag present, induced by a myriad of abiotic and biotic factors. On one hand, single island endemic and montane/alpine species don't have much more area available to migrate to, and on the other hand, invasive and more generalist species are shifting to areas where they put pressure on the species already established there and could replace them on the long term, thus leading to biotic homogenization and loss of valuable genetic resources. This phenomenon could lead to the extinction of the most vulnerable species and unbalance the Mediterranean ecosystems, leading to unforeseen consequences.

Therefore, there is an urgent need to assess the extinction risk and to spot the most vulnerable species to be able to establish efficient national and international plans to preserve biodiversity. Herein, we reviewed more than 90 publications concerning species and the climate change effects in a larger scale to assess the situation of the largest number of Mediterranean species and their predicted conservation status in different climate change scenarios.

P21. The seasonality of a *Halophila stipulacea* seagrass meadow near a fish farm

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Keywords: aquaculture, epiphytes, growth parameters, invasive species, Mediterranean Sea, marine angiosperms.

The seagrass *Halophila stipulacea* is natively distributed in the Red Sea and Indian Ocean. In the Mediterranean Sea, it was first recorded in 1894 and since then, it has been continuously spreading westwards throughout the basin. However, the physiology and seasonality of *H. stipulacea* both in its native and in the invaded areas are still not well understood. In this study, the seasonality of a *H. stipulacea* meadow near a fish farm in the Aegean Sea, Greece, was evaluated at three sampling sites.

Five random quadrats of plant material were collected per season and site. In each sample, the number of shoots, leaves and flowers, leaf age and area, biomass, and phenol content in leaves and rhizomes were determined to estimate the seasonal pattern of growth and the stress level posed on the plant in different sites and seasons, in relation to organic enrichment, temperature and light intensity. Epiphytes were also collected from leaves, rhizomes and shoots from each site and identified up to species level.

Results showed the seasonality of the *H. stipulacea* meadow, with peak values of shoot density in summer, followed by a biomass peak in autumn, and lowest values in winter. Plants directly under the fish cages showed an increased number of shoots, number of leaves, leaf area, female flower, and increased biomass but no difference in phenol content when compared to the other sites. Phenol content was highest in winter. Epiphytes also showed a qualitative and quantitative seasonality. Rhodophyta epiphytes dominated during all seasons, while Heterokontophyta were also highly abundant. During the summer period, the red algae *Spyridia filamentosa* was increasingly present.

These findings document the species' capability to adapt to a temperate environment and its resistance to the high organic input of the fish farm, which did not seem to negatively impact the meadow.

P22. Diversity of endophytic fungi in the marine angiosperms of the Aegean Sea

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Keywords: Seagrasses, endophytes, cultures, Mediterranean Sea

Terrestrial plants form symbiotic relationships with numerous endophytic fungi that differ in their taxonomy, ecology and physiological significance for their hosts. A similar trend is evident in freshwater aquatic plants and plants inhabiting salt marshes or mangroves. However, only recently the presence of endophytic fungi in the root tissues of the seagrass *Posidonia oceanica* has been confirmed.

In this study, the presence of fungal symbionts of the Mediterranean seagrass species *Cymodocea nodosa* and *Posidonia oceanica*, of the invasive seagrass *Halophila stipulacea* and of the angiosperm of traditional water *Ruppia maritima,* was investigated. Roots, rhizomes, and leaves were collected from different meadows growing in various areas of the Aegean Sea during summer, autumn, winter and spring, in order to isolate and identify endophytic fungi. Fungi were detected microscopically and isolated mainly from the *P. oceanica*, *C. nodosa* and *R. maritima* rhizomes. The majority of the endophytes were isolated from summer samples, whereas hardly any fungi were developed in culture from all other specimens. The isolated strains vary in macromorphology (growth rate, color, texture, exudate production), while in most of them, regarding micromorphology, no reproductive organs are formed. Therefore, for the identification of the fungal species and their phylogenetic analysis the ITS region of the nuclear ribosomal DNA will be used as a molecular barcoding marker. It is worth noting that endophytic fungi are referred for the first time from the Greek marine angiosperms and are numbered among the very few globally.

The discovery of endophytic fungi in marine angiosperms expands our knowledge on endophytism and its role, while it mainly contributes to a better understanding of the marine angiosperm biology. Detailed studies of the internal mycobiota of plants may reveal novel taxa, add distribution data of the known species and provide fundamental information for the evaluation of the global fungal diversity.

P23. Pilot study to asses diatom diversity of soda pans using morphological and molecular analyses (Vojvodina province, Serbia)

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Keywords: diatoms, soda pans, morphological analysis, molecular analysis, 18S rRNA gene

Saline lakes and ponds are unique and vulnerable habitats. In the Carpathian Basin, these habitats are mostly part of the Natura 2000 Network and they are protected under EU Habitats Directive (92/43/EC). In the Vojvodina province, soda pans have been intensively investigated since 2017, mainly their diatom community. In our study, samples of epipelic diatoms were collected in March 2021 from four soda pans in reference status (Velika Rusanda, Mala Rusanda, Pečena Slatina, and Okanj bara) and two modified pans (Slatina and Velika Slatina). In addition to morphology-based taxonomic inventory, sequence-based diatom lists (18S rRNA gene) were produced for the first time for this type of habitat in Serbia.

The morphological analysis determined the presence of 84 diatom taxa belonging to the 29 genera. The most dominant taxa were *Anomoeoneis sphaerophora*, *Craticula molestiformis*, *Navicula veneta*, *Nitzschia austriaca*, *N. frustulum*, *N. inconspicua*, *N. supralitorea*, *Surirella brebissonii*, and *Tryblionella hungarica*. On the other hand, after processing molecular data reads were generated in 679 amplicon sequence variants (ASVs), and among these ASVs, 311 (45.8%) were assigned to a species level, 179 (26.4%) to a genus level, and 107 (15.8%) to a family level. In total 80 taxa were obtained, belonging to 30 genera and 19 families. Due to an incomplete sequences database, 51 were assigned to the species level. The most dominant taxa were *Halamphora veneta*, *Navicula veneta*, *N. gregaria*, as well as unknown species from genera *Craticula*, Gyrosigma, *Mayamaea,* and *Surirella*. A considerable discrepancy in species composition was noticed comparing these two approaches.

The incompleteness of the reference barcoding library for halophilic and alkaliphilic species is an obstacle to the efficient use of diatoms in the bioassessment of inland saline waters. Therefore, comprehensive sampling campaigns and the application of both methods are necessary to complete the reference database for diatoms.

P24. Representative lichens of the alliance *Lobarion pulmonariae* in Nature Park Papuk (Croatia)

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Keywords: forest, ecosystem, mountain, diversity

The area of Slavonian mountains Papuk and Krndija was proclaimed as Nature Park in 1999, spreading over an area of 34 307 ha. The elevation extends from 162 to 953 m a.s.l. Papuk is geologicaly the most diverse Croatian mountain, consisting of rocks which originated in a time span of 350 milion years. Since 2007, Nature Park Papuk has been a member of UNESCO Global Geopark Network. It also comprises three areas of Natura 2000 ecological network in Croatia. Forest habitats covers 95% of the Park area, with 11 forest communities composed of *Fagus sylvatica, Quercus petraea, Carpinus betulus, Abies alba, Acer pseudoplatanus, Quercus pubescens and Quercus frainetto*.

The aim of the research, carried out in June and August 2019, was to determine presence of lichens from the epiphytic alliance *Lobarion pulmonariae* in Nature Park Papuk. Lichens that belongs to this alliance are known as indicators of biodiversity and conservation of old forest ecosystems in Europe, with pronounced sensitivity to effects of air pollution and forest management practice.

A total of 14 lichen species were recorded, mostly from genus *Peltigera* (7 species), followed by records of *Bacidia rosella, Lobaria pulmonaria, Lobarina scrobiculata, Nephroma parile,* and *Pannaria conoplea*. The main phorophytes of *Lobarion* lichens were *Fagus sylvatica, Quercus petraea,* and *Quercus pubescens*. Tree stem diameter ranged 102-167 cm. Records of *Lobarina scrobiculata* and *Pannaria conoplea* are remarkable due to the confirmed occurrence in the continental part of Croatia, for the first time. Their distribution range in Croatia is mostly confined to the Dinaric Mountains, including the coast and islands of the Adriatic Sea. The presence of *Lobarion* lichens represents a significant conservation value of the forest ecosystems and a valuable addition to the biodiversity of the Nature Park Papuk.

P25. Use of diatoms to monitor eutrophication in large lowland rivers

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Keywords: international large river, diatoms, Sava River, eutrophication, anthropogenic influence

Large lowland rivers are relatively rare and for centuries under a constant anthropogenic influence which has led to most of them no longer meeting natural reference conditions. One of those rivers is the Sava River which flows through Slovenia, Croatia, and finally through Serbia, feeding into the Danube in its capital, Belgrade. Some of the biggest influences on the Serbian part of the catchment are industry, thermal power plants, untreated communal water, and agriculture. In order to monitor the situation, 20 water and diatom samples were collected along the Sava River from the point of entry into the territory of Serbia to the confluence into the Danube River. The biological samples were taken to determine the diatom community and to characterize the water quality through this ecological indicator.

Using digital microscopy and the BIIGLE 2.0 image annotation web service, around 200 diatom taxa were identified. Some of the most dominant species were *Achnanthidum pyrenaicum*, *Cocconeis euglypta*, *Gyrosigma acuminatum*, *Navicula germainii*, *Nitzschia palea*, and *Sellaphora pupula* group. Following the van Dam ecological classification, most of the recorded species are alkaliphilic and eutrophic. Taxa like *N. palea* are characteristic of waters strongly impacted by industrial sewage. The presence of halophilic taxa was also noted (e.g. *Bacillaria paxilifera*, *Tryblionella* species, *Nitzschia clusii*, *Navicula salinarum*). These taxa are sensitive indicators of even short-term changes in lowland lotic ecosystems characterized by elevated conductivity. In almost all localities, the IPS diatom index indicates moderate ecological status, while trophic indices (Rot TI and TDI) show elevated nutrient concentration.

These are the first results of the ongoing project. Additional analyzes, such as eDNA analyses will help in a better understanding of the diatom community as well as provide knowledge for a possible rapid intervention for environmental protection.

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P26. Altitudinal patterns of orchid species diversity in the central Balkans

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Keywords: Orchidaceae, ecology, altitudinal patterns, distribution, species diversity, Balkan Peninsula, Serbia

Knowledge of species diversity patterns along the altitudinal gradient is one of the major goals of ecological and biogeographical research. The aim of this study was to investigate how the richness and density of orchid taxa with different life traits (underground organ systems, pollination systems) vary with altitude in the central Balkans (western Serbia).

The altitudinal gradient of the study area was divided into 21 100-m vertical intervals. Orchid diversity patterns were examined for both the total orchid flora and orchids recorded in forest and non-forest habitats. Data were analyzed using regressions. The results showed a hump-shaped pattern of orchid richness, peaking in the mid-altitude area (900-1,000 m), and that the richness of orchids of forest habitats is slightly higher than the richness of orchids of non-forest habitats in lowland areas, whereas the richness of orchids of non-forest habitats dominating at high-altitude areas. This study indicates the importance of low and mid-altitude areas for the survival of tuberous orchids, and the importance of mid- and high-altitude areas for the survival of orchids with palmately lobed and fusiform tubers ("intermediate orchids"). In addition, rhizomatous orchids were found to predominate in mid-altitude forest stands. Deceptive orchids dominate at low and mid-altitude areas, rewarding orchids dominate at high altitudes, whereas forest sites at mid-altitude were found to be crucial for the survival of self-pollinated orchids.

The results suggest that the altitudinal patterns of orchid species richness and density in the central Balkans are shaped by mechanisms related to land area size and habitat cover. This study contributes to a better understanding of the potential effects of habitat changes on orchid diversity, allowing for better conservation planning.

P27. Impact of climate factors on habitat suitability of an amphi-Adriatic plant *Festuca bosniaca* Kumm. et Sendtn.

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Keywords: Bioclimatic variables, *Festuca bosniaca*, habitat suitability, Maxent modelling

Festuca bosniaca is an endemic species of the Balkan and Apennine Peninsulas, occurring in alpine and subalpine grasslands. Species distribution modelling (SDMs) was used to determine the habitat suitability for current and past (Last Glacial Maximum - LGM) time periods. The occurrence points of *F. bosniaca* were collected in the field from 2018 to 2021 and were supplemented with additional points from the Flora Croatica database. The models were build on 103 points after filtering and of eight (one geomorphological and seven bioclimatic) selected environmental variables of initial set of 43 variables from CHELSA and exChelsa databases. Current habitat suitability was predicted based on 13 selected predictors. SDMs was conducted using the Maximum Entropy method, with 70% of the occurrences used for model training and 30% of the occurrences used for model evaluation. Projections for the LGM period were based on four general circular models (GCMs) (NCAR-CCSM4, MRI-CGCM3, MPI-ESM-P, MIROC-ESM) averaged to produce a consensus LGM projection. All resulting models performed very well (AUC > 0.9) and the main environmental variables affecting habitat suitability of *F. bosniaca* were: mean daily mean air temperatures of the wettest quarter (bio8), mean monthly precipitation amount of the warmest quarter (bio 19), mean daily mean air temperatures of the coldest quarter (bio11) and slope. Current habitat suitability was also influenced by soil organic carbon content and number of snow days. The habitat suitability coincides well with the known occurrences of *F. bosniaca* in the Balkans and Apennines. The models also showed some potentially newly discovered populations in the area of the Scardo-Pindic mountains and in the north-western part of the Apennine Peninsula. When comparing the models for the LGM and the present, a much wider range was observed in the past, which may be related to the lower temperatures favoured by *F. bosniaca*.

P28. Monitoring of vascular flora in Nature Park Kopački Rit (Danube River floodplain, Croatia)

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Keywords: wetlands, taxonomy, endangered plants, nature protection, Naturavita project

Nature Park Kopački Rit is a fluvial-marshy floodplain, situated in the north-eastern Croatia along the middle course of the Danube River. Due to its biological and ecological values, this area has been protected since 1967, and proclaimed a Nature Park in 1999, covering a total area of 23 126 ha. It is a part of Natura 2000 ecological network in Croatia, and UNESCO Five-country Biosphere Reserve Mura-Drava-Danube.

Monitoring of vascular flora is on-going in the period April 2021-October 2022. During the fieldwork, the presence of vascular flora taxa is recorded in order to create a checklist, and to analyse taxonomic and ecological characteristics of the flora. Special attention is given to endangered and protected species, and to occurrence and impact of the invasive plant species.

The current vascular flora diversity is comprised of 569 species, 310 genera and 97 families of the pteridophytes and angiosperms, which makes 11% of the total vascular flora of Croatia. Among the families, the most diverse are: *Asteraceae* (47 species), *Poaceae* (45) and *Lamiaceae* (38), and among the genera: *Carex* (17 taxa), *Ranunculus* and *Veronica* (10 each), and *Potamogeton* (9). Invasive plants are represented by 29 species. Furthermore, a total of 60 threatened species were recorded that are included in the Red Book of Vascular Flora of Croatia.

Comprehensive knowledge on vascular flora diversity provide an important tool for planning and implementation of various measures, with an aim to conserve and protect rare and threatened plants and their natural habitats in Nature Park Kopački Rit.

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P29. Plant diversity of olive groves under different management practices: the case study of the island of Kythera (Greece)

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Keywords: conservation, sustainable management, agricultural practices, olive groves understorey

Kythera Island is characterized by a rich plant species diversity and a high proportion of endemic taxa. Conservation of the island biodiversity should always be of a priority, and this is also the case for the conservation of agroecosystems biodiversity that is a demand for their sustainable development. The current study presents the results of the investigation of plant species diversity of olive groves under different management practices on the island of Kythera and in the framework of the Terra Kytheria project that aims for a novel biodiversity-friendly farming system.

Fieldwork on biodiversity identification and monitoring, has been carried out by researchers of the University of Patras, the University of the Aegean, KIPA and MedINA. The sampling has been realized in 12 olive groves from the north to south of the island and in and around of 24 plots. Field surveys to sample the flora and vegetation at field scale were performed during spring and autumn 2021.

More than 150 plant taxa have been registered on the studied olive groves belonging to more than 100 genera. Fabaceae, Poaceae and Asteraceae represent the 53% of the taxa registered and are among the most species rich families. *Trifolium* and *Medicago* are among the most species rich genera registered. Perennial taxa as the shrubs *Spartium junceum, Quercus coccifera* and *Calicotome villosa,* or *Sarcopoterium spinosum, Genista acanthoclada, Phlomis fruticosa, Cistus* spp. and *Satureja juliana* have been registered mainly near the borders of some of the olive groves. The results showed that olive groves under a traditional management, present a rich plant species diversity, mainly dominated by therophytes and especially of annual leguminous species and other insect-pollinated plants while conventional olive groves have a rather poor plant species diversity, also dominated by therophytes.

P30. Weed diversity in cultivated land: investigating optimum species richness in the plains of Thiva (Greece)

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Keywords: agroecosystems, arable flora, field margins, environmental parameters

Vascular plant taxa adapted to arable habitats are considered among the most vulnerable groups in several European countries. The intensification of agricultural practices, the common use of herbicides and the invasion of alien species may pose serious threats to traditional, arable weed communities.

The plains of Thiva cover an area of approximately 500 km^2, ca. 50 km NW of Athens, and are made of flat land and mild low hills at an average altitude of ca. 200 m. Agriculture is practiced in this area for more than 2,500 years. Given the rapid changes in land management over the last decades, we search for arable plant communities with an optimum species richness (i.e., maximum plant diversity and possible occurrence of rare or threatened species), focusing on crop edges rather than field cores. We investigated 64 plots measuring 25 m^2 (dimensions of 5x5, 2x12.5 or 1x25 m) each, intentionally selected to represent high species richness. We recorded altitude, orientation and cultivation type per plot.

Up to now, 196 plant taxa have been identified as arable weeds. Mean species richness is over 20 species per plot, with the maximum number (47 species) recorded once. The commonest weeds are *Papaver rhoeas* (found in 85% of the plots), *Sinapis arvensis* (68%), and *Anthemis altissima* (67%). *Anchusa stylosa* subsp. *spruneri*, *Ceratocephala falcata* and *Malvella sherardiana* are among the rarest species, found only once. Preliminary species richness was modelled as a function of altitude, orientation, cultivation type and plot shape. A weak positive effect of altitude was identified, with E, W and S orientations hosting a relatively lower number of species compared to N orientation. A higher number of species was recorded in plots adjacent to *Avena* cultivations, whereas a lower species richness was found in the 2x12.5 shape plots, compared to those of 1x25 shape.

P31. Comparative palynomorphological study of selected taxa of *Valeriana* L.: taxonomic and evolutionary implications

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Keywords: Eudicots, exine sculpture, pollen morphology, taxonomy, *Valeriana*, Valerianaceae, Caprifoliaceae

Valeriana is the largest genus in tribe Valerianeae, family Valerianaceae (the latter now included in family Caprifoliaceae) and comprises ca. 200–250 species distributed throughout much of the world. Pollen morphology of 34 herbarium specimens belonging to 17 taxa of *Valeriana* distributed in Europe was studied using light and scanning electron microscopy. Pollen grains of five taxa were analysed for the first time. The aim of this research was to assess the taxonomical value of palynomorpholodical data for species-specific identification.

Pollen grains are monads, radially symmetrical, isopolar, tricolpate, oblate to prolate, medium- or large-sized. Colpi are long, medium-length or short, with acute, obtuse or rounded ends. Four types and eight subtypes of exine sculpture were recognised: type I – echinate-verrucate (5 spp.), type II – echinate-nanoechinate-verrucate (10), type III – echinate-microechinate-nanoechinate-verrucate (1), type IV – echinate-microechinate-nanoechinate (1). Additional characters of taxa of *Valeriana* diagnostic at species level for the purposes of taxonomy are: size of pollen and colpi, exine sculpture: presence/absence of verrucae, their form, size and form of echini/microechini/nanoechini, their number, pattern of tectum in areas between echini, exine thickness in mesocolpia and apocolpia.

Our palynomorphological data support the results of molecular phylogenetic studies. The close phylogenetic relationships of the species *V. montana*, *V. tripteris*, *V. supina* and *V. pyrenaica* are also supported by their palynomorphological characters, such as the exine sculpture (type I). Cluster analysis mainly supports the definition of pollen types and subtypes, since species are grouped as five separate branches.

Our data showed that the pollen morphology of *Valeriana* species allows the establishment of hypotheses regarding the evolution of exine sculpture. In particular, we suggest that there is an evolutionary trend towards a decrease of echini size, loss of verrucae, and an increase in the number of nanoechini.

P32. Pollen micromorphology of *Arabis procurrens* and *A. hirsuta* (Brassicaceae) grown in Jerma River Canyon in Serbia

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Keywords: *Arabis*, palynomorphology, scanning electron microscopy

Two *Arabis* species (family Brassicaceae) from the Jerma Special Nature Reserve, located within the Dinaric Mountain Range, in the far southeast of Serbia, have been palynomorphologically analyzed to contribute to taxonomic and mellisopalinological research. Natural habitat for both *Arabis* species, namely *Arabis hirsuta* (L.) Scop. (hairy rock-cress) and *Arabis procurrens* Waldst. & Kit. (running eared-rockcress) is rocky mountain/ cliff sides, limestone slopes, rocks and walls, or dry sites. Moreover, the latter is a subendemic species to the Balkans.

The pollen morphology was examined by scanning electron microscopy (SEM). Pollen grains were photographed in polar and equatorial view and the following features were examined: length of polar (P) and equatorial axis (E), shape, ornamentation, apertures, polarity, symmetry.

The pollen grains of both *Arabis* species are isopolar, radially symmetric and medium-sized. According to T-test ($p<0.05$), P of *A. hirsuta* are a bit longer (P:32.8 ± 2.93 µm) relative to *A. procurrens* (P:30.1 ± 1.8 µm), while there is no statistically significant difference in E (17,7± 1.5 µm : 18.2 ± 1.3 µm), which slightly affects the shape. The P/E ratio in *A. hirsuta* and *A. procurrens* amounts 1.9 ± 0.2 and 1.7 ± 0.1, respectively, indicating prolate shapes. In equatorial view both pollen grains are elliptic and in polar view are three-lobate with interangular furrows.

The grains are tricolpate with ectocolpi arranged regularly meridionally, of mean length 27.3 ± 1.4 µm (*A. hirsuta*) and 24.5 ± 1.2 µm (*A. procurrens*). Mesocolpium is slightly wider in *A. procurrens* (11.7 ± 0.6 µm) than in *A. hirsuta* (10.7 ± 0.4 µm).

The exine ornamentation is reticulate with polygonal lumina of similar size among the species studied, while muri in *A. hirsuta* are narrower.

P33. An LC-HRMS and GC-MS approach for the chemotaxonomic investigation of the natural hybrid *Origanum x lirium* and its parents, *O. vulgare* subsp. *hirtum* and *O. scabrum*

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Keywords: *Origanum* x *lirium*, *Origanum vulgare*, *Origanum scabrum*, GC-MS, LC-HRMS, essential oil

The genus *Origanum* L. (Lamiaceae) is widespread in the Mediterranean region, even though approximately 75% of the species can only be encountered in the eastern part. Nine species (eleven taxa) and three natural hybrids occur in Greece. However, in several studies there is no consensus regarding their precise botanical classification. In fact, the taxon *Origanum* x *lirium* has been proposed both as a separate species as well as natural hybrid between *O. vulgare* subsp. *hirtum* and *O. scabrum*.

In that framework, the aim of the current work is to shed light on the matter through the investigation of the chemical composition of both the essential oil and the polar extracts of the above taxa, collected from different geographical regions of Greece.

As it was indicated by both the GC-MS and the LC-HRMS data and highlighted by our comparative statistical analysis, it appears that *Origanum* x *lirium* shares its chemotype with its parent species concerning both volatile and polar constituents. What is more, climatic conditions stood out as a key factor influencing the samples' chemical composition.

In summary, the present work provides useful information on the chemical composition of the taxa under investigation. In addition, our findings support the opinion expressed by Ietswaart, that *Origanum* x *lirium* should be regarded not as a separate species, but rather as a hybrid "on the way to species".

P34. Bioactive compounds of *Arctostaphylos uva-ursi* growing in Bulgaria

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Keywords: bearberry, arbutin, flavonoids, phenolic compounds

Arctostaphylos uva-ursi (L.) Sprengel (bearberry), Ericaceae is a valuable medicinal plant occurs in large area in Europe, Asia, North America and Greenland. However in Bulgaria the plant is considered as rare species and is included in the Red List of Bulgarian vascular plants with the category "vulnerable". Many of the natural localities of the species are protected under different regimes, including in protected territories. Leaves of *A. uva-ursi* are used mainly as a diuretic, antimicrobial, anti-inflammatory and skin-whitening agent. Content assessment of bioactive compounds of *A. uva-ursi* growing in Bulgaria was the aim of the present study. Leaf samples were collected from three natural populations of Pirin, Vitosha, and Western Rhodope Mountains of Bulgaria. Bioactive compounds of methanolic extracts of the samples were identified by GC/MS and TLC. Total phenol content was determined using Folin– Ciocalteu reagent. Arbutin and quinic acid were detected in the highest amounts. Galic acid, catechine, 4-hydroxybenzoic, chlorogenic acid, triterpenes (α- and β-amyrin, lupeol) vitamins, and other primary and secondary metabolites were found by GC/MS in the studied samples, also. Flavonoids (hyperoside, rutin, isoquercetin, quercetrin) were detected by TLC. Differences in the content of individual compounds between samples of different origin were found. However, significant differences in the total phenolic content between samples of different origin were not established. The presented data characterizes the content of bioactive compounds in the Bulgarian bearberry raw material.

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P35. Chemical composition of four *Salvia* taxa essential oils from North-East Greece

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Keywords: *Salvia*, essential oils, wild populations; Mount Pangaion; North-East Greece

The genus *Salvia* L., a member of the Lamiaceae family, comprises over 900 species worldwide. In Greece, 22 species have been reported and the total number of taxa reaches 26 if subspecific entities are also considered.

Three *Salvia* species were collected from the lower parts of Mt. Pangeon (NE Greece) on the 15th of June, 2021. These were determined as *Salvia aethiopis* L., *S. amplexicaulis* Lam. and *S. sclarea* L. A fourth species, *S. fruticosa* Mill., was also added to our study but this originated from cultivated material. Aerial parts of all four species were subjected to hydrodistillation and the chemical composition of their essential oils was analysed by the GC-MS method in triplicates.

Four different major constituents were identified in the essential oils, as follows: 1,8-cineole was the major compound in *S. fruticosa*, germacrene D in *S. amplexicaulis*, caryophyllene E in *S. aethiopis* and linalool acetate in *S. sclarea*. With respect to the rest of the chemical compounds, distributions and concentrations were varied according to the species. We present the essential oil compositions and discuss our results in comparison to previous investigations of the same species, as well as different *Salvia* species grown in Greece.

P36. Chemical investigation of volatile compounds in Balkan Tripleurospermum (Asteraceae) species

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Keywords: Bulgaria, chemical analysis, Greece, essential oils, matricaria esters

The genus *Tripleurospermum* Sch. Bip. (Anthemideae, Asteraceae) comprises approximately 40-50 taxa of annual, biennial or perennial herbaceous plants with a Paleotemperate distribution. According to recent studies, *Tripleurospermum* forms a monophyletic group with *Anthemis* and *Cota* (Anthemidinae). In Greece, the genus is represented by eight species, distributed mainly in the northern part of the country. Four species are known from Bulgaria.

Representatives of this genus have exhibited important pharmacological and biological activities such as antioxidant, anti-inflammatory, and antimicrobial. Infusions and decoctions of the aerial *Tripleurospermum* spp. parts have been used as folk remedy for the alleviation of asthma and other respiratory tract ailments, stomachache, and fever. The chemistry of the genus is characterized by terpenoids, steroids, organic acids and aroma)c compounds as well.

In the framework of our ongoing research on aromatic medicinal plants, we investigated the volatile composition of two widespread *Tripleurospermum* species, *Tr. inodorum* (L.) Sch.Bip. and *Tr . tenuifolium* (Kit.) Freyn, collected from four different native populations in N. Greece (Eastern and Central Macedonia) and S. Bulgaria (Pirin Mountains). The volatiles were obtained by hydrodistillation (Clevenger apparatus) and their composition was analyzed by GC and GC-MS. The investigated essential oils were particularly rich in polyacetylene derivatives, specifically matricaria ester s. The Tr. *tenuifolium* essential oils were characterized by a high amount of 2*E*,8*Z*-matricaria ester (34. 9%-37.9%), followed by 2*Z*,8*Z*-matricaria ester (20.6%-27.4%). The *Tr. inodorum* volatile oils were dominated by 2*Z*,8*Z*-matricaria ester in a strikingly higher amount (76.6%-79.2%).

P37. Chemical profile of essential oil of Helichrysum arenarium (L) Moench. distributed in Bulgaria

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Keywords: Bulgaria, essential oil; *Helichrysum*; protected species; *α*-pinene; sabinene

Helichrysum arenarium (Asteraceae) has a long tradition as a medicinal plant in the European ethnomedicine. In Bulgaria, *H. arenarium* occupies limited area and grows on coastal and inland dune habitats up to 500 m a.s.l. along the Black Sea Coast, the Danubian Plain (central part), in Northeast Bulgaria and in some places in Southeast Bulgaria. The purpose of this study was to determine the composition of the essential oil (EO) of *H. arenarium* distributed in Bulgarian flora. Overall, 75 EO constituents were identified and grouped into the following classes: monoterpenes, sesquiterpenes, diterpenoids and long-chain alkane, totaling 90.82–94.4% of the total oil. The monoterpenes (65.72–73.99%) predominated in the tested samples. *α*-Pinene (34.64–44.35%) and sabinene (10.63–11.1%) were predominant EO constituents in all samples while β-pinene, *trans*-verbenol and D-limonene were observed in similar quantity. Of the total sesquiterpenes in *H. arenarium* EO, (16.08–19.41%), germacrene D (3.56–4.86%) and β-gurjunene (3.61%) were predominant. According to statistical processing, the concentrations of sabinene, D-limonene, *trans*-verbenol, n-tetradecane and β-gurjunene in *H. arenarium* EO where were not significantly different between the three locations. The results from this study affirmed a new chemical type (chemotype) of *H. arenarium* in Bulgaria.

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P38. Chemotypes of *Pinus heldreichii* Christ. in Bulgaria and the antimicrobial activity of essential oils

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Keywords: Bulgaria, essential oil; *Pinus;* Tertiary relict; Balkan endemic; limonene; germacrene; chemotypes

Pinus heldrejchii is a Balkan endemic, Tertiary relict, and distributed on the Apennine Peninsula (Southern Italy), in the western and southern parts of the Balkan Peninsula, as well as areas a with sub-Mediterranean climate. In Bulgaria, the species is naturally distributed in the Pirin and Slavyanka Mountains at 1400 - 2200 m asl, while in Vitosha mountain it was introduced. The objectives of this study were to assess the variability of essential oil (EO) content and composition of *P. heldrejchii* twigs collected at Bulgarian populations (interpopulation) and it's an antimicrobial activity. The monoterpenes and sesquiterpenes were the predominant classes comprising 87.92 to 97.47% of the total EO. *α*-Pinene, limonene, *β* – caryophyllene and germacrene D were the main constituents of the EO. *α*-Pinene varied from 8.39% to 46.94% and limonene from 3.85% to 69.45%. Germacrene D also varied widely, from 3.14% to 29.81%. There were significant variations of EO between three populations and within the same location. This study identified several chemotypes: (1) *α*-pinene, limonene and germacrene D; (2) *α*-pinene, *β*-pinene, *β*-caryophyllene and germacrene D; (3) *α*-pinene, *α*-phellandrene, limonene and *β*-caryophyllene; (4) *α*-pinene, *β*-pinene, limonene, *β*-caryophyllene and germacrene D; and (5) *α*-pinene, *β*-pinene, limonene and germacrene D. This is the first comprehensive study on the endemic plants *P. heldrejchii* that identified several chemotypes based on the EO composition. The EOs showed moderate antimicrobial activity towards *Escherichia coli, Salmonella enterica susp. enterica* and *Listeria monocytogenes.*

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P39. Chemotypes of *Pinus peuce* in Bulgaria and the antimicrobial activity of its essential oils

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Keywords: Bulgaria, essential oil; *Pinus*; Tertiary relict; Balkan endemic; limonene; germacrene; chemotypes

Pinus peuce is a Balkan endemic found only in Bulgaria, Albania, Greece, Macedonia, Montenegro, and Serbia. The Bulgarian mountains (Rila, Pirin, Stara Planina) are the eastern part of the distribution area for this species. The aim of this study was to establish the variability of essential oil (EO) content and composition of *P. peuce* collected from Bulgaria (interpopulation) and it's antimicrobial activity. The EOs from thirteen locations were obtained from branches by hydrodistillation and were analyzed by GC/MS/FID. Generally, the EO yield on the interpopulation level of *P. peuce* varied from 0.88% to 1.96%. The monoterpenes were the predominant class comprising 76.8 to 91.53% of the total EO. *α*-Pinene, β-pinene, limonene, camphene and germacrene D were the main constituents of the EO. *α*-Pinene varied from 24.36% to 49.64% and limonene from 5.73% to 44.94%. Germacrene D and β-pinene also varied widely, from 4.38% to 12.49% for germacrene D and from 7.70% to 16.92% for β-pinene. There were significant variations of EO between locations and within the same location. This study identified several chemotypes: (1) *α*-pinene, camphene, β-pinene, limonene and germacrene D; (2) *α*-pinene, β-pinene, camphene, limonene, bornil acetate and germacrene D; (3) *α*-pinene, β-pinene, β-myrcene, *α*-phellandrene and germacrene D; and (4) *α*-pinene, camphene, β-pinene, limonene, β-myrcene and germacrene D. This is the first comprehensive study on the endemic plant *P. peuce* that identified several chemotypes based on the EO composition. The EOs showed moderate antimicrobial activity towards *Escherichia coli, Salmonella enterica* susp. *enterica* and *Listeria monocytogenes.*

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P40. Medicinal plants - a source of new acetylcholinesterase-inhibitor molecules in the fight against neurodegenerative diseases

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Keywords: Medicinal plant, conservation, climate change, diversity

Medicinal plants are an irreplaceable source of biologically active substances and attract the attention of researchers around the world looking for the potential to use this wide variety of metabolites in the treatment and prevention of many diseases. Neurodegenerative diseases are the result of progressive damage leading to neuronal loss and affect millions of people worldwide. The incidence rate is rising every year (according to estimates for 2050 - Alzheimer's disease alone will affect 131 million people). The reasons for this progressive damage to nerve cells are not fully understood, but some of the pathological pathways have been identified and summarized in several key hypotheses - oxidative (increased free radicals, mitochondrial damage, β-amyloid plaque formation), inflammatory (increased cytokine production, microglial cell activation), apoptotic (glutamate-induced, H_2O_2-induced). The search for specific inhibitor molecules to be involved in certain steps of the cascade pathways and to prevent degenerative processes is a challenge that must be solved. Bulgarian flora is extremely rich in species, many of which are poorly or completely unexplored in this aspect. The present study aimed to investigate the ultrasonic-assisted preparation of *Sideritis scardica* extracts and their acetylcholinesterase-inhibitor potential. The polyphenols and diterpenes are identified in the extract. Among them, phenylethanoid glycosides, phenolic acids, and flavone glycosides were presented in higher concentrations.

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P41. Micromorphological and phytochemical investigation of endemic *Satureja kitaibelii* Wierzb. ex Heuff.

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Keywords: savory, essential oil, flavonoids, alkanes, morphometry, Serbia

Satureja kitaibelii Wierzb. ex Heuff. is a Balkan endemic species that inhabits dry cliffs and open areas along the Balkan mountains range. The previous studies of this taxon focused mainly on the essential oil composition and its biological activities. However, morphological and phytochemical variability of this species was largely neglected, with the exception of several authors in the 70's. This is largely due to the fact that up to recently this taxon was considered to be a subspecies of *S. montana*. Since molecular data did not separate taxa within genus *Satureja*, morphological and phytochemical characters were investigated. In this work, we studied leaf and calyx characteristics using a morphometric approach. Additionally, several phytochemical markers of *S. kitaibelii* were also studied - namely essential oils (EOs), alkanes, and exudate flavonoids. Morphometric results showed differentiation between all three populations based on leaf characters. EO analysis showed different main components in studied populations, *p*-cymene, linalool and geraniol. Dominant *n*-alkanes were *n*-C31 (39.3%), followed by *n*-C29 (29.9%) and *n*-C33 (17.6%). Dominant surface flavonoides were cirsimaritin (28.8%), xanthomicrol (36.1%) and gardenin B (19.1%). Comparison of these results with other taxa of the same genus from the Balkans showed stronger differentiation from geographically more distant *S. subspicata* than with *S. montana*. Continental populations of *S. montana* were the most similar with *S. kitaibelii*. In conclusion, interpopulation variability on all studied markers followed a more-or-less similar pattern. Additionally, interpopulation variability was stronger than in other studied Balkan *Satureja* species with continuous distribution range, such as *S. montana*. This is probably due to fragmented distribution, which influences the gene flow between populations.

P42. Overview of carotenoids distribution among wild plant species of the Balkan Peninsula

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Keywords: Balkan peninsula, carotenoids, database, wild plants

The Balkan Peninsula is characterized by a great diversity of flora and vegetation. Moreover, it is native to a large number of wild plant species containing carotenoids, biologically active compounds, beneficial for human health. Carotenoid pigments exhibit a great antioxidant and anti-inflammatory effect, in addition to beneficial impact on eye health, heart, blood vessels, cognitive function and antiaging. Nevertheless, their role has been scientifically proven in prevention and treatment of cancer.

The aim of the research was to form a database on carotenoid plants of Serbia and the Balkans that is set up electronically for easy access, management and updating. The research included the analysis and organization of information on collected plants, as well as literature data related to the traditional use and storage of plants and plant parts and products rich in carotenoids in fresh, dried or canned state.

Sixty wild plants from more than ten plant families were registered to contain these antioxidant pigments. Among them three endemic species namely *Lilium bosniacum* (Beck) Fritsch (lily native to Bosnia and Herzegovina), Ramonda nathaliae Pančić & Petrović and *R. serbica* Pančić were inscribed, of which the last two are Tertiary relicts. The type and level of carotenoids varied depending on the plant species and organs including leaves, petals, immature and ripe fruits, pulp, seeds, etc. According to database, fruits were the richest source of these pigments. Reported carotenoid content, included both xanthophylls and carotenes, whereas lutein and β-carotene were predominantly major compounds in berries and flowers respectively. Total carotenoid content, determined by HPLC method, was the highest in fresh berries of *Rubus fruticosus* L. (440 µg/100g).

P43. Phenolic compounds and free radical scavenging activity of endemic Thymus species

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Keywords: *T. atticus T. comptus T. longedentatus T. perinicus T. sibthorpii*

Thymus species are valuable medicinal and aromatic plants with application in the pharmaceutical, cosmetic and food industries. Currently, the number of species of the genus Thymus in Bulgaria is 21. The aim of present study was to examine phenolic acids profiles and free radical scavenging activity of five endemic Thymus species. Objects of analysis were the following *Thymus* species: *T. perinicus* (Bulgarian endemic) *T. longedentatus, T. comptus* (Balkan endemics) and *T. atticus*, *T. sibthorpii* (sub-endemics). Methanolic extracts of studied species was analysed by GC/MS. Phenolic acids of the species were characterized in their three forms: free (identified in methanolic extract), esterified (identified in methanolic extracts after alkaline hydrolysis) and methanol insoluble bound (identified after alkaline hydrolysis of residue material after methanol extraction). Total phenol content was determined using Folin–Ciocalteu reagent. Free radical scavenging activity of methanolic extract was evaluated by DPPH method. 4(p)-Hydroxybenzoic (**1**), vanilic (**2**), hydroxycinnamic-p-*trans* (**3**), protocatechuic (**4**), syringic (**5**), caffeic-*trans* (**6**), ferulic-*trans* (**7**), quinic (**8**), chlorogenic (**9**) and rosmarinic (**10**) acids were identified in the free form in the studied methanolic extracts. As methanolic soluble alkaline hydrolysable phenolic acids, cinnamic-*trans* (**11**), hydroxycinnamic-p-*cis* (**12**), ferulic-*cis* (**13**), caffeic-*cis* (**14**) and (**1,2,3,4,5,6,7**) were found. Salicylic (**15**), sinapic (**16**) and (**1,2,3,4,5,6,7,11,12,13,14**) acids were established as methanolic unsoluble alkaline hydrolysable. Differences in quality and especially in the quantitative composition of phenolic acids between different species were established. Phenolic acids in a bound form were found in the highest quantity. High antiradical activity (IC_{50} < 50 µg/mL) was established for all studied extracts with exception of *T. perinicus* extract. The observed radical activity have correlation with rosmarinic acid and total phenolic contents in the studied samples. The present study provides new data about chemical composition and antioxidant capacity of five endemic species.

P44. Phytochemical and molecular analysis of *Sideritis* taxa from Greece

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Keywords: chemotaxing, DNA markers, Greek flora, mountain tea, gene trees, terpenoids

The genus *Sideritis* encompasses more than 150 species distributed in Northern Hemisphere but mostly found in the Mediterranean area. Greece hosts 16 *Sideritis* taxa: 5 Greek endemics, 5 Balkan endemics and 6 Mediterranean elements. Many of them are commonly known as "mountain tea" or "ironwort" and are widely used in traditional medicine. The genus is characterized by complex taxonomic classification due to hybridization possessing also various pharmacological properties primarily attributed to the presence of diterpenes, flavonoids, and essential oils.

The aim of this study was to investigate the phytochemical composition and the genetic relationships of Greek *Sideritis* taxa (*Sideritis clandestina* subsp. *clandestina*, *S. clandestina* subsp. *peloponnesiaca*, *S. euboea*, *S. raeseri* subsp *raeseri*, *S. raeseri* subsp. *attica*, *S. scardica*, *S. sipylea*, *S. syriaca* subsp. *syriaca*) and also to examine whether a correlation exists between the chemical composition and the genotype. For the phytochemical analysis, the volatile and nonpolar secondary metabolites were extracted and compared using Gas Chromatography – Mass spectrometry (GC-MS) followed by statistical analysis (CATPCA, AHC, DA). For the molecular study, three chloroplast regions (*matK*, *psbA-trnH*, *trnL-F*) were sequenced and analyzed employing distance (NJ, UPGMA) and character-based (ML) methods.

Our preliminary results demonstrate that in all taxa diterpenes predominate with two main compounds, siderol and sideridiol, which are highest in *S. clandestina*. Regarding chemotaxing, *S. cladenstina* and *S. euboea* showed many similarities in terms of composition, as well as *S. scardica* with *S. raeseri* subsp. *raeseri*. All the generated trees indicate that *S. sipylea* and *S. syriaca* subsp. *syriaca* belong to separate well-supported clades whereas for the remaining taxa the relationships are not clearly resolved. However, one population of *S. clandestina* subsp. *clandestina* from Mt. Parnon forms a separate clade from the other populations of the species as well as *S. raeseri* subsp. *attica* is distinguished from the typical subspecies.

P45. Volatile organic compounds of an endemic species *Centaurea tomorosii* Micevski from North Macedonia

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Keywords: Asteraceae, GC-FID/GC-MS, essential oil

Centaurea tomorosii Micevski (Asteraceae, Circum - Mediterranean Clade (CMC), subsect. *Centaurea*) is a perennial herbaceous plant with pale yellow flowers. It grows among calcareous rocks, on Mt. Galičica: [Tomoros, 1450 m.a.s.l.] and is endemic to the southwestern part of North Macedonia. In this study, the volatile constituents of dried aerial parts of *C. tomorosii* from Mt. Galičica were analyzed. Essential oil was obtained by simultaneous distillation and extraction using Likens–Nickerson type apparatus and analyzed by GC-FID/GC-MS. Out of 56 compounds detected, 41 were identified (90.65%). Aliphatic hydrocarbons were the most represented class of compounds (68.38%). In the case of terpenoid constituents, sesquiterpenes were more abundant (20.20%) than monoterpenes (2.06%), with the prominent occurrence of oxygenated derivatives of sesquiterpenes and monoterpenes (15.37% and 1.73%, respectively). Dodecanoic acid was identified as a principal compound (13.03%), followed by hexanoic acid (6.78%), and (2E)-Hexenal (3.93%). This is the first data related to the volatile organic compounds of an endemic *C. tomorosii*.

P46. "Double-arrow" phragmoplasts under heat-stress in various plant species: possible heat-sensitivity of katanin

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Keywords: cytokinesis, heat-stress, katanin, microtubules, phragmoplast

Higher plant cytokinesis is achieved by the centrifugal expansion of the phragmoplast/cell plate apparatus. During lateral phragmoplast expansion, its microtubules are released from the surface of telophase nuclei, as their (-) ends are severed by p60-katanin, the enzymatic subunit of the heterodimeric katanin protein. As a result, the microtubules of the expanding phragmoplast remain short, restricted to the edges of the cell plate. In *Arabidopsis thaliana* mutants defective in p60-katanin activity, such as *fragile fiber2* (*fra2*), phragmoplast microtubules are not severed, remaining thus connected to the telophase nuclei, being abnormally long and bended, exhibiting a characteristic "double-arrow" configuration. Apart from this peculiar morphological deviation, p60-katanin malfunction delays cytokinesis and results in cell plate malformations.

In an attempt to assess phragmoplast formation and expansion under heat-stress, wild-type and *fra2 A. thaliana* seedlings were subject to short-term (20–60 min) exposure to 37°C. Surprisingly, the phragmoplasts of heat-stressed wild-type seedlings phenocopied those of untreated *fra2*, exhibiting the "double-arrow" configuration. The above effect was reversible, when the heat-stressed seedlings were left to recover at 20 °C for 24 h.

In order to evaluate the effectiveness of high temperature, as a universal "tool" to temporarily hinder p60-katanin activity, the same heat-stress was imposed in various dicot (*Vigna sinensis*) and monocot (*Zea mays*, *Triticum turgidum*) species, as well as to the liverwort *Conocephalum salebrosum*. After 20-60 min of exposure to 37°C, "double-arrow" phragmoplasts were commonly found in cytokinetic cells of all the above species. It is tempting thus to assume that the severing activity of p60-katanin is heat-sensitive. Further research is needed to verify the involvement of p60-katanin to this effect and reveal the details of the above outcome.

P47. Leaf structural traits of carob tree bioindicating air pollution

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Keywords: biomonitoring, *Ceratonia siliqua*, leaves, morphology, pollution

Leaves of the evergreen carob tree (*Ceratonia siliqua* L.) expanded and exposed to more and less polluted habitats in Athens metropolitan area (namely herein urban and suburban, respectively) were studied using light microscopy.

Healthy leaves (i.e., the 3rd leaf counting from the top of each shoot) were collected from carob trees grown in suburban and urban sites, which were selected taking into consideration the existence of nearby air quality monitoring stations. Leaves grown in the urban sites and exposed to air pollution possess increased thickness of the lamina and elevated ratio of palisade *vs* spongy parenchyma, in comparison to leaves collected from suburban site; also, the number of palisade cell layers varied between four and three for leaves expanded in urban and suburban conditions, respectively. The thickness of both the upper and the lower epidermis was higher in suburban leaves in comparison to urban leaves. Also, thicker walls of adaxial and abaxial epidermal cells and smaller intercellular space have been observed in suburban leaves, in comparison to urban leaves. The specific leaf area (SLA) was also investigated and smaller values were estimated in suburban leaves, when compared to urban leaves of carob.

Differences in leaf optical properties and pigments' concentration (which have been investigated) have significant implications for designing and modelling simulation purposes linked to air pollution.

P48. Leaf vascular characteristics of the wild *Helianthus* species

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Keywords: sunflower, leaf, anatomy, vessels

Variations in leaf vascular system among wild perennial *Helianthus* species could indicate their different tolerance to drought, which is becoming more important due to rapid climate change. Therefore, the aim of this research was to perform detailed comparative analysis of petiole and lamina main vein vessels in 19 perennial *Helianthus* species.

Cross sections were obtained from the middle part of petiole and lamina main vein, using cryotechnic procedure. Observations and measurements were performed using light microscope.

The cross section of the petiole varied from horseshoe to sickle shape. The most developed vascular bundle was always centrally placed, two more better developed ones were observed laterally, and significantly smaller conductive bundles (1 to 3) were present between them. The only two species with sessile leaves were *H. mollis* and *H. salicifolius* which significantly differed in examined parameters. Species *H. mollis* was characterized by the large cross-section area of the main vein as well as total area of vascular tissues (xylem and floem), size of lumen and number of vessels. On contrary, *H. salicifolius* was distinguished by *t*he smallest values of the above montioned parmeters. Among the species with petiole, *H. tuberosus* and *H. hirsutus* had the largest petiole cross section area with a higher number of large vascular bundles. In most of the examined species, vessels of smaller lumen (<100 μm^2), dominated in the main vein. Oposite, *H. mollis*, *H. tuberosus, H. resinosus* and *H. hirsutuss* stood out with the most frequent (>50%) presence of large-lumen vessels (100-500 μm^2) and theoretically the highest hydraulic conductance. A relatively large number of small vassels in the petiole and the main vein was also present in *H. divaricatus* and *H. pauciflorus.* Xeromorphic structure in *H. salicifolius, H. pauciflorus* and *H. divaricatus* could indicate higher drought tolerance and new possibilities in breeding of cultivated sunflower.

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P49. Root cell wall modifications present in *Arabidopsis arenosa* and *Arabidopsis halleri* Zn and Cd hyperaccumulators

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Keywords: heavy metals; matrix polysaccharides; metalliferous soils; pseudometallophytes

Heavy metals and other environmental contaminants pose serious threats to ecosystems. Due to the mineral makeup of the lithosphere, heavy metals are found in all soils in different concentrations. Heavy metal stress can drive changes in plants morphology and physiology. One of the mechanisms commonly used by plants for their detoxification is the distribution of the metal to trichomes and to the cell walls. Cell walls, therefore, play a very significant dual role, being at the same time a barrier and a target of heavy metal toxicity. Plant cell walls can be remodeled in order to respond to various conditions and their composition can be modified to cope with the stress condition applied.

Although there is a lack of knowledge about the ecophysiology of hyperaccumulator species, some *Arabidopsis* species have been identified as pseudometallophytes, among them *A. arenosa* and *A. halleri*, which are considered as hyperaccumulators of zinc (Zn) and cadmium (Cd). In this study, seeds of *A. arenosa* and *A. halleri* populations were collected from Central Europe. Each species included (sub)populations growing in metalliferous and non-metalliferous soils. The differences in the cell wall composition between the above (sub)populations was therefore examined. Cell wall matrix components distribution varied between the diverse (sub)populations of the same species. Furthermore, when Cd was exogenously applied to plants, the cell wall matrix distribution resembled that of the (sub)population originating from metalliferous soils.

The above results pinpoint the significance of the cell wall matrix materials distribution in the effort of the plant to fight the specific stress condition. They also imply that a common mechanism is triggered when populations of a specific species are faced with heavy metal stress and that the changes occurring due to this mechanism remain in the metalliferous (sub)population root morphology and anatomy even when stress is not anymore applied.

P50. Stomata in contact: a special feature of the stomata structure in the Amaryllidaceae family

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Keywords: callose, crystalline cellulose, homogalacturonans, *Pancratium maritimum*

Amaryllidaceae family is widely distributed from temperate to tropical regions, showing dry-adapted characteristics. A special feature found in these plants, is that the guard cells of neighboring stomata complexes form a connection or are in close contact. In the present study, this feature was studied both in terms of its composition and its effect on the function of the stomata in *Pancratium maritimum* L., while its presence was evaluated and in other members of the Amaryllidaceae family.

To elucidate the composition of this specific structure, digitalized polar, optical and electron microscopy were utilized. Additionally, cell membranes and cell wall matrix materials were labeled, while through immunohistochemistry, homogalacturonans, hemicelluloses, mannans and extensins epitopes were detected. Furthermore, the possibility of this structure to affect stomatal morphology and function was investigated by examining various stomatal characteristics (width, length, aperture size) on the stomata that were in contact, in connection, or not displaying any kind of connection.

The data suggested that the structure connecting the dorsal cell walls of two adjacent stomata is formed at the middle of the intermediate epidermal cell adjoining the two stomata. It is comprised of cell wall matrix materials, with various homogalacturonans and callose to be the main components, and was prone to pectinase application. Cellulose crystallinity is increased in the epidermal cell wall, at the site where the two stomata are in close contact or in connection. Connected stomata were observed in the three sub-families of the Amaryllidaceae family, namely Amaryllidoideae, Allioideae and Agapanthoideae, while variations in intensity, form and leaf area of presence were observed. Also, this structure seems to influence the size of the stomata and their aperture size; consequently, it is possible to have an effect on stomatal function. The role of this feature in the adaptation strategies and microevolution of the family is discussed.

P51. Variation in hydraulic conductivity on sunflower root seedlings

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Keywards: sunflower, root, anatomy, vessels

In sunflower breeding, seeking an increase in yield is a priority for improving the drought tolerance of plants. At the Institute of Field and Vegetable Crops (Novi Sad, Serbia) by the sunflower breeding program, the inbred lines and drought-tolerant hybrids are being developed for more than 20 years. These efforts included the traditional approach of crossing parental lines that are suspected of having drought-tolerant characteristics and assessing off spring in field conditions. Tolerance to drought is a complex phenomenon comprising a number of physiological-biochemical process and the root architecture (morphology and anatomy).

For the detailed root anatomical characterization, especially xylem features, we selected the sunflower genotypes which generally have higher yields in a range of conditions with limited water. Furthermore, we analyzed inbred lines that differ in maturity: early, medium early and late maturing. Roots of fourteen days old seedlings grown in rhizotrons were analysed. Root cross-sections were cut along the root maturity. Three sections per root were made using cryotechnic procedure.

The comparative root anatomy revealed significant phenotypic variability among genotypes. According to the results obtained by an application of the Discriminant Analysis of the main components, characteristics: % of cortex, cortex parenchyma cell layers, % of xylem cross-section area, and % of vessels with lumen <1000 μm^2 contributed to the discrimination among the genotypes. Genotype NS Gricko had the largest total vessels lumen and vessels diameter, and consequently the highest theoretical hydraulic conductance. The early maturing inbred lines had the highest % of vessels with lumen <1000 μm^2. The ratio of these vessels decreasesalong the maturity gradient. The vessels with lumen area between 1000-4000 μm^2 were the most numerous for all genotypes. The obtained results showed that the inbred lines with xeromorphic structure IMI AB 14 and Ha 26 OL could be useful in breeding for drought tolerance.

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P52. Accumulation of Manganese in *Euphorbia glabriflora* studied *in situ* and by the portable XRF herbarium scanning

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Keywords: Euphorbiaceae, XRF spectroscopy, manganese accumulation, Balkan Peninsula

With 45 hyperaccumulators known to date, the Euphorbiaceae family is one of the plant families with the largest number of hyperaccumulators. Considering that most of these species hyperaccumulate Ni, it is of particular importance to study them in the Balkan Peninsula, with the largest ultramafic outcrops in Europe. To determine the potential metal accumulation, samples of plants and soils of *Euphorbia glabriflora* from two limestone and three sites with ultramafic geological substrate were analyzed. Biological concentration factor and shoot-to-root ratio were used to evaluate accumulation potential. The results of the soil and plant material analyzes are consistent with the basic characteristics of the substrate on which they occur. Although no element exceeds the nominal hyperaccumulation threshold, relatively high Mn concentrations were found, which have been shown to have active accumulation in above-ground tissues, as the shoot-to-root ratio is greater than 1 in all samples (up to 9 in the sample from Žuta stijena in Jadovnik). Additional screaning was perfomed on the herbarium material of *E. glabriflora* and the closely related *E. spinosa* deposited in the Herbarium of the Institute of Botany and Botanical Garden "Jevremovac" of the University of Belgrade (BEOU) using X-ray fluorescence spectroscopy. Manganese concentrations of more than 1000 ppm (with a maximum of 4000 ppm) were detected in a considerable number of specimens. Significantly lower values were found in *E. spinosa*.

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P53. A common Mediterranean diatom shifts lipid and protein production under influence of relevant climate change stressors

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Keywords: diatom, phytoplankton, marine lipids, lipid remodeling, climate change

The Mediterranean Sea is considered a climate change hotspot due to the specific physical and climatological properties that define the basin. The increasingly warm surface layer in the Mediterranean Sea, accompanied by a stronger oligotrophication, is reflected in the vulnerability of phytoplankton populations to introduced stresses. These changes in environmental conditions influence carbon allocation and remodeling of organic classes in phytoplankton. In this study, we subjected the diatom *Chaetoceros pseudocurvisetus*, abundant and ecologically important primary producer in the Mediterranean Sea, to a matrix of different temperature and nutrient conditions: 15 °C as optimal and 25 °C and 30 °C as temperature stress, and varying inorganic nitrogen (N) availability, mimicking optimal, eutrophic, and oligotrophic conditions. We examined the lipidomic response using thin-layer chromatography coupled with electrospray mass spectrometry, while the total protein content was quantified according to the modified Lowry method. The sampling timing proved to be crucial in the interpretation of data. During the exponential growth phase, no significant changes between *C. pseudocurvisetus* responses in different treatments were observed, while the following trends were established at the onset of the stationary phase. Bulk lipid content decreased with increasing temperature and decreasing available N in the medium. Protein production was strongly limited in oligotrophic conditions, and it remained constant at different growth temperatures, while it decreased with temperature in eutrophic and optimal N conditions. We found that the assessment of the protein-to-lipid ratio can provide a good insight into cell biochemistry. Changes in lipid and protein content have a profound effect on the wellness of an individual cell, however, alteration in their availability can impact the entire food web structure and health.

P54. A comparative study of stress resistance between *Triticum aestivum* and *Triticum diccocum*: microtubule organization and mitotic cell division as targets of adverse abiotic challenges

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Keywords: abiotic stress, cell division, cytoskeleton, mitosis, Triticum aestivum, Triticum dicoccum, wheat

Currently, there is as shift in wheat cultivation towards *Triticum dicoccum*, because it is considered as nutritionally better and as more robust against several abiotic stress conditions, in comparison to *Triticum aestivum*. In the present study, the above wheat species were subject to extreme temperature stress, heavy metal toxicity and increased salinity. Their responses at cellular level were compared, assessing microtubule integrity and organization, as well as the process of mitotic cell division.

Under all treatments, both species exhibited defects in microtubule organization and chromosome morphology and distribution, depending on treatment duration. In addition, the mitotic index was altered under all conditions, compared to the control. Unexpectedly, *T. dicoccum* cells appeared more sensitive than those of *T. aestivum*, in almost all kinds of stress. Under exposure to low temperature on ice (0°C), defective metaphase and anaphase spindles were observed in both species, resulting in incomplete chromosome segregation. Furthermore, abnormal phragmoplast organization and ectopic daughter nuclei localization were recorded in cytokinetic cells. Under heat stress (37°C), extensive microtubule depolymerization was recorded after 12h and 24h, while only few remnants were only scarcely observed.

In cells exposed to Cr and Cu, several defects were observed, the most frequent of which was faulty cytokinesis, due to impaired phragmoplast organization, and the presence of nuclei constricted by a microtubule ring. Under high salinity, cells with lobed nuclei and binucleate cells were observed. In addition, defective preprophase band, metaphase and anaphase spindles were also recorded.

Our findings reveal several aspects of cell response to various stresses, confirming the significance of microtubule organization and cell cycle as targets of stress factors. However, this study refutes the view that *T. dicoccum* is more resistant than *T. aestivum*, at least against the treatments applied here. Accordingly, this concept has to be further re-examined, also in terms of ecophysiology.

P55. New Zn hyperaccumulator within the genus Cardamine revealed by portable XRF herbarium scanning

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Keywords: Brassicaceae, *Cardamine waldsteinii*, Zn hyperaccumulation, XRF spectroscopy

The discovery of new hyperaccumulator species has improved in recent years with new methods that can detect elements in plants at concentrations above the nominal threshold in a shorter time. In particular, X-ray fluorescence spectroscopy has recently been widely used as a non-invasive method for screening plant material and determining their chemical composition. In this way, the material deposited in the Herbarium of the Institute of Botany and Botanical Garden "Jevremovac" of the University of Belgrade (BEOU) and in the Herbarium of the Natural History Museum in Belgrade (BEO) was analyzed. The portable XRF device was used to analyze representatives of the genus *Cardamine*, one of the largest within the family Brassicaceae (with 239 recognized species). The results of this analysis showed a mean Zn concentration of 1020 ppm and a maximum value of 3300 observed in specimens of *C. waldsteinii* in non-metalliferous soil. These values above the hyperaccumulation threshold indicate a potential hyperaccumulation capacity of the species, which needs to be confirmed by analysis of material from the field. Relatively high values were also found in *C. pancicii* with 576 ppm as mean and maximum values of 1500 to 1900 ppm Zn. Several specimens of this species were found to have Cu concentrations exceeding the threshold for hyperaccumulation (350, 555, and 6000 ppm). However, considering the much lower values observed in other specimens of this species and the site characteristics (former Fe-Cu mine), these anomalous concentrations suggest contamination with soil particles. Nickel concentrations are generally low and values above 100 ppm were observed in only one specimen of *C. glauca* and *C. plumierii*.

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P56. Nickel accumulation of *Odontarrhena chalcidica* (Janka) Španiel & al. and its effects on morphological and physiological parameters under drought stress

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Keywords: Agromining, hyperaccumulation, *Alyssum murale*, drought stress

In this experiment we studied the effect of drought on the growth of the Ni hyperaccumulating plant species *Odontarrhena chalcidica* (Brassicaceae), a potential candidate for use in Ni Agromining. Serpentine soils are characterized by very low levels of essential macronutrients (N, K, P), a Ca/Mg ratio < 1 and high concentrations of heavy metals such as nickel, chromium and cobalt. The aim of this study was to explore the adaptation mechanisms of *O. chalcidica* to serpentine soils and also the responses of *O. chalcidica* to simultaneously stress of drought and Ni toxicity. The study was conducted in spring 2020 in the farm of International Hellenic University (IHU). Two soil types were considered: the first from the surface soil (0–20 cm) of the farm of the International Hellenic University and the second was collected from the mountain range of Northern Pindus (serpentine soil). Hence, 15 pots were randomly assigned to non-serpentine soil and 15 to serpentine soil. 15 pots of each soil type were taken and divided into 5 treatments of 3 plants (control, irrigation 80%, 50%, 40%, 25%), respectively. The experiment lasted 120 days and all plants were irrigated frequently. At the end of the experiment leaf material was collected in order to be analysed for macronutrients and micronutrients using atomic absorption spectroscopy. Leaf K and Ca concentrations were significantly higher in non-serpentine soil, compared to the serpentine soil treatment.

Additionally, we have estimated photosynthetic and chlorophyll fluorescence parameters. Our results showed that photochemical activity of PSII was inhibited in plants growing in the serpentine soil regardless of the irrigation treatment; this inhibition was lower in the 80% and 50%, respectively. The reduction in the photosynthetic performance is most probably due to reduced water supply. Moreover, nickel accumulation increased when water stress was more severe (25% supply).

P57. Partitioning of free proline in organs of four Mediterranean geophytes within the context of the seasonality

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Keywords: geophytes, Mediterranean, proline, seasonality, stress

The perennial geophytes exhibit a life-cycle, within the context of seasonality, which is characterized by two phenological stages: the active and the dormant phase, when the aboveground plant parts are not visible. Also, their life-cycle is usually associated with temporal separation of leaf development from flower expansion. The Mediterranean geophytes in their natural habitats possess several ecophysiological traits, contributing to their response to abiotic stresses. A well-studied mechanism is the accumulation of proline, which has proven to be a multi-functional tool in plant metabolism. Four Mediterranean wild-grown geophytes, which complete their biological cycle at different months of the year, were selected i.e. (cited in alphabetic order) *Cyclamen graecum*, *Iris germanica*, *Pancratium maritimum* and *Sternbergia lutea*., in order to study free proline accumulation in their organs. Within the context of seasonality, the highest proline values in the belowground organs (bulbs, rhizome and tubers, which support annual growth) were measured in *I. germanica* in January, in *S. lutea* in March, in *C. graecum* in June and *P. maritimum* in December. In the leaves elevated proline accumulation was estimated in *P. maritimum* in January, in *C. graecum* in February, in *I. germanica* in October and *S. lutea* in December. In the petals high proline accumulation was measured in *I. germanica* in May, in both *C. graecum* and *S. lutea* in October and *P. maritimum* in July. Free proline accumulation is linked to ecophysiological adaptation of the considered geophytes grown under ambient conditions in the eastern Mediterranean.

P58. Protective effects of nitric oxide on the photosynthetic apparatus under salt stress

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Keywords: sorghum, NaCl, nitric oxide, chlorophyll fluorescence, membrane integrity, oxidative stress markers

The aim of present study was to assess the effect of exogenous nitric oxide (NO) on two varieties of sorghum (*Sorghum bicolor* L. Albanus and *Sorghum bicolor* L. Shamal) under salt stress.

The plants were grown in ½ Hoagland solutions for 14 days and then treated with 150mM NaCl for 6 days. The co-treatment with different concentrations (0, 25mM, 50mM, 150mM, 300 mM) of SNP (donor of NO) was applied through foliar spraying on the plants. Chlorophyll fluorescence (PAM and JIP test), P700 photo-oxidation, pigment analysis, determination of the membrane integrity and antioxidant markers were used for characterization of the protective role of NO under salt stress.

The treatment of plants with 150 mM NaCl led to an inhibition of the functions of the photosynthetic apparatus: the maximum quantum yield of primary PSII photochemistry (jPo), the photochemical quenching (q_P), the electron transport flux from Q_A to Q_B (ETo/RC) and electron transport flux until PSI (REo/RC). These changes corresponded with membrane damage, a decrease of the pigment composition, an increase of the hydrogen peroxide and non-photochemical processes (q_N). The analysis of the P700 photooxidation revealed that the PSI photochemistry was also inhibited by NaCl. Data revealed that the treatment with NO decreases the negative effects of salt stress on the studied varieties (Albanus and Shamal). Experimental results also showed different salt-induced changes, as well as different NO protection in the both varieties of sorghum. Data clearly revealed that the protective effects of NO were better after spraying the plants with lower concentrations of SNP (–below 150mM). The reasons for different sensitivity and protection of studied plants are indicated.

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P59. The use of different LEDs wavelength and light intensities on photosynthetic function, leaf anatomy and in vitro rooting of MM106 apple rootstock

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Keywords: light absorption spectra, root explants, chloroplast ultrastructure, photosystem II function, chlorophyll content

Currently, many clonal rootstocks have been developed which are considered better than seedling rootstocks due to their wide adaptability, disease and insect pest's resistance. Among them, one of the suitable apple clonal-rootstock is MM106 (*Malus domestica* Borkh.).

In preliminary experiments examining photosynthetic pigments, photosystem II photochemistry, leaf anatomy and *in vitro* rooting of MM106 under three light wavelength absorption spectra including 400-700 nm (White Fluorescent Light, WFL), 450-660 nm (blue-green-yellow-orange-red, LED1) and 450-550 nm (mainly blue-red, BR, LED2) at 40 μmol m^{-2} sec^{-1} intensity, LED2 was found to be the most beneficial one. For this reason, three different light intensities of the absorption spectrum (BR) were tested [40 μmol m^{-2} s^{-1} (LED2), 120 μmol m^{-2} s^{-1} (LED3) and 20 μmol m^{-2} s^{-1} (LED4)]. All root formation attributes were significantly higher in LED4 while the highest light intensity of 120 μmol m^{-2} s^{-1} (LED3) led to 100% stressed explants and severe rooting inhibition, with underdeveloped grana thylakoids and noticeable presence of plastoglobuli, indicating oxidative stress. *In vitro* grown MM106 rootstock explants at LED2 exhibited the typical anatomy for the dicots with the upper epidermis having larger cells than the lower one but being devoid of stomata, which were numerous on the lower epidermis. Ultrastructural observations revealed that LED4 explants possessed more but smaller chloroplasts. Under LED4, the fraction of energy used for photochemistry (Φ_{PSII}) increased significantly due to an increased fraction of open PSII reaction centers (q_P), while at the same time, the fraction of non-regulated energy loss (Φ_{NO}) decreased significantly compared to LED2 and LED3. Moreover, this higher efficiency of PSII function under LED4 was correlated with decreased Chlb content and an increased Chla/Chlb ratio.

Therefore, it was concluded that *in vitro* rooting of MM106 was best promoted under LED illumination of BR spectrum at 20 μmol m^{-2} s^{-1} intensity.

P60. Variation of photosynthetic traits of chasmophytic *Campanula* taxa (Campanulaceae) as a response to temperature and season

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Keywords: chasmophytes, chlorophyll fluorescence, endemics, photosynthesis

Obligate chasmophytes are a significant part of the Mediterranean plants and, particularly in Greece, comprise 21% of Greek endemic flora. They are adapted to tolerate the extreme conditions imposed by a vertical habitat and withstand the hot and dry summer of Mediterranean climate. The geographic limits of the chasmophytic communities are mainly defined by climate, type of substrate and their local distribution by the aspect of the cliffs. The exposure of the cliffs indicates the significant role of the light supply, the prevailing temperature, the wind, the insolation and the minor differences of habitats in the differentiation of chasmophytes. In this view, understanding the interactions between the chasmophytic plants and their environment is important. The studied taxa of *Campanula* are typical obligate chasmophytes, except *C. pelviformis*, which is facultative.

The response of the photosynthetic machinery efficiency to temperature change was examined in *Campanula* taxa both experimentally in the laboratory (15°C, 24°C, 35°C) and seasonally under natural environmental conditions (winter, spring, summer). The methods of chlorophyll fluorescence and leaf reflectance spectrometry were used for the calculation of several biophysical indices related to various aspects (traits) of photosynthetic performance.

According to our results, the photosynthetic machinery of the studied taxa appeared sensitive to high temperature either experimentally in the laboratory or during summer under field conditions. The effect was most pronounced in *C. pelviformis* and *C. merxmuelleri*. The low winter temperature, which is generally considered as a second stressful period for Mediterranean plants, did not seem to be particularly stressful for the studied taxa. Comparing the photosynthetic profiles of the studied species, *C. anchusiflora* and *C. topaliana* subsp. *delphica* showed the minor capacity for acclimating to the hot and dry summer. However, *C. topaliana* subsp. *delphica* seems to be the most capable in terms of photoprotection adjustments among all the studied species.

P61. Utilization green energy technologies for water/carbon footprint minimization of an intensive combined cultivation in a controlled, protected environment: a lettuce-*Chlorella vulgaris* example

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Keywords: carbon footprint, hydroponics, *Chlorella vulgaris*, green-energy technologies

Hydroponic cultivations are facing major problems due to higher operational cost and pollution originated from the discharge of waste nutrient solution. We therefore investigated the possibility of recirculating hydroponic effluents from a commercial greenhouse to cultivate photoautotrophic microalgal biomass.

A system of collecting, cleaning, and reusing hydroponic effluents from a lettuce culture has been therefore established. Five experiments were conducted combining the different values of chemical parameters on effluents of each experiment. Effluents were collected for a span of 30 days in two different time periods (June 2021-November 2021). The samples were analyzed for pH, Electrical Conductivity, various Nutrients (K^+ ,Na^+, Ca_2^+,Mg_2^+), Total Organic Carbon(TOC) and Total Nitrogen(TN) in order to determine their chemical behavior and how it affects the cultivation. The results showed a steady decrease in the concentration of the above parameters for the first 3 weeks, were stabilized in the fourth week and a slight increase was observed in the last days of the sampling cycle. In the hydroponic effluent, without any adjustment or dilution, *Chlorella vulgaris* cultures (EF-culture) were established and their growth rates were compared with cultures growing in a BG11 medium (BG-culture). Judging from the OD_{680} values of the cultures, the growth rates of the EF-cultures were 0,065 day^{-1} and for BG cultures 0,072 day^{1}, with their productivity to be calculated to 0,016 and 0,023 g/L/day for EF-and BG- cultures respectively.

The results identified that *Chlorella vulgaris* was capable of proliferating even to the hydroponics effluent while, lettuce seemed to accumulate all the necessary nutrients in the beginning of the culture and ultimately reject the excess in the effluent. However, the concentrations of all nutrients were found within the limits of Water Directive 2000/60 / EC, making the discharge of this effluent water safe for the environment.

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P62. Cytotype diversity and genome size variation in *Festuca varia* complex (Poaceae) in south-eastern Europe

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Keywords: cytotype diversity, *Festuca varia*, flow cytometry, relative genome size

Festuca L. is the most species rich and highly diverse genus of grasses. *Festuca* species are perennial and dominate nearly worldwide in various types of dry, steppe, mountain and alpine grasslands or meadows, with some species also growing in forests, while some are cultivated as crops or ornamentals. Recent phylogenetic studies revealed two main evolutionary lineages within *Festuca*, corresponding to broad-leaved and fine-leaved species. Within fine-leaved fescues, the earliest diverging groups is *F.* sect. *Eskia*, known also as *F. varia* complex, which includes approximately 20 species distributed on Iberian Peninsula, Balkan Peninsula, Alps, Carpathians, Sardinia, North Africa and Caucasus. The taxonomic complexity of the group is especially evident on the Balkan Peninsula, from where several narrowly endemic taxa and a number of lower taxonomic entities have been described, but their taxonomic status remains uncertain. Within *F. varia* complex, the majority of taxa are reported to be diploid, but tetraploid species are known from the Iberian Peninsula and *F. varia* includes tetra- and hexaploid populations. The aim of the present study is to explore genome size variation and the incidence of polyploidy within the representatives of *F. varia* complex on the Balkan and Apennine Peninsulas based on comprehensive geographic sampling. Our relative genome size measurements conducted with flow cytometry revealed that the majority of populations is diploid (2n=14), but also tetraploid and hexaploid populations were found. Diploids are distributed across most of the distribution area, whereas tetraploids are more restricted and found in southern Dinaric Mountains. Hexaploids were found only on Mt. Pirin in Bulgaria. Overall our detailed screening of cytotype diversity and genome size variation in *F. varia* complex will contribute to the integrative approach including also phylogenomic and morphological analyses in order to resolve relationships in this intricate group.

P63. DNA fingerprinting of *Abies cephalonica, A. alba* and their hybrid (*A.* × *borisii-regis*)

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Keywords: *Abies cephalonica, A. alba, A.* × *borisii-regis, species-specific DNA markers, hybridization, identification*

Hybridization events are common among plant species and have played an important role in their evolution. However, hybridization may cause difficulties in the classification and identification of hybrid individuals, due to the absence of distinct morphological traits.

Such an example is the fir species in the Balkans, where three *Abies* taxa of ecological and economic value are found: Silver fir (*A. alba,* with extensive distribution in Europe and sporadic presence up to the northern borders of Greece), Greek fir (*A. cephalonica*, a Greek endemic distributed in the central/southern part of the country) and King Boris fir (*A.* x *borisii-regis*, a Balkan endemic and a hybrid of the first two species). Although there are distinct morphological characters for the parental species, difficulties exist in the taxonomic identification of *Abies* individuals in populations of hybrid origin. The use of DNA markers is an effective and widespread tool in such cases. Towards this purpose, conifers (and firs in particular) offer the advantage of the uniparental inheritance of cpDNA and mtDNA.

In this study, representative populations of the three *Abies* taxa along their natural distribution in a latitudinal gradient from north to south were studied by employing a newly-developed species specific marker in cpDNA and an already existing one in mtDNA. The combination of the two markers allowed the taxon identification of fir individuals belonging to *A. alba*, *A. cephalonica* and *A.* × *borisii-regis*. In addition, *A.* × *borisii-regis* individuals were identified within the range of *A. cephalonica*, as well as *A. alba* individuals within the range of *A.* × *borisii-regis*.

P64. Functional diversity of the genus *Hypericum* in Greece

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Keywords: functional traits, vegetative traits, chemical composition, flavonoids, medicinal species, ecosystem services

Hypericum is an almost universal genus of medicinal and aromatic plants including 36 sections with more than 480 taxa and consequently an important ecosystem services provider. In Greece, the genus has 44 taxa, two of which have been described recently (*H. icaricum* Kit Tan and *H. cycladicum* Trigas). Among them, there are widespread species as *H. perforatum* but also 18 range-restricted taxa of which 16 Greek endemics, and one, *H. aciferum,* included in Annexes II, IV of the Directive 92/43/EE). Distribution patterns show that NE Greece is the richest, in different *Hypericum* taxa, phytogeographical area, but KK (Kriti and Karpathos) is the richest in range-restricted taxa.

The aim of this study is the investigation of the genus *Hypericum* functional diversity in Greece. A database has been created including various functional traits for each *Hypericum* taxon referring to: vegetative characters, chemical constituents, and medicinal properties. The taxonomic descriptions of the taxa revealed more than 100 different vegetative-functional traits including traits concerning black and translucent glands presence in different vegetative parts, as also size, shape, texture, and colour of the different vegetative parts above ground. The study of chemical constituents included four group of compounds (organic acids, flavonoids, naphthodianthrones and phloroglucinols) and revealed more than 20 compounds. Since black and translucent glands in *Hypericum* have been previously correlated with certain compounds, their pattern and correlation are to be proven by statistical analysis. However, the lack of data for one fourth of the taxa, regarding their chemical composition, shows a gap of knowledge to be filled.

P65. Taxonomy of Acinos Mill. (Lamiaceae) in Greece: Morphological variation and distribution

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Keywords: Acinos, taxonomy, distribution, morphometry, morphological study

The genus *Acinos* Mill. (Lamiaceae) is controversial both for its affinity to other genera since, based on different approaches, it has been included in *Calamintha* Mill., *Satureja* L. and more recently in *Clinopodium* L. and *Ziziphora* L., but also for the taxonomic confusion regarding the circumscription, status, and nomenclature of the taxa at the infra-generic level.

Acinos occurs mainly in Southern and Southeastern Europe, with its biodiversity centre located in the Balkan Peninsula. According to different taxonomic treatments, the number of its taxa in Greece is between five and eight, including local endemics (*A. alpinus* subsp. *nomismophyllus*, *A. nanus*) and widespread taxa with striking diversity (e.g., *A. arvensis*). The identification of specimens often faces serious difficulties because of overlapping or obscure diagnostic characters.

The present work is part of a broader one, that concerns the taxonomy of the genus *Acinos* in Greece, using a combination of morphological, chemical and molecular characters. In particular, in this work, the variation of morphological characters (including diagnostic characters) is presented based on the study of 843 herbarium specimens (from ATH, B, LD and TAU) belonging to 7 taxa. The variation is analyzed using simple and multivariate statistics and the results are discussed in relation to the existing taxonomic treatments.

Additionally, the distribution of *Acinos* within Europe and the Mediterranean is presented, based on the studied specimens as well as data from digital specimens included in databases available online (GBIF and JACQ).

P66. *Verbascum salicifolium* (Scrophulariaceae), a new species from Central Macedonia, Greece

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Keywords: Balkans, chloroplast genome, Greek flora, karyotype, morphology, taxonomy

Verbascum is an Old-World genus with ca. 455 species and main diversification center found in the Southern Balkans, Anatolia, Caucasus and the Eastern Mediterranean region. Greek Flora is considered rich in *Verbascum* species as well as in endemics while the genus is included in the top-ten richest genera of Greece in terms of range-restricted taxa.

A new species, *Verbascum salicifolium*, was discovered in the eastern shores of Doiran lake (Perfecture of Kilkis, Central Macedonia) and described on the basis of morphological and molecular evidence. Analysis of chloroplast genome markers indicated the inclusion of the new species within a group of morphologically dissimilar taxa, whereas the closest morphologically related species (*Verbascum adenanthum*) is sister to that group. The morphological differences among *V. salicifolium* and its closest species are discussed. Additionally, the chromosome number ($2n = 36$) and karyotype microphotograph of the new species are provided. The only known distribution of *V. salicifolium* is confined to its *locus classicus*, where a single, threatened population exists. Thus, the newly described species should be listed as Critically Endangered (CR) according to IUCN criteria.

P67. Ecological diversity and overview of floodplain poplar communities in Vojvodina (Serbia)

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Keywords: classification, ecological diversity, poplar comunities, Vojvodina

Floodplain forests are one of the most endangered treatable ecosystems; they are acting as interfaces between terrestrial and freshwater ecosystems and providing some of the most diverse and species-rich habitats in the world. These forests are increasingly endangered, both due to climatic factors and mostly due to devastation caused by anthropogenic factors.

As for the lowland forests in Serbia, they are connected to the alluvial soil. The communities that occur in Vojvodina province are mainly poplar (*Populus ssp*.) forest formations and pedunculate oak (*Quercus robur*) forests.

The object of research is the poplar floodplain forests in the Vojvodina region. This region is permeated by rivers and is a good basis for the development of these ecosystems.

The aim of this paper is to present the plant communities in which the poplar appears. An overview of the associations and their classification will be shown. With the help of ecological diversity, we will see to what extent communities discern from each other.

Analyses were performed using 83 relevés from the field, and with relevés from literature sources.

Phytocoenological relevés were collected using a Braun-Blanquet abundance scale. They are stored in the TURBOVEG database and further analyses were done in the JUICE 7.1 software package. The classification of the data set was completed by TWINSPAN. Ecological diversity will be shown with the help of DCA analysis.

P68. Allergenicity assessment of urban green spaces in the city of Thessaloniki: The AlleGreen project

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Keywords: vegetation, pollen, allergenicity index, public health, plant reproductive ecology

Urban green spaces are valuable components of sustainable and liveable cities. The ongoing effects of climate change increase their importance even more and, hence, the demand for urban green. Several factors must be taken into consideration when designing and managing them. One of these, underestimated so far, is pollen allergenicity. Allergic diseases have become the most prevalent chronic diseases of the 21st century with half of the European population being expected to be affected by 2025. Allergenic pollen, in particular, affects a considerable part of the human population, having a high social and economic cost.

The AlleGreen project, funded by the Hellenic Foundation for Research and Innovation, is the first attempt in Greece to evaluate the quality of urban green spaces with respect to their allergenic potential. Thessaloniki, the second largest city of Greece, for which a long time-series of airborne pollen data exists, was chosen as a case study. Seven green spaces of different types were selected. For each one, allergenicity indices provided in the literature will be estimated; these are based on quantitative information for a number of attributes of the woody taxa present in them, including abundance, height and spread, pollination strategy, pollen season duration, level of pollen emission, pollen allergenicity, etc. Values for all plant attributes are taken *in situ*, except for pollen allergenicity for which they are collected only from literature sources.

An outcome of the study will be the production of a booklet with a guide of the woody plant taxa in the green spaces of Thessaloniki and of their pollen features, plant selection criteria, general guidelines for the design and management of the urban green and specific recommendations for the city of Thessaloniki, so as to minimize negative impacts, among which on human health.

The research project was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the "1st Call for H.F.R.I. Research Projects to support Faculty Members & Researchers and the procurement of high-cost research equipment grant" (Project Number: 3456).

P69. Application of DPSIR framework to assess the mining pressures on Mount Giona, Greece

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Keywords: DPSIR, conservation, mining, Mount Giona, Greece, habitat loss

Mount Giona is the highest mountain of the Sterea Ellas region and Greece's fifth biggest mountain. It covers 30,000 ha, includes twenty-four (24) peaks above 2,000 m and is a NATURA 2000 site. The mountain's flora comprises 1,273 taxa, 151 of which are endemic. The geographical position of Mount Giona in Sterea Ellas, where it neighbors with three other high mountains (namely: Vardousia, Oiti and Parnassos), constitutes a meeting point for plants with different geographical distributions. This fact, along with the highly diversified landscape, high altitudes, extended alpine vegetation zone and the vast area covered by the mountain, is extremely important in the case of the endemic elements. Furthermore, 171 plant taxa of the total flora are rare or under some protection status. Thirteen (13) vegetation groups were identified, containing twenty two habitat types, three of which are of conservation priority under the Council Directive 92/43/EEC.

In order to evaluate the human impacts on Mount Giona, we have implemented the DPSIR causal framework, which was applied for the first time in a mountainous ecosystem in Greece. Fifty-five (55) indicators of the above-mentioned framework were used, three of which were new and refer to the pressures caused by the bauxite mines in the area. The analysis of the three indicators showed 48 surface mines during 2007, covering an area of 820,785 ha and 3.75% of the NATURA site. Almost all mines are in fir forest (habitat type code: 951B) or in the Oro-Mediterranean zone (habitat type codes: 4090, 5217, 5216). In seven years' time, two new surface mines were added, covering 40 ha. The DPSIR framework is a very useful tool to reflect the pressure caused by bauxite mining, propose management measures and can be of great value, in the hands of decision makers.

P70. Assessing plant and vegetation diversity in Mediterranean-type agroecosystems

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Keywords: agroecosystems, vegetation, biobiversity, Attiki

In the Mediterranean region, climate and land use change are expected to impact on natural and agricultural ecosystems by warming, reduced rainfall, direct degradation of ecosystems and biodiversity loss.

In order to assess biodiversity of the agroecosystems of east Attiki (Greece) a floristic and vegetation study was performed. A data set of permanent plots encompassing vegetation in agroecosystems and fields of the area was established. This data set was classified using cluster analysis to identify vegetation differences between the different cultivation types. The ecological interpretation of sites covered by agroecosystems was based on classic analysis of the chorological and life-form spectra of the plant taxa recorded from these sites, Böhling's ecological indicator values of certain plant species and plant – substrate relation. Diversity indices of agroecosystems were also calculated and compared to the ones of the natural vegetation of the surrounding area. Temporal changes in the agroecosystems were also studied.

Our results revealed five different types of cultivation vegetation with different substrate preferences and different plant diversity values. The contribution of agroecosystems to the areas' plant diversity proved to be significant. Open dry fields were found to be the richest and most temporally heterogeneous agroecosystems.

Conservation of the agroecosystems of the study area is strongly suggested since they constitute a land use continued for the area from antiquity. They have proved to be a significant diversification agent contributing to the Mediterranean's high biological diversity. Additionally, indicator plant species found in agroecosystems may be used to monitor ecological change and environmental changes on the area.

P71. Vegetation survey for the delineation of wetlands outside Natura 2000 sites in the Peloponnese (Greece)

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Keywords: wetlands, Peloponnese, vegetation, protection

The delineation of boundaries of important or endangered wetlands, with emphasis on wetlands of medium and small size, is a priority in the Action Plan (2014-2018) of the National Biodiversity Strategy. Besides, according to national law (Biodiversity Law 3937/2011, article 13) wetland vegetation is a criterion for documenting the boundaries of wetlands. The objective of this study was to conduct vegetation survey in natural wetlands in the Peloponnese, in order to verify and/or improve the wetland boundaries, initially produced from remote sensing data.

Vegetation sampling points were pre-selected at marginal locations of 33 wetland sites, currently located outside Natura 2000 sites. In total, 78 vegetation relevés have been taken according to Braun-Blanquet method. The identified plant communities have been assigned to the corresponding habitat types. The following habitat types were identified: 1410 (22 relevés), 1420 (19), 72A0 (10), 92D0 (9), 6420 (6), 72B0 (3), 92C0 (2), 3150 (2), 1210 (2), 1310 (1), 2190 (1) and 2110 (1). During the survey, we recorded 186 taxa of vascular plants belonging to 59 families.

The outcome of this survey will contribute to a connectivity assessment between Natura 2000 sites in Peloponnese. Furthermore, the documentation of the wetland boundaries is relevant for the promotion of protection regulations according to the provisions of the national Biodiversity Law (articles 13 and 20 of law 3937/2011).

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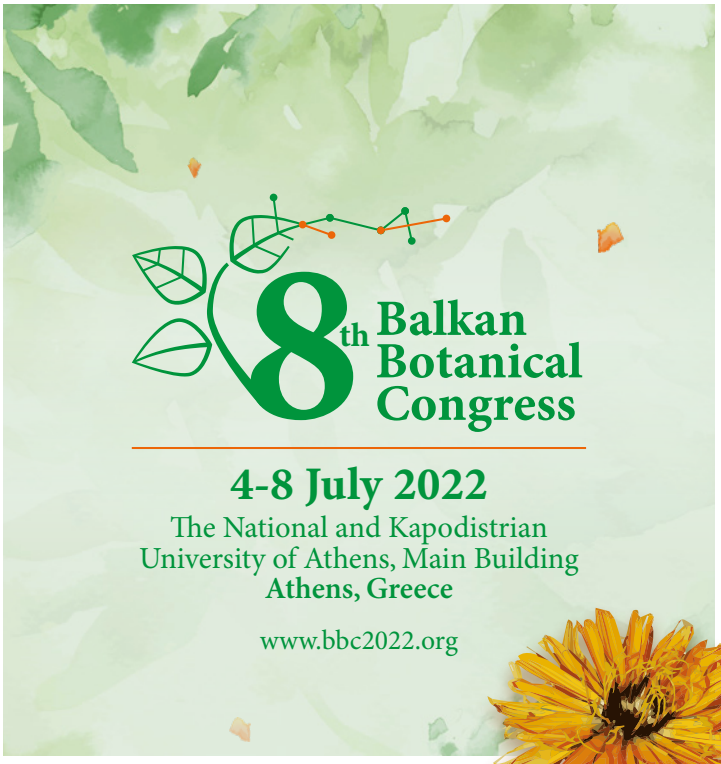

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