BOOK OF ABSTRACTS

VALENCIA (SPAIN) | 23-27 OCTOBER | 2023

Plant Conservation and Ecosystem Restoration in the Mediterranean

4th Mediterranean Plant Conservation Week

VALÈNCIA | 23-27 OCTOBER | 2023

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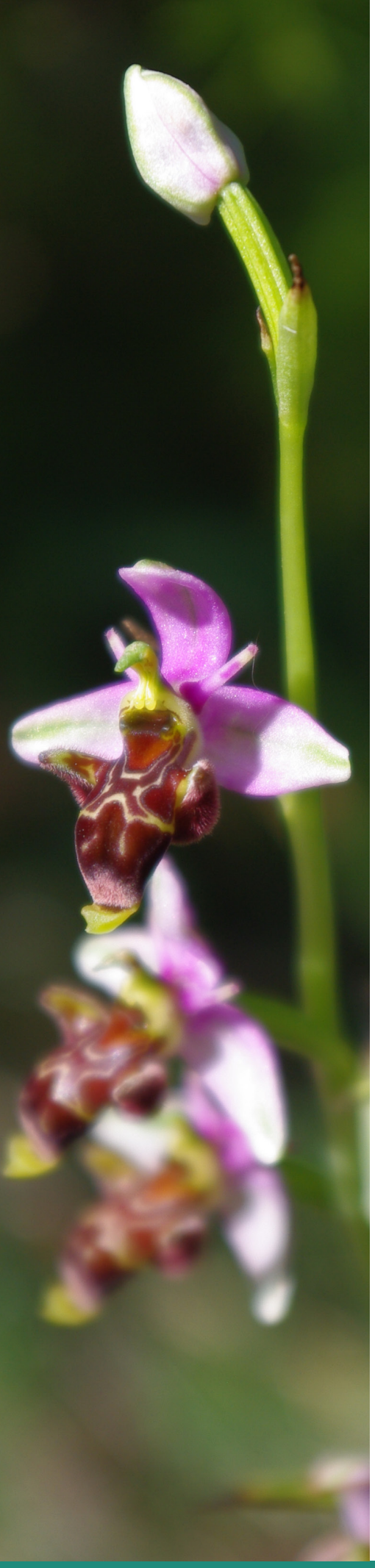

4th MEDITERRANEAN PLANT CONSERVATION WEEK

The 4th Mediterranean Plant Conservation Week (4th MPCW) is a congress that aims to bring together researchers and managers related to the conservation of wild plants and their habitats around the Mediterranean. For this edition, the 4th MPCW expands its initial goal—centered on the conservation of species and the relationships between people and wild or cultivated plants—towards the complementary recovery of habitats, as a contribution to the United Nations Decade for Ecosystem Restoration.

This congress is a meeting point where different opinions and experiences from diverse fields of knowledge converge. This is done by connecting experts on plant conservation and ecological restoration, being conscious that the goal of plant rescue is not possible without the full recovery of the ecological functions on-site.

Additionally, the 4th MPCW also intends to be a forum where experiences from the different sides of the Mediterranean region can meet and establish links for future cooperation projects. Specialists from Southern Europe, the North of Africa, and the Middle East can find here a forum for the conservation of a common natural heritage, including plants, their habitats, and the knowledge on how to manage and use them in a sustainable way.

The 4th MPCW is a window to show research results and experiences in the form of oral presentations and posters, not only from the plant or ecological sciences but also about the relationships between the public and the plant conservation world (citizen science, ethnobotany, local involvement, bottom-up initiatives, landraces, etc.), opening a new paradigm for the next decades around the Mediterranean: The plants are for the people, but with the people.

All this has been possible thanks to your participation, to our sponsors support and to our helpers involvement.

We do hope that you enjoy the Mediterranean Plant Conservation Week!

MEDITERRANEAN PLANT CONSERVATION WEEK

The first event of the 'Mediterranean Plant Conservation Week' took place in October 2016 in Montenegro, with the main organiser being the IUCN; it was attended by about 80 people from 18 countries.

The second 'Mediterranean Week' took place in November 2018 in Malta with main organisers being IUCN and MAICh through the 'CARE-MEDIFLORA' project (funded by the MAVA Foundation) and the participation of about 130 people from 25 different countries.

The third 'Mediterranean Week' was held in Chania, Greece, and 84 people in person and 39 virtually from 20 different countries, attended the congress.

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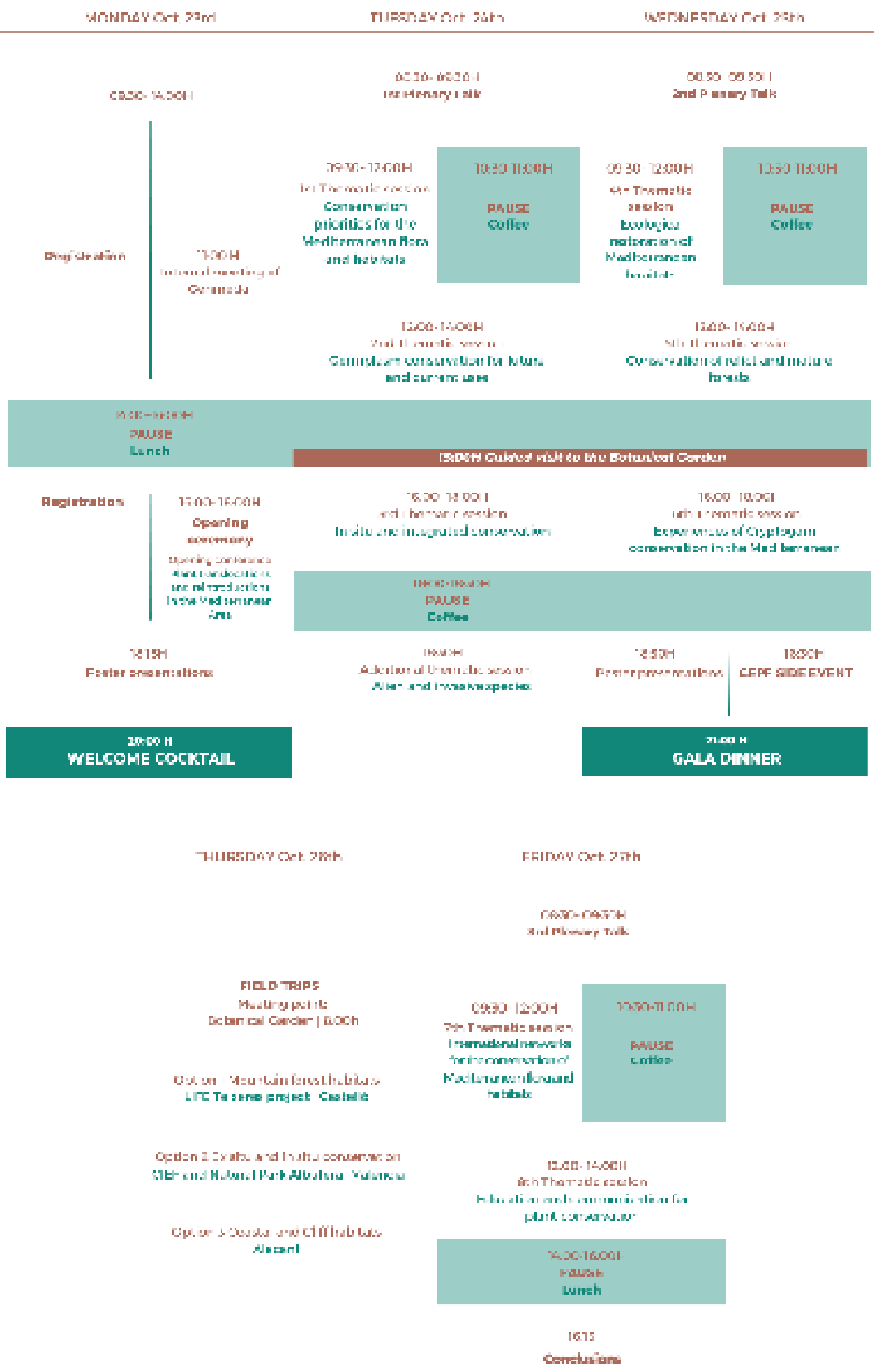
THE PROGRAMME AT A GLANCE



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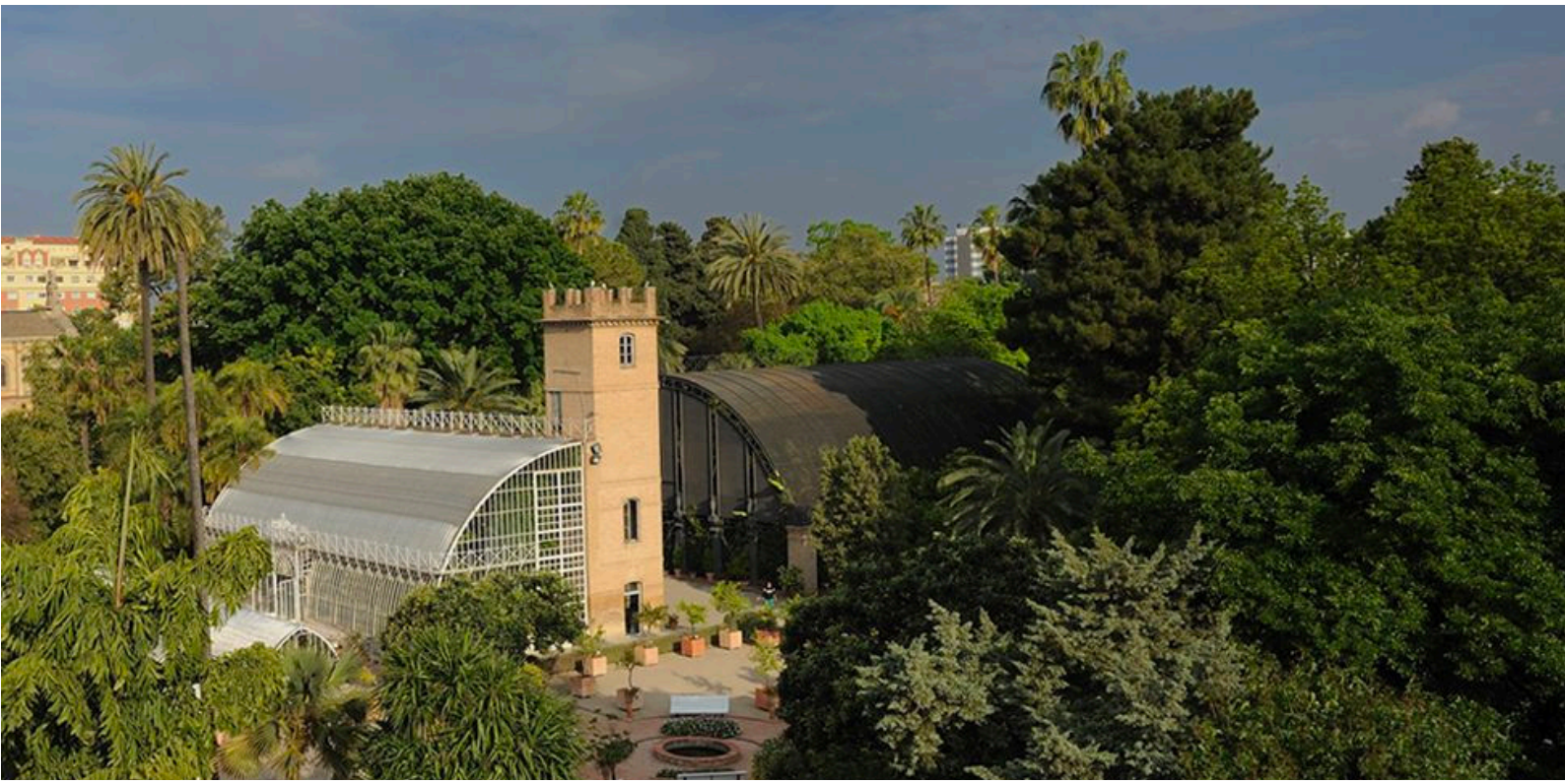
The venue

Jardí Botànic de la Universitat de València



The Botanical Garden of the University of Valencia is a living museum located in the historical centre of the city which is open to the public and aims to let people connect with the plant world by fostering its study, teaching, dissemination and conservation, as well as its sustainable use. Among other objectives, the Garden maintains a scientific collection of live plants, preserving a historic legacy of continuous cultivation, which includes monumental trees and historical buildings. Furthermore, it has the responsibility of maintaining the tradition of botanical gardens in Valencia, which date back to the 16th Century, when the university created a physics garden for the purpose of teaching medicine.

Beneath its cloak of vegetation, which extends over approximately 4 hectares, we can travel to each of the continents, imagining exotic or far-off places, or seeing close-up the plants that inhabit our Mediterranean countryside, all of which serve to remind us of the great biodiversity housed on our planet. This is a wonderfully rich plant world that we are discovering more and more thanks to botanists such as those who work in our Garden; those who participate in different investigation projects centred on the conservation of rare, endemic or threatened plant species of the Mediterranean, the conservation of natural habitats, and the knowledge of plant diversity.

MAP OF THE JARDÍ BOTÀNIC

Source: Jardí Botànic de la Universitat de València.

The 4MPCW starts with a meeting of Genmeda: the Network of Mediterranean Plant Conservation Centres. It is a network of seed banks and conservation centres of genetic resources of the Mediterranean flora who share a common floristic region, a geographical area with a similar landscape and a common set of problems concerning natural environment disruptions. GENMEDA's 25 members and 2 new associate members from 12 countries of the Mediterranean contribute to the conservation of Mediterranean flora genetic resources.

Its mission is to contribute to the conservation of Mediterranean flora genetic resources through the following objectives:

- Enhancement of human capital, equipments and methodologies to boost flora conservation applied knowledge.
- Harvesting of most threatened species genetic materials and creating, as far as possible, living plant collections.
- Creation of a virtual common collection of vegetal genetic and reproduction materials.
- Planning of joint initiatives concerning flora conservation and/or management
- Backing-up the making-decision processes of flora conservation public policies
- Support of environmental education and public awareness on biodiversity conservation.

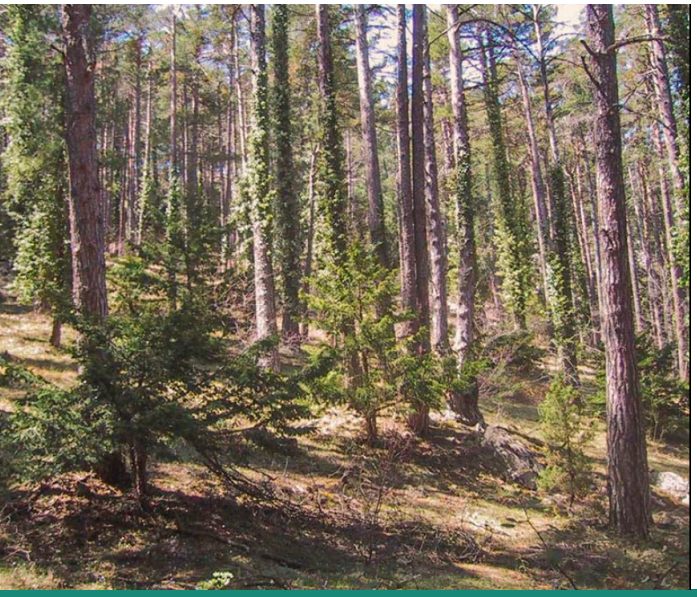
The 4MPCW hosts a Critical Ecosystem Partnership Fund side event.

The Critical Ecosystem Partnership Fund has been supporting civil society to conserve biodiversity since 2000 and has since supported more than 2,670 civil society partners in 109 countries and territories. CEPF started investing in the Mediterranean Basin back in 2012, with more than 280 conservation projects, mostly with local organizations, for a total of more than US$ 25 million.

In 2017, CEPF included plant conservation as one of the strategic priority, with dedicated funding, calls for proposals and support to organizations engaged for the preservation of the botanical heritage of the Mediterreanean Basin. During these last 6 years, 38 projects have been supported in the Balkans, Middle East, North Africa and Cabo Verde.

This side event will be an opportunity to present the first results of this investment, and a time of celebration of the work of CEPF partners. Twelve representatives, coming from Tunisia, Montenegro, Morocco, Palestine, Lebanon and Cabo Verde, will introduce their projects to the audience – presenting diverse approaches for preservation of endangered species with local communities. We expect then a lively discussion with participants on paths for improvement and strengthening of partnerships within the region.

4MPCW Field trips



MOUNTAIN FORES HABITATS. LIFE TEIXERES PROJECT | Castelló

This field will visit some LIFE Teixeres project sites for the restoration of *Taxus baccata* woods in the Valencian Community in the Penyagolosa Natural Park.

This is one of the most important Valencian sites for relict Euro-Siberian and sub-Mediterranean vegetation, consisting mainly of forests of *Pinus sylvestris* and *P. nigra* subsp. *salzmannii*, where relevant conservation actions have been developed, among others, in the Plant Micro-Reserve Barranc de la Pegunta, focus of several conservation works through LIFE and other EU funds since the late 1990s.

EX SITU AND IN SITU CONSERVATION | València

This option will visit several ex situ conservation projects: the Germplasm Bank of the Botanical Garden of the University of Valencia and CIEF's conservation units, including the Valencian Forest Seed Bank, the Valencian Wild Flora Germplasm Bank and the nurseries producing endangered species.

The in situ part of the trip will include a stop related to the recovery of *Cistus heterophyllus* subsp. *carthaginensis,* the only Spanish species to have achieved the legal status of "in critical condition", and a second stop at the largest dune restoration project in Spain, in Albufera Natural Park.

COASTAL AND CLIFF HABITATS. PLANT MICRORESERVES AND CONSERVATION TRANSLOCATIONS | Alicante

The field trip will have three main stops: the first one, located in Teulada – Moraira, where the plant communities of the PMR Cala del Portitxolet, will be observed as well as conservation translocation work, mainly of the *Helianthemum caput-felis* species. It will also visit a small wetland (El Senillar), the result of the ecological restoration carried out by the city council of Teulada.

Later, there will be a stop at the PMR Cap de Sant Antoni and the surroundings of the Montgó Natural Park. The different plant communities and conservation translocation work will be observed, especially those framed in the Silene hifacensis Recovery Plan.

Finally, there will be a guided tour of the Jardí de l'Albarda, in Pedreguer, created in 1990 and home to more than 700 native species.

Plenary conferences

23, 24, 25 and 27 October

Opening Ceremony

What are the drivers of plant translocation outcome? A global perspective

Prof. Thomas Abeli

Associate Professor at the Department of Science, Roma Tre University.
PhD in Experimental Ecology and Geobotany. University of Pavia.

With thousands of performed cases, conservation translocation is now widely used to restore rare and threatened plant populations worldwide.

The large amount of data accompanying past and present plant translocations is a massive source of information for improving techniques of future translocations and eventually their outcome. The need of a large worldwide database of plant translocation has not been met, yet; however, several databases developed at the country level has made these data available or partially available to the scientific community and practitioners involved in plant translocation. Thanks to these databases, we have entered a new era of the translocation science, an era where the analysis of large data sources is shading light on a key question. What are the drivers of plant translocation outcome (i.e., success or failure)? Transplant survival and recruitment is typically related to the release of a high number of juvenile or adult individuals from mixed source populations with stable demographic trends. Site preparation, management and protection also increase the chance of better performance.

More uncertain is the contribution of plant life form and to the type of plant materials used, with herbs and juvenile plants best performing in terms of percentage survival. Moreover, higher flowering and fruiting performance was observed among herbs propagated vegetatively, and for introductions compared to reinforcements and reintroductions.

In my talk, I will summarize the latest knowledge around drivers of plant translocation outcome by reviewing the most recent worldwide literature and unpublished data on diverse aspects such as, site selection, site preparation, planting methods, aftercare, costs of translocation.

1st Plenary Talk

Ex situ conservation of Mediterranean threatened and rare species

Prof. Costas A. Thanos

Professor Emeritus of Plant Physiology.
Head of the NKUA Seed Bank.

In the landscape of nature conservation, 1992 stands out as a landmark year that marked the inception of transformative initiatives with lasting impacts: the Biodiversity Treaty (CBD) and the Habitats Directive (Council Directive 92/43/EEC), in the Global and European stage, respectively. These groundbreaking worldwide initiatives not only breathed life into the realm of nature conservation but also laid the foundation for comprehensive strategies. As a result, the field of plant conservation witnessed the launching and establishment of ex situ conservation practices, with Seed Banking gaining prominence as a vital complement to both large- and small-scale in situ conservation efforts.

Zooming in on the European and Mediterranean regions, the early 2000s witnessed the initiation of two iconic projects: ENSCONET and GENMEDOC/SEMCLIMED. These projects exemplified the power of international collaboration, bringing together botanical gardens, universities and research institutions (both public and private) and networking their goals, initiatives and resources; these efforts led to the creation of manuals and directives for seed collecting, handling and storing along with seed banking of a considerable number of native plants. Remarkably, these projects continue to live on today in the form of ENSCONET and GENMEDA networks, serving as legacies of their visionary beginnings.

The presentation showcases a compilation of important developments, best practices and protocols that have emerged over the last two decades in the Mediterranean Seed Banking scene. Notably, this period has witnessed the establishment of numerous seed banks and national networks along with the implementation of several national and regional conservation projects, each contributing to innovative research and development of extensive seed collecting and curating. All these efforts have resulted in major accomplishments, with the restoration of several endangered plant species serving as a testament to their efficacy. Among these achievements worth mentioning is the IUCN Top 50 Plants of the Mediterranean Islands list, which has acted as a driving force behind many conservation initiatives.

As we reflect on the past achievements, we believe that the time is ripe for a renewed initiative and we propose the creation of a new comprehensive inventory of Top Plants for the entire Mediterranean area. By addressing the challenges and opportunities specific to this region, the proposed TopNNN initiative aims to attract further attention on the rich endemic and endangered flora, stimulate conservation efforts and provide a platform for essential discussions. This presentation sets the stage for deliberations that are crucial to organizing the launch of such a new endeavour.

2nd Plenary Talk

The IUCN Red List of Ecosystems

Marcos Valderrábano

Assessment and Knowledge team of the International Union for the Conservation of Nature (IUCN)

The IUCN's Red List of Ecosystems (RLE) is a global standard for assessing risks to ecosystems[1]. It allows scientists to identify common symptoms, both spatial and functional, to understand the level of risk that an ecosystem is facing. But, Can this information be used for conservation of Mediterranean flora? How does it work? What is the status of ecosystems in the Mediterranean?

Ecosystems are highly complex and knowing which ecosystems are the highest priorities for global conservation action is a huge challenge. The RLE is a tool that helps to identify and prioritize ecosystems conservation and restoration, based on their threats. It is also used to monitor progress towards global targets, like the Global Biodiversity Framework, where is one of the headline indicators. The information of RLE provide information on area, integrity and risk of collapse[2].

Since plant conservation depends on the health of the ecosystem they are part of, ensuring plant conservation across different levels of biodiversity, from genes to species and ecosystems is essential step.

But defining ecosystem units, in an heterogenous region as the Mediterranean is very challenging. National ecosystem classifications are in some cases integrated in national legislation (or regional like EU Directives. Identify appropriate ecosystem units is challenging and the recently completed IUCN Global Ecosystem Typology can provide much needed direction[3].

This session will present the IUCN Red List of Ecosystems methodology, how its applied in different geographies, from global to local scales. It will present overview on its development status today and future perspectives in the Mediterranean. The session will also explore synergies between RLE and in situ plant conservation action, and how can interact with other tools to design in situ conservation plans, restoration priorities, and site-based actions.

For more information:
https://iucnrle.org/documents_and_publications

1: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0062111

2: https://www.nature.com/articles/s41559-021-01538-5

3: https://www.nature.com/articles/s41586-022-05318-4

3rd Plenary Talk

Environmental education and citizen science projects for plant conservation: are we effective in communicating?

Francesca Meloni

Centre for Conservation of Biodiversity,
University of Cagliari (Italy)

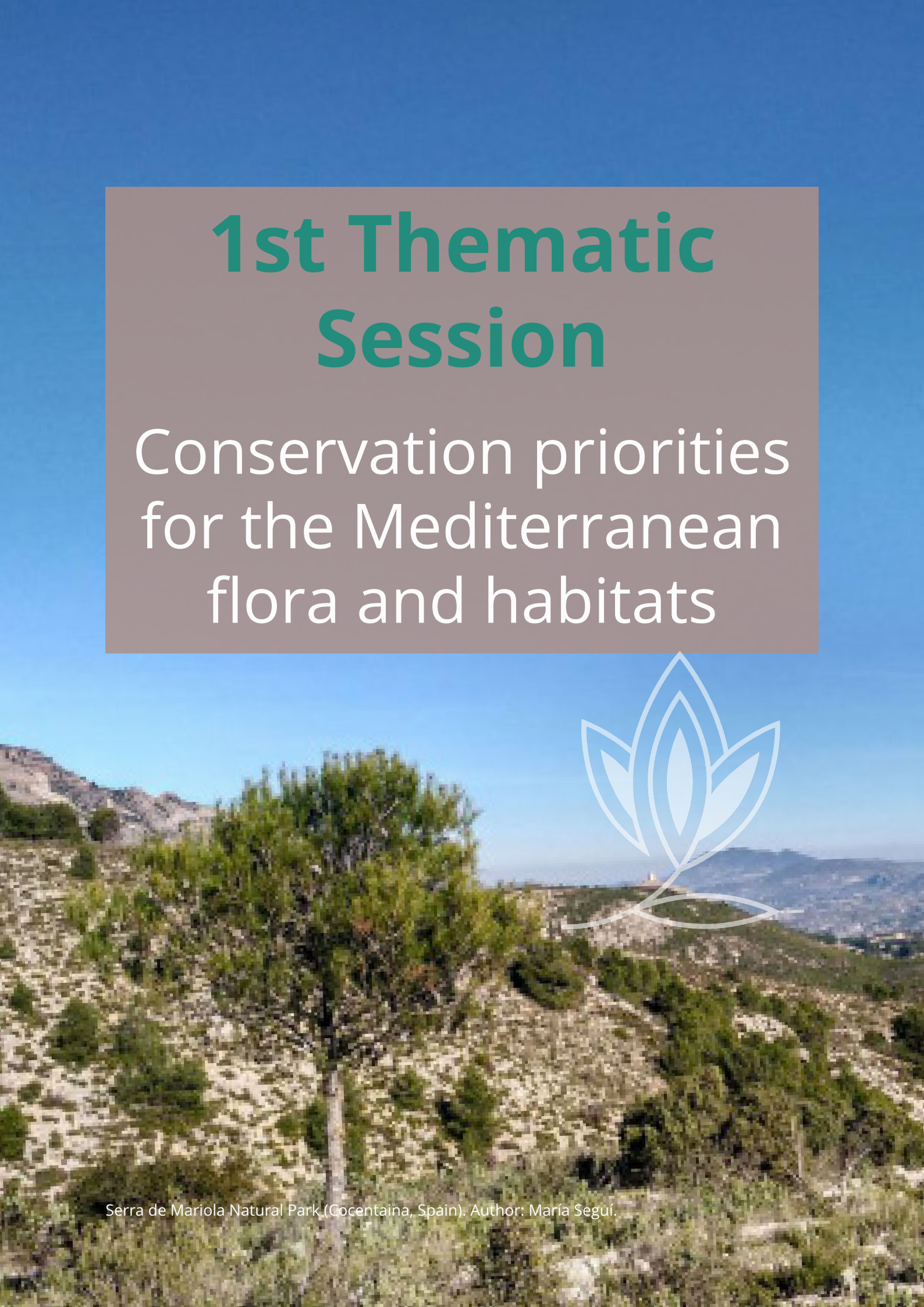
Among the goals of the 2030 Agenda for Sustainable Development, we can find, in the goal number 15, “halt biodiversity loss”; speaking about the barriers to achieve it, the lack of public awareness on the importance of biodiversity ranks as one of the most serious. Without an awareness of the importance of biodiversity, citizens, stakeholders and politicians are not likely to take the steps needed to mainstream biodiversity considerations into their daily lives, practices and policies.

So, as people involved in projects focused on citizen science and environmental education, our assumption is “If we, through our work, make people aware about the importance of biodiversity, specifically plants, they will have a responsible behaviour or they will take actions and measures pro-plant conservation”.

Are we sure about it? According to Stanley Asah, (University of Washington), “Awareness does not make people change their behaviours”. With this presentation, we will reflect on how we can be effective in promoting pro-plant conservation behaviours and see examples of various projects aimed at different types of users, exploring different methodologies, strengths and weaknesses.

1st Thematic Session

Conservation priorities for the Mediterranean flora and habitats



Serra de Mariola Natural Park (Cocentaina, Spain). Author: María Seguí.

Chair

Professor José María Iriondo

Full Professor of King Juan Carlos University (URJC) in Madrid. His research is focused on plant conservation biology, using ecological and genetic approaches, having worked with narrowly distributed endemics, alpine plants threatened by climate change and crop wild relatives. He has studied the population dynamics, plant-pollinator interactions and local adaptation processes of alpine plants and their responses to climate change, assessing patterns of adaptation in marginal populations. He has published over 120 research articles in scientific journals and more than 100 publications as books and book chapters and articles of scientific dissemination. He has led 47 research projects as principal investigator with a total budget of over 1.400.000 Euros and participated in more than 80 funded national and international research projects (5th, 6th, 7th Framework Programs of the European Union, as well as the H2020, AGRIGENRES and LIFE programs. The relevance of his scientific publications and their contribution to generation of knowledge, ideas and practical applications rely on three dimensions: 1) the successful application of demographic, ecological and genetic approaches for the diagnosis and evaluation of threatened plant populations. 2) the integrated climate change vulnerability assessment of Mediterranean alpine plant populations, involving demographic, genetic, ecological, and evolutionary approaches. 3) The development of a conceptual basis and detailed methodology for the conservation of crop wild relatives. This research has been performed in the context of the Wild Species Conservation in Genetic Reserves Working Group of the European Cooperative Programme for Plant Genetic Resources (ECPGR) and the implementation of four European Commission funded projects (PGR Forum, AEGRO, PGR Secure, Farmer's Pride). At the national level, it has resulted in the development of the Spanish National Strategy for the Conservation and Sustainable Use of Crop Wild Relatives and Wild Food Plants approved by the Ministry of Agriculture and the Autonomous Communities in 2022.

Former Director of the International Doctoral School of King Juan Carlos University. Former Secretary General of OPTIMA (Organization for the Phyto-Taxonomic Investigation of the Mediterranean Area). Vice-Chair of Wild Species Conservation in Genetic Reserves WG (ECPGR). Vice-President of the Spanish Society of Plant Conservation Biology (SEBICOP).

The silent effect of changes: towards genomics-informed assessments of extinction risks

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The intensifying climate change confronts, more than ever, conservation biologists with the difficult task of trying to predict which species or populations are most threatened with extinction. Knowledge of the geographical distribution is often a starting point for species assessments but also often, a dead-end situation. Long term monitorization of species and populations is often scarce as hen's teeth. In the best-case scenario, researchers can quantify the extinction risk based on ecological and demographic factors from extant populations, which are often resource-limited to few populations, as well as temporal-limited to short time scales. Yet, adaptative capacity – the intrinsic ability of species to keep pace with changing environmental conditions – has been and will be essential for species resilience and viability. Indeed, several studies have provided evidence of the processes by which some (some) species can respond to change, and an increasing number of recommendations have explicitly recommended to address the adaptive capacity of species and populations.

In this communication, we review the advances and challenges of using the adaptative potential of species targeting specific cases of Mediterranean plants, and Red List assessments. Despite many evolutionary, genomic, ecological, and theoretical studies concerning the adaptative potential of Mediterranean plants, we found that studies still lack the incorporation of that potential into estimations of regional or species-wide extinction risk in response to changes. Although this information is considered in some (theoretical) recovery plans through actions such as assisted gene flow, this is often perceived as a last ditch attempt to prevent extinction rather than part of a frontward strategy to build adaptive capacity for long-term survival of species.

Overall, there is a gap between the available science and the ability to integrate the evidence into management decisions. This gap constitutes a major barrier to advances in conservation practices and requires key transformations in the dialogue between lab scientists, field scientists, managers, politicians, and practitioners. Ignoring the evolutionary potential of species implies that conservation prioritization can be misdirected, and actions misguided, shifting the already scarce resources away from species at higher risk.

Keywords: Biodiversity, evolutionary history, genomic erosion, species blurring.

Identification and Mapping of Important Areas for Aromatic and Medicinal Plants in Algeria: Methodological Approach, Selection of Criteria and Preliminary Results

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2 Département of Ecology and Biotechnology. Faculty of Nature and Life sciences. Ibn Khaldoun University of Tiaret. Algeria.
3 Centre d'Écologie Fonctionnelle et Évolutive, CNRS, Montpellier, France

Like Important Plant Areas (IPAs), Important Aromatic and Medicinal Plant Areas (IAMPAs) represent an important tool for the conservation of plant biodiversity at global and regional scales.

In North Africa, this biodiversity, having an often-crucial socio-economic interest at the regional and/or national scale, constitutes a major conservation issue because of overexploitation and uncontrolled harvesting which are accompanied by some ecological and anthropogenic factors favoring their regression in abundance and diversity.

Knowledge of these natural areas, although very important and urgent, constitutes a scientific challenge for specialists, particularly in terms of defining the criteria for characterizing these areas, mapping them and then protecting them if necessary.

Indeed, considering the difference of national socio-economic contexts between the countries of this region, we initially chose Algeria given the almost total absence of industrial exploitations of the MAP. In this country, Aromatic and Medicinal plants not exploited industrially, are often harvested locally through organized networks constituting a well-structured commercial chain. However, these are often rare and sometimes endemic plants meeting the trigger species criteria used to define ZIPs.

A first methodological approach aiming to identify the IAMPAs rich in MAP in Algeria tries to use the available literature data in particular: the flora of Algeria as well as the articles published in peer-reviewed journals with plant specimens deposited in recognized herbarium. The following parameters are used in the analysis: the number of species citations, species abundance indices, distribution and chorology.

Furthermore, the criteria of *trigger species* (rare and endemic MAP species) is used to define the IAMPAs representing conservation issue.

The results obtained made it possible to propose a first map of IAMPAs in Algeria. Ongoing studies are considered to cover Morocco and Tunisia.

Keywords: Algeria, ethnobotany, flora, IAMPs, medicinal plants, plant conservation

Establishment of a Plant Micro-Reserve Network within the responsibility areas of the Management Unit of Chelmos - Vouraikos National Park and Protected areas of Northern Peloponnese (Greece)

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The Management Unit of Chelmos - Vouraikos National Park and Protected areas of N. Peloponnese (CVMU) is responsible for the conservation of species and habitats of eighteen protected areas that are characterized by especially high floristic diversity and endemism. A high number of Peloponnesian endemic plants exists especially at the Mts Chelmos and Killini. Six single mountain endemics, namely *Alchemilla aroanica*, *Lonicera alpigena* subsp. *hellenica*, *Polygala subuniflora*, *Silene conglomeratica*, *Valeriana crinii* subsp. *crinii* and *Veronica contandriopouli* were selected for the establishment of the Plant Micro-Reserves (PMRs). *E*xtinction risk assessment based on IUCN criteria and standards provided the baseline for future conservation research and ecosystem services maintenance and showed that these species will face serious decrease of their potential distribution and they are projected to continue being considered as critically endangered and to face large range contractions under any climate change scenario. Thus, continuous monitoring of their populations is urgently needed. A PMR Network, the first in the Greek mainland, has been established on public land, within Chelmos-Vouraikos National Park and one more Natura 2000 site supervised by CVMU, based on the results of the extinction risk assessment and the experience and outcomes concerning PMRs in Spain, Italy, Slovenia, Bulgaria, Slovenia, Crete (Greece), Cyprus and Lebanon. Target taxa are habitat specialists occurring only at medium to high elevations with other rare, endemic and range restricted taxa, such as the Peloponnesian endemic *Globularia stygia*, that is included in the Annex II of Directive 92/43/EE. A detailed inventorying of the localities for the target species and their habitats is implemented, covering population size, plant community and habitat type characteristics, their structure and functions and current pressures and threats. A monitoring process for these parameters was applied for the last three years. The results of this study provide baseline reference data for every PMR that will be used: (a) to identify and prioritise conservation targets, (b) support decision and policy making on spatial planning efforts and (c) promote and integrate conservation research into CVMU daily practice. Study's outcomes highlight that in situ and ex situ conservation of these taxa is of high priority. More precisely, ex situ conservation of all target species will be combined with reinforcement of the natural populations for selected species, starting with the critically endangered *Silene conglomeratica*. Monitoring plans are elaborated for each PMR and the necessary conservation actions are proposed.

Keywords: local endemic, endangered, plant protection, plant conservation

Acknowledgements: The authors thank the Natural Environment and Climate Change Agency for funding,

Rediscovery of the critically endangered *Onobrychis conferta* subsp. *conferta* in Tunisia: calls for urgent conservation management

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Onobrychis conferta subsp. *conferta* (Fabaceae) is one of the most endangered endemic species in Tunisia and is on the verge of local extinction. Conservation of this species requires better information on its habitat requirements and population status. Field surveys and historical records were used to characterize the distribution of *O. conferta* in Tunisia. Habitats were characterized using topography, soils, climate, land cover variables and phytosociology. We determined the optimal seed germination requirements for an optimal regeneration and conservation. Expeditions on ten previously reported locations revealed the presence of *O. conferta* in only one of the previous recorded localities and, for the first time, two more new localities. We recorded a sharp decreasing trend for the total number of plants per population in all locations over 6-year period. Our findings showed that the current status of *O. conferta* in Tunisia according to IUCN Red List Category and Criteria is Critically Endangered (CR). *O. conferta* faces an extremely high risk of extinction in the wild. Prompt comprehensive *in-situ* and *ex-situ* conservation actions are proposed to ensure the survival of the species. *In-situ* actions are aimed at minimizing the effects of the identified threats and to create new populations of *O. conferta* in its characterized habitat. *Ex-situ* actions include creation of an *ex-situ* collections, increase knowledge about germination requirements and genetic diversity as well as an environmental education campaign highlighting the ecological and socio-economic values of the species.

Keywords: conservation status, endemic species, habitat characteristics, Mediterranean Basin, overgrazing, germination requirements

Acknowledgements: Authors thank Pr Zeineb Ghrabi-Gammar from the National Agronomic Institute of Tunisia for the assistance in specimen's identifications, Pr Lamia Lajili-Ghezal, Mr Abdelwahed Ben Ahmed and Mrs Hind Dhif for providing administrative, logistic and technical facilities. We thank the TREFLE project, implemented by the association Les Amis de CAPTE Tunisie and funded by CEPF.

Hypericum balearicum L., an endemic shrub of the Balearic Islands, threatened by global change? Management opportunities within the framework of Serra de Tramuntana, World Heritage Site

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The Mediterranean basin represents a notable biodiversity hotspot characterized by its high rate of endemism, while it is also one of the most profoundly impacted regions by global change. In order to effectively tackle the challenges arising from global change and ensure the successful conservation of biodiversity, a comprehensive assessment of the specific implications posed by the main threats on distinct ontogenetic stages of key species within Mediterranean ecosystems is imperative. Therefore, threats such as climate change and alterations in land use may make seedlings more vulnerable when compared to adults. In the present study, our focal species is *Hypericum balearicum* L., a shrub endemic to the Balearic Islands. Although the International Union for Conservation of Nature (IUCN) designates *H. balearicum* as "Least Concern", our preliminary observations suggest that the species is facing bottlenecks in terms of seedling recruitment within natural habitats.

The objective of this study is to evaluate the impact of several global change stressors, such as drought and predation by alien herbivores (mainly wild goats), on the seedling recruitment capacity in several populations of *H. balearicum*. By assessing these factors, we aim to increase our knowledge about the population dynamics of this taxon and help managers design effective conservation strategies.

In 2022, our study revealed that nearly 90% of the *H. balearicum* populations exhibited almost no seedling recruitment. Surprisingly, the presence of ungulate herbivores, typically associated with adverse impacts on island endemic species, seemed to confer certain ecological advantages on the *H. balearicum* populations. These herbivores not only avoided the consumption of *H. balearicum* but also appeared to suppress competing species. However, our findings revealed the role of the summer drought in exacerbating the negative impact on the population and bringing about an imbalance between mature and juvenile individuals. The heat-humidity index revealed that populations with higher density and a well-established demographic structure were located in cooler and more humid environments. On the other hand, compared to adult plants, seedlings exhibited lower physiological resilience to drought, as observed in experimental plantations. As a consequence, summer drought was the main cause of seedling mortality and inhibited the regeneration of *H. balearicum* populations. Considering a moderate climate change projection for the Mediterranean region throughout the 21st century, the predicted distribution range of this endemic species would experience a significant decline before the end of the century, disappearing from some areas such as Cabrera Gran Island. This underscores the urgent need to address the possible threats and implement effective conservation measures to ensure the persistence of *H. balearicum*.

The unique topography of the Serra de Tramuntana, recognized as a UNESCO World Heritage Site, offers the most favorable conditions for the survival of H. balearicum within its distribution area. However, even in this region, the endemism faces some key challenges regarding seedling recruitment. Because H. balearicum is not affected directly by ungulate herbivory and has adapted to withstand summer drought, it is compatible with the traditional cultivation of olive trees in certain areas that do not interfere with crop management and make it compatible with ethnologic land uses. The land uses of these areas include marsh edges, sheep pastures, and road margins. Implementing such land management practices would not only reinforce the presence of H. balearicum in the Serra de Tramuntana but also provide essential ecosystem services. These services include promoting pollinators, mitigating erosion, and enhancing biodiversity in the agricultural landscapes that characterize the cultural heritage of the Serra de Tramuntana

Keywords: seedling recruitment, drought resistance, land use, traditional management

Acknowledgements: M.Carriquí was supported by the POSTDOC-UIB-2020 postdoctoral fellowship of the *Vicerectorat d'Investigació i Internacionalització* of the *Universitat de les Illes Balears*, and by the European Regional Development Fund (ERDF) and the Juan de la Cierva-Formación 2020 postdoctoral fellowship (FJC2020-042856-I), funded by MCIN/AEI/10.13039/5011000011033, and by the European Union "NextGenerationEU/PRTR". M.Capó was supported by Margarita Salas postdoctoral fellowship (Ministerio de Universidades, Gobierno de España) through the Recovery, Transformation and Resilience Plan funded by the European Union (NextGenerationEU) and the Juan de la Cierva-Formación 2021 postdoctoral fellowship (FJC2021-046888-I), funded by MCIN/AEI/10.13039/501100011033, and by the European Union "NextGenerationEU/PRTR".

Evaluation of assisted evolution as a conservation strategy for climate change adaptation

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Organisms can respond to climate change in different ways. However, given the speed at which environmental changes are occurring, these responses may be insufficient to ensure the survival of certain populations. In this context, it is necessary to search for new conservation tools. The objective of artificial selection and assisted gene flow strategies is to improve the adaptive potential of populations in response to climate change. Flowering onset has been described as a key trait for the adaptation of plants to climate change. Although it has been observed that climate change is favoring plants to flower earlier in temperate zones, it is not clear whether they will be able to evolve fast enough and the consequences this may have. In this context, the general objective of this work is to evaluate the use of artificial selection and assisted gene flow to improve the adaptive potential of certain populations with respect to the advancement of flowering onset. For this purpose, four populations of *Lupinus angustifolius* L. located in the Iberian Peninsula were selected from two contrasting latitudes and climatic conditions. Seeds from the four populations were sown in a common garden experiment in Móstoles (Madrid) and different lines were established, created both by self-crossing of *L. angustifolius* individuals and by manual crosses, both intrapopulation (artificial selection) and interpopulation (assisted gene flow). The effectiveness of artificial selection and assisted gene flow was evaluated, as well as the impacts that these types of actions may have on other reproductive and vegetative traits. Moreover, the descendants of the northern population lines obtained in the common garden experiments were sown *in situ* in one of the source localities, and the effects of artificial selection and assisted gene flow were evaluated. The results obtained indicate that artificial selection and assisted gene flow have been able to bring forward the flowering onset, although only in the northern populations. In addition, these strategies also entailed the modification of other plant traits. The experiment under natural conditions showed that the plants descending from the individuals under the artificial selection treatment did not undergo changes in any trait. However, plants from the assisted gene flow treatment did maintain the changes in flowering onset and shoot growth observed in the experiment under controlled conditions.

Keywords: adaptive potential, evolutionary changes, facilitated adaptation.

Population size as a major determinant of mating system and population genetic differentiation in a narrow endemic chasmophyte

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The mating system plays a pivotal role in shaping both intra- and interspecific genetic structures, exhibiting variations both within and between plant populations. In our research, we focused on all known populations of *Moehringia tommasinii* (Caryophyllaceae), a chasmophytic plant species with a restricted range in the northwestern Adriatic region. We also included populations of the co-occurring and widely distributed *M. muscosa*, a closely related species with distinct ecological characteristics. To explore mating patterns, we conducted reciprocal crosses both within and between these two taxa. In addition, molecular markers were employed to estimate the extent of gene flow, both within populations and between taxa. Our investigation encompassed a range of factors, including the coefficient of inbreeding, population size, seed weight, pollen-to-ovule ratio, and flower display size. We also looked for evidence of a selfing syndrome.

A surprisingly high variation in mating systems was observed among populations of *M. tommasinii*. These populations exhibited genetic structuring, with their size positively correlated with both seed weight and pollen production. Although a selfing syndrome could not be confirmed as the majority of selfing resulted from allogamous treatments, the occurrence of selfing was notable. In the presence of *M. muscosa*, at a site where both species coexist closely, a distinct pattern of fruit production was observed in *M. tommasinii* following various pollination treatments. Molecular and morphometric data provided evidence of hybridization followed by local extinction at this site.

Population size emerged as the key factor influencing the mating system in genetically structured populations of *M. tommasinii*. While lighter seeds and reduced pollen production were observed in populations with higher selfing rates, they did not conclusively indicate the presence of a selfing syndrome. The detection of gene flow between *M. tommasinii* and sympatric *M. muscosa* pointed to weak reproductive barriers between these taxa, potentially posing conservation challenges for the former species. This hybridization also led to local extinctions, resulting in floral polymorphism and disrupted mating patterns within *M. tommasinii*.

Keywords: first, second, third, fourth, fifth

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Analysis of the endemicity of the Dianic territory. Implications for the conservation of species and habitats

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The Dianic territory includes most of the Baetic mountains of limestone nature that reach the provinces of Valencia and Alicante. It has a dry to humid ombrotype. It is an area strongly dependent on the rains from the east, favored by the mountain ranges transversal to winds and by closed basins. From the biogeographical point of view, this region would correspond to the "Alcoyano-Diánico" territory proposed by De la Torre, Alcaraz & Crespo.

The main goal is the analysis of the natural populations of the endemic species of the Alcoian-Dianic subsector and constitutes the backbone of the doctoral thesis of one of the authors (Jaume X. Soler).

Revision of herbaria (BC, G, MA, MACB, P, and VAL, among others), both in situ and their digital version, search in databases and analysis of natural populations will be the basis of the study. The bibliographic review of the groups of plants related to the endemic Alcoian-Dianic flora will help us to propose its phylogeographic and evolutionary origin.

Data compiled from previous studies as those of the Valencian authors G. Mateo and M. B. Crespo suggest a range of 30-50 endemic taxa for the study area. We are aimed to address the following aspects: (1) defining the endemic Alcoian-Dianic element; (2) studying the taxonomy of Alcoian-Dianic endemic taxa; (3) establishing phylogenetic relationships with species close to the Alcoian-Dianic endemic element; (4) assessing the threat degree of Alcoian-Dianic endemic taxa based on population studies, (5) modeling the evolution of the populations of threatened taxa in different scenarios of global change and in the face of future changes in land use; and (6) proposing management and conservation measures for the taxa presenting the highest threat degree.

One of the first concepts to be considered is the definition of Relevant Populations for Conservation, which we suggest naming as RPC. From the exhaustive knowledge of the populations of each one of the endemic taxa to the Alcoian-Dianic territory, we will analyze and further identify which populations are candidate to be included in management and conservation plans.
As a preliminary results of this study we consider that there are 11 endemic taxa as well as 14 subendemic taxa in this area, and many of them are protected and/or endangered species at regional or at national level.

Keywords: Endemism, Biogeography, RPC (Relevant Populations for Conservation), Dianic Territory, Taxonomy

Can we define effective conservation priorities for evolving systems? Mediterranean Basin as a training area

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Extinction and speciation had played an active role in the past shaping the high plant diversity of the Mediterranean region. But these events never stopped, they are still active. Speciation through hybridisation is a complex and long evolutionary process occurring in nature, where several intermediate stages might occur, all with divergent evolutionary outcomes and therefore, difficult to deal with in terms of conservation policies. The main existing tools to define conservation priorities are based on the delimitation of geographic areas and the elaboration of categorized lists of species usually prioritizing “pure species”. Generally, these approximations are subsequently transposed into legislation (local, national or international) defining the uses and restrictions on the territories or taxa. The whole process has proven effective in most cases and has been adapted and updated throughout history. Yet, these conservation policies overlook any potential benefits in promoting the protection of hybrids. Despite potential advantages that many hybrids might have in facing environmental changes, they are often tagged with negative connotations: hybrids are not to be conserved as hybridization itself is a threat to the persistence of species.

In this study, we addressed this question by evaluating how many hybrids are considered in national and regional Floras, and how many are legislated across the Mediterranean area to discuss the biological, ecological and ethical reasons for not conserving hybrids. We first compiled a list of plant hybrids described in the Mediterranean basin, searching all known vascular plant species accepted by the World Checklist of Vascular Plants (WCVP). WCVP allows the quantification of spatial, temporal, and taxonomic global patterns of hybrids, and to identify potential limitations or bias. Deep data analysis and analytics on WCVP reinforced with Plants of the World Online (POWO) were further used for the extraction of patterns. We use data mining to obtain taxonomical, historical, and geographical trends across the Mediterranean. Overall, results show great heterogeneity in the degree of knowledge of hybrids in the Mediterranean area, both in their taxonomic status and in their geographical distribution. This disparate baseline information limits the development of protected area networks or the preparation of lists of hybrid taxa to be monitored. Even if we consider hybrids as a threat, there is an overall gap of knowledge limiting the success of any action or the creation of accurate guidelines to deal with hybrids.

We also tackled the question of hybridization being considered a threat to species survival using 120,369 global species assessments available on the IUCN Red List Data. However, from these list assessments, only 91 of them mentioned hybridization in the Mediterranean countries but only 44 as threatened taxa. Altogether, the results showed that hybridization has been involved in species extinctions less often than thought, leaving the question: in what circumstances should hybrids be considered a threat? Considering the large evidence supporting the presence of hybrids, the debate dealing with the conservation of hybrids should be re-opened.

Keywords: Speciation, hybridization, Red listing, conservation policies

Compiling the Red List of the Greek Vascular Plant Species

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The Greek vascular flora consists of 5927 species, distributed in 184 families and 1089 genera. Almost 20% of the Greek plant species are endemic and more than 90% of them have narrow-restricted distribution. Such a high percentage of rangerestricted species may be attributed to the high topographic complexity of Greece, as well as its paleogeographic history. The Mediterranean basin is one of the 36 Biodiversity hotspots around the world, and 3 out of its 14 most important microbiodiversity hotspots are located within Greece. This renders the conservation of the Greek flora of high importance. In order to plan and implement appropriate and effective conservation measures for the plant species hosted in Greece, it is necessary to estimate their extinction risk. The first Red Data Book of Rare and Threatened Plants of Greece was published in 1995, including 263 plant taxa (species and subspecies). In 2009, a two-volume work, Red Data Book of Rare and Threatened Plants of Greece, was published, reporting the risk assessment for 300 taxa. In the latter Red Data Book, risk assessment was made following the current threat categories of the International Union for Conservation of Nature (IUCN), and conservation measures were proposed for each taxon. A total of 466 plant taxa have been so far included in the two published editions of the Red Data Books for the Greek flora. Ninety-seven (97) plant taxa are common to both editions, while 166 are included only in the 1995 edition and 203 only in the 2009 edition. Currently, a project entitled “Compilation of Red Lists of Threatened Species of Plants, Animals and Fungi of Greece”, funded by NECCA (Natural Environment and Climate Change Agency) is in progress and the Hellenic Botanical Society coordinates accordingly the assessments concerning plants and fungi. The project is scheduled to be completed by the end of November 2023 and is expected to include the assessment of threat categories for up to 17,000 plant, fungi and animal species, according to the IUCN criteria and specifications. Until now, 90% of the plant species occurring in Greece including 1000 endemic plants have been assigned to assessors. In total, sixty assessors have been involved up to date in the Red List assessment for vascular plants and were trained by IUCN on the Red List Process. All the assessments are entered, stored and managed in the IUCN Species Information Service (SIS). With the completion of the project, Greece will have, for the first time, a dynamic Red List of the vast majority of its vascular plant species, while through the evaluation process, it will be possible to identify data gaps that are necessary for the proper management and conservation of the Greek flora. The progress of plant species’ threat category assessment so far, revealed the occurrence of important data gaps concerning species’ population size and trends, as well as the main pressures and threats to them.

Keywords: IUCN, likelihood of extinction, Greek flora, plant conservation

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Habitat conservation value, assessing biodiversity preservation priorities applied to western Mount Hermon in Lebanon

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Mount Hermon, the second highest mountain in the Levant, shelters important plant and key biodiversity areas. The western Lebanese slopes were designated as protected area in 2020. The habitat conservation value (HCV), a simple replicable method with adaptable scoring technique integrating species-based approach, namely species richness, endemism, threatened species, and habitat-based approach, namely threats and rarity of the habitat in terms of species association and area occupied at the national scale, was designed to evaluate the conservation priority for habitats.

The landscapes and habitats of Hermon, as well as recent impacts on biodiversity, are the outcomes of anthropic activities. These disturbances include crop cultivation, grazing, harvesting activities, logging (timber products, charcoal, and firewood), hunting, introduction of exotic species, urban expansion and fires. The HCV was calculated for 11 habitats. Habitats located at the montane-Mediterranean level (1600-2000m) scored the higher conservation values, followed by the oro-Mediterranean habitats (2000-2800m), and mixed *oak* woodlands of *Quercus infectoria* and *Q.coccifera* of the supra-Mediterranean (1200-1600m).

Scores, criteria and spatial scale used in the assessment can be adjusted depending on the context of the study to ensure repeatability. This constituted the first conservation assessment to prioritize the habitat types that require urgent management efforts in Mount Hermon. Based on the assessment, proposed protection measures aim to guide future management plans.

Keywords: in-situ conservation, habitat conservation, Levant, management plan, priority index

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Identification of threats and population dynamics of *Helianthemum caput-felis* Boiss. in the main population of the Iberian Peninsula (south of the province of Alicante, Spain)

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The cystaceous *Helianthemum caput-felis* Boiss. is a plant endemic to the western Mediterranean. Its area of distribution is located in the southeast of the Iberian Peninsula (northern and southern coast of the province of Alicante), Balearic Islands, Melilla, Sardinia and northern Algeria and Morocco. In an area such as the Mediterranean, its exclusively coastal distribution has subjected the populations of this plant to an increasing number of threats, mainly derived from human activity. The processes of habitat alteration have been very intense in areas with tourist pressure and major changes in land use. This has led to a change in its threat category according to the IUCN criteria, from Vulnerable to Endangered. Since 2006, the research group Medspai (Environment, Society and Landscape) of the University of Alicante has been systematically monitoring the populations in the south of the province of Alicante.

The collection of field data and the monitoring of several populations during fifteen years has allowed us to identify the main threats affecting *H. caput-felis* and their temporal evolution. In this communication, two main sets of threats are identified. The first and main threats are anthropogenic, derived from urbanization, development of the coastline, road infrastructures, frequentation (of people and vehicles) related to tourism and leisure and, to a lesser extent, agriculture. Natural threats have also been detected, derived from geomorphological dynamics (erosion and landslides) and plant dynamics (competition with native species and invasive flora). For each of these threats, real examples are presented that allow us to qualitatively and quantitatively assess the alteration and elimination of the habitat. These results are fundamental for designing actions to reduce the impact of these threats in the short and medium term, as shown with an applied case in the sector of Cala La Mosca (Orihuela, province of Alicante).

Keywords: plant endemic, GIS, LULC, spatial planning, natural and anthropogenic therats

Interdisciplinary studies to improve the conservation status of *Cistus heterophyllus* subsp. *carthaginensis*

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Cistus heterophyllus subsp. *carthaginensis* (Pau) M.B. Crespo & Mateo (Cistaceae) is an exclusive endemism to the west of the Mediterranean basin. Only three populations are known: two in the southwest of the Iberian Peninsula (Valencia and Murcia) and one more in the Balearic Islands. This is the only plant taxa plant catalogued as Critically Endagered in Spain (according to IUCN criteria) and it is included in the Spanish Catalogue of Endangered Species Catálogo Español de Especies Amenazadas and regional catalogues of Valencia and Murcia.

The Valencian population presents the most extreme case with only one natural individual known. Nevertheless, and despite its high degree of self-incompatibility, after several crossings were obtained seeds that started a sexual production line. After years of intense work resulted in more than 1,700 plants are now distributed in more than 15 translocated populations, all of them from the unique natural specimen. However, both this population and the Murcian population are at high risk of hybridisation with its sister taxon *C. albidus*, and therefore of extinction due to genetic dilution if the species was not monitored.

An interdisciplinary group of the Botanical Garden of the University of Valencia has been involved in this project and has been working to improve its knowledge over the last three years. In this sense, a microsatellite library has been designed as a simpleto-use genetic tool for the genotyping of individuals and for the early and reliable detection of hybridisation. In addition, reproductive biology studies have been carried out. Microsatellite genotyping has also been applied to plants studied during these experiments, trying to understand the high variability of fruit production observed during these studies.

Analysing the reproductive studies, it has been observed that most of the fruits fail to set, regardless of the pollen used during the six pollination treatments applied. However, some of the few individuals that showed higher flower and fruit production showed alleles in their genotype that were outside the genetic background expected in Valencia. This situation highlights the need for genetic enrichment to maintain the autonomy of the species in this region.

This kind of interdisciplinary studies demonstrate the importance of collaborative research for major improvements, especially for Critically Endangered Species.

Keywords: endangered, endemic, microsatellite markers, hybridisation

Monitoring and evaluation of the conservation status of *Gadoria falukei* after 10 years

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Gadoria falukei is one of the most critically endangered species of Spain. It is a rupicolous plant and most of the population grow in a rock shelter. It is an autogamous species that present only one small population with less than 90 individuals.

This species was discovered in 2013, and since then, have been conducted several studies to improve the knowledge of the species. It has been carried out several *in situ* and *ex situ* studies. Annual censuses and prospections of new areas has been done to understand population dynamics and try to find new populations. The *ex situ* experiments have been conducted at the Botanical Garden of the University of Valencia, where nowadays there is a collection of potted plants that act as seed orchard. These allow to obtain each year hundreds of seeds that are being preserved for long term, increasing the seed collections at the University of Valencia and Almeria seed banks. These plants had also used to conduct the reproductive experiments without disturb the natural population.

The last three years have conducted precise census following the development of several individuals of the population to analyze their evolution over the time and how the reduced rainfall is influencing the viability of the population.

In 2023 has obtained the lower census until the date, several plants have reduced its size and the production of flowers has reduced, and therefore also the fruit and seed formation. On the other side, every year have been observed some new seedlings.

The results show a decrease of the population, as well as the size and the flowering of the plants. The decrease of the population is not dramatic nowadays. The low rainfall records of the last years do not seem to have a devastating effect, since some individuals have a good appearance. Due to its habitat, most plants of *Gadoria falukei* take only percolation water and never receive rainfall directly. This can be one of the characteristics that avoid the negative effect of the reduced rainfall, at least at short term. Studies must be continued as this species is only known for 10 years and there are so many aspects that are unknown, even the long-term species dynamics.

Keywords: endemic, endangered, census

Plant diversity of the SCI ES0000213 - Serres de Mariola i el Carrascar de la Font Roja and current status of its populations of protected species in the Valencian Community

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The SCI ES0000213 is in the SE of the Iberian Peninsula, in the S of the province of Valencia and the N of Alicante, in the northeastern part of the Betic System, with 19.946 ha of which 14.835 ha are included in the natural parks of the Carrascar de la Font Roja and the Serra de Mariola. The altitudes oscillate between 410 m from the closest point to Ontinyent and 1.390 m from the top of Montcabrer, with the upper thermo-Mediterranean, lower mesomediterranean and upper mesomediterranean thermotypes, and the dry and sub-humid ombrotypes.

The objective of the study is to obtain the total floristic diversity of the SCI as well as the current situation of the protected species present.

To achieve the proposed objectives, field work has been carried out in the 282 1km^2 UTM grid cell in which the LIC or the PORN areas of both natural parks are included. A bibliographic review has also been carried out, as well as a visit to various herbaria with material from the area.

Regarding the results, 1,344 taxa have been located from 64,654 records (17,171 bibliographic records, 3,460 herbarium sheets and 44,023 direct field observations). Of the 1.344 taxa present or mentioned, 44 are included in Decree 70/2009 that regulates the Valencian Catalog of Threatened Flora Species. Of which, two are in the category of endangered (*Anacamptis papilionacea* subsp. *grandiflora*, *Festuca patula*), the following three as vulnerable (*Apium repens*, *Euphorbia nevadensis* subsp. *nevadensis*, *Himantoglossum hircinum*), other 29 as Guarded and the last 10 Protected Not Cataloged.

The presence of all of them and the areas of greatest value for conservation due to the higher density of threatened species are analized. There are 3 areas with a greater number of protected species: a) Montcabrer, the highest area of the SCI, with some high mountain species present, b) the fresh meadows between Pla d'Aparici and Pla dels Assencis, where numerous rare orchids appear in the area of the SCI and in the Valencian Community as a whole and c) the shady slope of Font Roja, where there are a large number of rare forest species, both trees and orchids.

Of the 44 taxa studied, 6 do not present recent locations, so their search should be a priority of the other 38 taxa, at least their location in a 1km² UTM grid cell is known. The populations of some of them have been censused at the minimum once.

Keywords: Conservation, protected species, SCI, Valencian Community

Prioritization of useful medicinal plants for conservation in Pre-Rif, Morocco

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Due to its geographical position, Morocco has a great ecological and floristic diversity and a long phytotherapeutic tradition from different civilisations and cultures. Currently, medicinal plants are still used locally in the treatment of various diseases and are also exported to satisfy the increasing needs of the world market. However, several species are threatened with extinction due to natural threats (climate change, restricted distribution ...) and also anthropogenic threats (overexploitation, increased commercialization, destructive harvesting methods, deforestation ...). This is why there is a necessity for conservation of these plant resources.

The first step in developing conservation strategies for threatened species is the prioritization of species with the highest conservation risks. The establishment of an effective prioritization method depends on a good definition of the prioritization criteria. In our study we used a combination of ecological and ethnobotanical criteria to evaluate the impact of the different threats.

A total of 151 medicinal plant species were identified in Pre-Rif based on their medicinal value, availability and market value, and uses in traditional herbal medicine. Of these, 19 emerged as priority species for conservation actions.

Keywords: Biodiversity, Indigenous uses, Priority conservation, Sustainable use, Morocco.

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Rediscovery of two rare, threatened and strict Fabaceae in the Dyr el Kef- Key Biodiversity Area-Northwest Tunisia: *Trifolium tunetanum* Murb. *& T. juliani* Batt.

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The 7 taxa of the Urceolata sub-section have a calice with 10 nervers and a throat closed by two callosities [1]. *T. tunetanum*, endemic from Tunisia & *T. juliani*, endemic Tun.-Alg. [2, 3, 4, 5, 6] are not well known and were not reviewed since more than 50 years, they were rediscovered in 2012 in their unique site in Tunisia, l'IPA - KBA- Dyr el Kef. The purpose of this work is to found those two taxa, to determine their nomenclatural, taxonomic and threat status.

Referring to the published locations and habitat types of these two taxa, surveys have been carried out since 2012 in and around the KBA to find *T. tunetanum* and *T. juliani* in order to clarify their habitat type, population size and the threats they face.

A detailed and comparative morphological analysis of Hebarium (MPU, MHNP, CJB Genève, JB de Lund (LD), Herbarium Algeria, Rabat Tunisia) samples of the subsection *Urcelata* species collected in Maghreb, was done to identify the specific citerias and the fact that *T. tunetanum* belongs to this sub-section.

Surveys found *T. tunetanum* in 2012 and 2015, *T. Juliani* and *T. squarrosum* subsp. *squarrosum* in 2012, 2015, 2021-22 and 23, on two temporary streams bordered by cereal crops. The area of their habitat is less than 1000 m2 and the population size of *T. tunetanum* is <250 individuals. Those of the other taxa are larger. Drought and overgrazing in dry years are the main threats to these taxa. These data enable us to assign a status of (CR) for *T. tunetanum* and (EN) for *T. juliani* according to the criteria of the IUCN red list of threatened taxa.

T. tunetanum is not classified in the Urceolata sub-section [1]. Consultation of the herbaria reveal the Holotype of *T. juliani* (P00084345), *T. tunetanum* (LD 1212135) but not a sample labelled *T. squarrosum subsp. tunetanum*. Morphological analysis of the samples from Dyr el Kef with those from the sub-section found in the herbaria consulted revealed that the Tun. end. has specific characteristics and strict morphological characteristics to the urceolata sub-section. We have therefore adopted the nomenclature for *T. Tunetanum* to Murbeck's original nomenclature [2] and propose its inclusion in the Urcéolata sub-section.

Keywords: taxonomy, Trifolium, endemic and threatened plants.

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Understanding the resilience of the endemic halophyte *Limonium irtaense*: biochemical and ion regulation responses to salt stress

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The conservation of plant diversity is of upmost importance for preserving ecosystems. *Limonium irtaense* Ferrer *et al*., is an endemism exclusive to the Sierra de Irta in the province of Castellón, Spain, first discovered in 2011 and represented only by a small number of individuals in the wild. Efforts have been made to reinforce the population, but the species is still classified as critically endangered. Like other species of the genus *Limonium,* it is a recretohalophyte, growing on coastal cliffs on saline substrate. This study aimed to investigate the responses of *Limonium irtaense* to increased salinity, focusing on its biochemical and ionic regulation mechanisms.

Fully grown plants grown in pots in the greenhouse were subjected to increasing salt concentrations, up to 300 mM NaCl, to induce salt stress. After five months under stressful growth conditions, their biochemical profiles changed. The decrease in chlorophylls and carotenoids, together with the accumulation of osmolytes (especially proline) and secondary metabolites (flavonoids and phenolic compounds), suggests the activation of protective mechanisms against salt-induced oxidative stress. In the root and shoot, sodium accumulation increased, whereas potassium levels remained stable with lower values, reflecting ionic regulation strategies of the plant to cope with salt stress.

Evaluation of the responses of *L. irtaense* to prolonged salt stress may provide helpful information for the conservation strategy of this extremely rare and threatened species. The ability of the species to activate its metabolic and ionic regulation processes demonstrates its adaptability and survival strategies under saline conditions. These results present opportunities for ecological restoration activities and preservation of genetic diversity to improve the resilience and long-term viability of *L. irtaense* populations in facing environmental changes caused by global warming.

Keywords: Abiotic stress tolerance, biodiversity, conservation strategies, halophyte adaptation, ion transport regulation

Vulnerability of grassland species and communities to changes in nutrient load and stoichiometry

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Nutrient enrichment can lead to species loss and changes in plant community composition by altering habitat conditions and making communities more vulnerable to invasive species. It is unknown however how nutrient enrichment and climate jointly affect endemic and already rare and threatened species. Here we present a novel investigation that aims to understand the vulnerability of herbaceous species and ecosystems to changes and interactions in nutrient supply, stoichiometry, and climate. To do so, this research combines manipulative field and mesocosm experiments and the analysis of a large and unique dataset of grassland sites across Europe. Specifically, for a set of dry grassland (priority habitat 6220 of Directive 92/43) sites located along an aridity gradient in East Spain, we investigate the independent and combined effects of nitrogen and phosphorous addition, and the interacting impact of increasing drought, on species and functional diversity, species loss and turnover. In addition, through several sets of greenhouse mesocosm experiments, we investigate nutrient enrichment and drought effects on the outcome of plant-plant interactions for species of interest, including common-endangered, common-invasive, and endangered-invasive species pairs. Our results will help to identify species and communities most vulnerable to nutrient enrichment, and to design and prioritize policy and management strategies for the protection of vulnerable species and communities in already water-limited grasslands in southern Europe from a nutrient perspective.

Keywords: dry grasslands, nutrient enrichment, plant diversity, species interactions, threatened species, invasive species

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When taxonomy matters for conservation priorities: some cases among the genus *Allium* L.

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The genus Allium is one of the most diverse in the world, with more than 1000 accepted species yet [1]. But a lot of new species are regularly described (several per year), including in the Euro-Mediterranean subgenus Allium. Within the sections *Allium*, *Codonoprasum*, *Cupanioscordum* and *Pseudoscorodon*, some old described species were recently rehabilitated and/or splitted into species complexes. This situation is not due to hazard, but to the difficult conservation of the main discriminant criteria when the plants collected were classically put in herbaria (A somewhat comparable situation is known for orchids and broomrapes for the same reasons). But the recent and prolific color photograph activities plus the more traditional comparative experimental cultivation have led several botanists to better understand the variability and therefore the taxonomy of the genus Allium.

During the last 10 years, redlisting activities supported by the IUCN-Med challenged us to choose a pragmatic taxonomy, not dependent to one or another backbone database but to conservation units identifiable on the field by botanists. The parallel progress of both taxonomy and redlisting are commented in details for the Euro-Mediterranean *A. ampeloprasum* complex (sect. *Allium*). We can also enlarge the problematics to the Mediterranean *A. cupanii / hirtovaginatum* complex (sect. *Cupanioscordum*), the western Mediterranean *A. rouyi* complex (sect. *Pseudoscorodon*), and some Maghrebian species of the *A. pallens / oleraceum / paniculatum* and the *A. flavum / stamineum* complexes (sect. *Codonoprasum*).

Keywords: Conservation units; Red listing; Species complex; Threatened species;

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2nd Thematic Session

Germplasm conservation for future and current uses

Silene Cambessedesii at CIEF (Quart de Poblet, Spain). Author: Emilio Laguna.

Chair

Marco Porceddu

Marco Porceddu (Serramanna, 1983), bachelor's and master's degree in Natural Science (2007, 2010) and PhD (2014) in Environmental and Applied Botany, University of Cagliari (Italy). From 2014 till 2018 he worked as a research fellow at the Department of Life and Environmental Sciences and currently he is the Curator of the Sardinian Germplasm Bank (BG-SAR) of the University of Cagliari. His research are mainly focused on seed dormancy and germination, ex situ conservation and seed banking, in particular on Mediterranean species and threatened endemic plants of Sardinia. As a result of his research, he has published over 50 works in international/national scientific journals and book chapters. Marco collaborates with the Network of Mediterranean Plant Conservation Centres – GENMEDA-, and the Italian network of seed banks – RIBES. He serves as a peer reviewer for several international journals on the field of ecophysiology of seed germination and ex situ conservation. He is a member of the Editorial boards of Plants, Seeds and Odissea Seminum, Review Editor for Frontiers in Conservation Science, Advisory Board member of Sci and member of the EC Agriculture Editorial Panel. He participates in different national and international projects linked to the plant conservation as the "LIFE SEEDFORCE: Using SEED banks to restore and reinFORCE the endangered native plants of Italy". He also collaborated in several projects as ECOPLANTMED "ECOlogical use of native PLANTs for environmental restoration and sustainable development in the MEDiterranean region", HEI PLADI by ERASMUS PLUS KA2 "Higher Education Innovation in Plant Diversity: flexible learning paths for emerging labour market", and CARE-MEDIFLORA "Conservation Actions for Threatened Mediterranean Island Flora: ex situ and in situ joint actions".

Research priorities for *ex situ* and *in situ* conservation on the East Mediterranean coniferous forests

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Mediterranean mountainous coniferous forests contribute considerably to the landscape diversity in the Eastern Mediterranean area. Forests with endemic Mesogean pines (*Pinus halepensis* and *P. brutia*, including *P. mugo* and *P. leucodermis*), black pines (*P. nigra*) and junipers (*Juniperus* spp.), in addition to circum-Mediterranean firs (*Abies* spp.), cedars (*Cedrus* spp.), yew (*Taxus baccata*) and cypresses (*Cupressus* spp.) constitute extensive and representative habitats, included in the Annex I of Directive 92/43/EEC.

Nowadays these habitats are increasingly threatened by wildfires, climate change and other types of human pressure, making the *ex situ* (seed banks, arboreta) and *in situ* conservation a challenging, worth pursuing objective.

Aiming at an effective conservation plan for tree species and the sustainable management of their habitats, the updated knowledge on selected Mediterranean conifers studied in Greece (e.g. *Abies cephalonica* Loudon, *Pinus heldreichii* H. Christ. and *Juniperus drupacea* Labill.) will be presented. Data concerning the reproductive biology of several, endemic or tertiary relict Mediterranean conifers, might contribute to the reforestation and habitat restoration management programmes, which aim to enhance the functionality and adaptation of Mediterranean trees and forests (i.e. 951B, 95A0 and 9560 forest habitats) to the global environmental change.

Keywords: Endemic Grecian fir, Heldreich's pine, Syrian juniper, Climate change.

Co-conserving Indigenous and local knowledge systems with seeds

Teixidor-Toneu, I.,[1,2*] Westengen, O.,[3] Ulian, T.,[4] McMillion, A.,[5] Lorimer, M.,[6] Grace, O.,[7] Caillon, S.,[8] Shrestha, P.[9] & Kool, A.[1]

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Indigenous and local knowledge (ILK) is being rapidly lost across the globe. ILK holders have deep ecological, horticultural and practical knowledge of plants grounded in their relational values, yet this cultural heritage is not routinely conserved with ex situ seed collections. In this presentation, conceived collaboratively by a team of experts in botany, ecology and ethnobotany, and practitioners in biodiversity and ILK systems conservation, we propose seven actions to overcome barriers and encourage stakeholders towards the routine co-conservation of seed and associated knowledge [1]. Success depends on simultaneous changes in practices, new collaborative relationships, and shifts in policy and legal frameworks for sharing and conserving biocultural diversity. Failure to act will witness the continued erosion of ILK and depreciation of ex situ seed collections.

Keywords: biocultural diversity, germplasm conservation, Indigenous peoples and local communities, situated knowledge, sustainability

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The importance of Seed Banks for the conservation of endangered species

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Although in situ conservation strategies are considered the best methods for preserving plant diversity, the *ex situ* conservation is a necessary and complementary method for ensuring the preservation of endangered species. One of the most effective ways to preserve *ex situ* the plant diversity is storage germplasm in seed banks, which allows conserving a large amount of genetic material in a small space with low risk of genetic degradation. In addition, the study of germination of seeds and propagation methods, both sexually and vegetatively, carried out by seed banks are a very useful tool to assist *in situ* activities and ensure effective biodiversity conservation.

The Global Strategy for Plant Conservation (GSPC) stimulated the establishment of several networks for *ex situ* plant conservation activities at international, national and regional level. At international level plant conservation consortia have been set up, such as the Network of Mediterranean Plant Conservation Centers (GENMEDA) and the European Native Seed Conservation Network (ENSCONET). The Sardinian Germplasm Bank (BG-SAR), a facility belonging to the University of Cagliari (Italy), participates actively in these international networks; it is also a founding member of the Italian Network of Germplasm Banks for the *ex situ* conservation of native flora (RIBES).

BG-SAR plays a central role in the conservation of Sardinian endemic, threatened and policy species, as well as taxa from insular territories of the Mediterranean region, and in the preservation of the most sensitive ecosystems of the island. To today, BG-SAR stored at -25°C and +5°C ca. 3,500 seed lots, relating to about 1500 plant taxa. The bank is a partner of the LIFE SEEDFORCE (LIFE20 NAT/IT/001468) “Using SEED banks to restore and reinFORCE the endangered native plants of Italy” (funded by the LIFE + Nature and Biodiversity Program) and of the Prioritized Action Frameworks (PAFs - financed by European funds). The first project aims to recover and reinforce the populations of native Italian plants in danger of extinction thanks to seed banks, while the second one focuses on implement the EU-wide Natura 2000 network (action 6.5.1 POR FESR 2014-2020).

As part of the activities of these projects, the study cases of *Ribes sardoum* and *Centranthus amazonum* are presented. These plants are two critically endangered (CR) endemic species of priority community interest (included in Annex II of Directive 43/92/EEC) of Central-Eastern Sardinia. An integrated *ex situ/ in situ* approach is being undertaken to remove the threats and improving habitat and population status of these two species.

Keywords: Germplasm Banks, *ex situ* conservation, *in situ* conservation, network, Mediterranean flora

Can germplasm storage compensate for habitat loss? Handling the conservation of the priority species *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve in central Italy

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In the ongoing scenario of continuous decline of European secondary grasslands due to the abandonment of traditional grazing/mowing practices, there is an increasing urgency to better understand the effectiveness of different conservation methods for grassland species. Even if, compared to ex-situ, in-situ conservation appears to be more easily applicable (especially in terms of practical implementation and costs) there is overwhelming evidence that this approach is not sufficient considering the difficult reversibility of societal-economical changes that have led to the abandonment of traditional management. Some pastoral activities, such as extensive grazing and mowing, represent emblematic examples. Indeed, it has already been proposed that both ex-situ and the in-situ conservation approaches should be implemented to meet the purpose of biodiversity conservation. In particular, ex-situ techniques are of great value when the in-situ approach can't realistically keep up with the rate of habitat loss; this could be the case of montane grasslands. The here presented study aims at shedding light on the applicability of in-situ and ex-situ conservation methods to the priority species *Klasea lycopifolia* in central Italy. This is a hemicryptophytic species with a SE-European (Pontic) distribution, considered endemic to SE-European mountain ranges and listed as a priority taxon in the Habitat Directive Annexes II-IV (Dir. 92/43/EEC). According to the Italian Red List of flora, *K. lycopifolia* is classified in the category "Nearly Threatened" (NT) meaning that the species is next to be deemed at risk and could potentially face endangerment in the foreseeable future if appropriate conservation measures are not implemented. Its native habitat is represented mainly by grasslands, mowable meadows, open scrublands and shrublands between 500/600 and 1400 m a.s.l. Our study concerns two isolated Apenninic populations *of K. lycopifolia* (M. Pennino and M. Faeto), hosted in patches of the Annex I habitat 6210, of which only a minor rate is included in the Natura2000 European Network and is thus subjected to protection measures. Population parameters, distribution data and macromorphological traits of the two target populations were collected as baseline data for planning in-situ conservation measures tailored to the Appenninic context. Collected geomorphological, climatic and land use/land cover-related data were analyzed to assess which environmental and use-related features mainly affect the populations in terms of morphology, distribution and reproductive patterns. The possible role of ex-situ conservation approaches in securing *K. lycopifolia* germplasm was also evaluated. To the purpose, and in order to develop suitable protocols in case of future needs of reinforce and restoration of the species in the wild, seeds from new collections, as well as already stored in the Department Germplasm Bank (FAO Code: ITA363), have been subjected to germination tests. Data produced in this study provide valuable insights for developing a comprehensive complementary conservation strategy for *K. lycopifolia.* Currently, there is in facts a lack of specific conservation guidelines and in general of information about this species, making these findings particularly significant in guiding future conservation efforts. The study is part of the integrated LIFE Project "IMAGINE" LIFE19 IPE/IT/000015.

Keywords: abandonment, biodiversity, ex-situ, in-situ, secondary grasslands

Integrate approach of *ex situ* and *in situ* conservation of *Linaria flava* subsp. *sardoa*, an endangered species of Habitats Directive

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Mediterranean vascular flora is characterized by high levels of species richness and high rates of endemism. The protection of plant diversity is regulated by international treaties and conventions, by national and regional laws relating to the conservation of natural and semi-natural habitats, flora, and fauna. However, much remains to be done to achieve effective *ex situ* and *in situ* conservation of the wild flora. Here, we present the case study of *Linaria flava* (Poir.) Desf. subsp. *sardoa* (Sommier) A.Terracc., an endangered endemic of Sardinia and Corse.

Linaria flava subsp. *sardoa* (Plantaginaceae) is an annual psammophilous plant, whose reduction of populations is mainly attributable to the impact of human activities and presence of alien invasive species (IAS). To our knowledge, there is no information on its reproductive biology and seed germination behaviour. The aims of this work are evaluating the seed germination behaviour under controlled and field conditions, and the response of *in situ* seed germination after IAS eradication in one selected natural site.

Seeds from 5 populations from Sardinia and 1 from Corse were sown on agar substrate and then incubated in growth chambers in the light at different temperatures. The effect of gibberellic acid (GA_3) was evaluated by sowing seeds on the substrate of agar with 0, 125, 250 and 500 mg/L GA_3 and incubated in the light at different temperatures. In an attempt to evaluate the presence of seed dormancy, several pre-treatments were. Control test in all populations and pre-treatments applied showed a germination percentage equal to zero. Seeds tested at GA_3 500 mg/L recorded higher germination (100% at 5, 10 and 15°C) rates than other concentrations (of up to 90% at GA_3 250 mg/L at 15°C, and no more than 50% at GA_3 125 mg/L at 15 and 25/10°C).

An experimental trial is being carried out to study the seed germination phenology in the field. In the population of Molentargius Regional Park (Sardinia), where in April 2022 the invasive species *Carpobrotus* spp. has been eradicated, seeds were collected and placed in fine-mesh polyester envelopes and buried in soil at a depth of 2–3 cm. Envelopes were buried in the area where *Carpobrotus* spp. was eradicated, and in the area where there is no *Carpobrotus* spp. and *Linaria flava* grows naturally, with a distance between them of approx. 4-5 m. The envelopes buried in the experimental sites were exhumed once a month to evaluate the presence of germinated seeds. Soil temperatures at the level of the envelopes were recorded using automatic loggers.
These preliminary results combining data from the laboratory and from field experiments permit us to better understand the ecophysiology of seed germination and provide new and useful information for implementing conservation strategies of a threatened plant species.

Keywords: Seeds, germination, endemic vascular flora, Mediterranean, dormancy

Seed lipid thermal fingerprints of Mediterranean terrestrial orchids can be used to optimize ex-situ conservation

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Orchidaceae is one of the largest plant families in the world but also one of the more threatened. Terrestrial orchids are particularly susceptible to habitat and environmental changes, so they are often the first species lost from disturbed habitats. Ex-situ seed storage offers a potential solution to mitigate the extinction risk of threatened plants. Terrestrial orchid seeds are orthodox in storage behaviour so their ex-situ conservation in seed banks can be a cost-effective tool to provide a long-term backup of their genetic diversity. Due to their minute size, large numbers of seeds can easily be stored in small volumes, making orchids ideal for seed banking without the need for large facilities. However, dry seed longevity under conventional seed bank conditions (ca. -20°C) is known to be extremely variable, with some families, like Orchidaceae, tending to be relatively short-lived. But why? Orchid seeds have lipids as the main, high-energy storage compound, which have been thought to be a determinant of seed ageing, with lipid composition impacting differing susceptibility to oxidation and variation in thermal behaviour. In particular, the thermal characteristics of lipid melting and crystallisation are hypothesized to influence the storage stability of oily seeds. So, understanding the balance of lipid composition and thermal characteristics of their melting and crystallization behaviour could be useful for identifying, and potentially predicting, longer-term cold storage problems in lipid-rich seeds, helping to inform storage practices. Only very few data are available on the thermal properties of orchid seeds. In this study, we have used differential scanning calorimetry to explore potential links between poor storage performance, lipid composition, and lipid thermal fingerprints of seeds of 15 Mediterranean terrestrial orchids. We determined the temperature spread and complexity of the lipid melt, the peak temperature and enthalpy of the main peak, and the short-term crystallization kinetics at ca. -70°C and -20°C. We aimed to test the hypothesis that Mediterranean orchid seeds, as typical for temperate environments, have polyunsaturated fatty acids with melting temperatures around -30°C as the main storage lipids. We wanted to test whether species with short lifespans present lipid compositions that tend to show multiple melting events at -20°C and high-temperature melting ends, as typical in the saturated fatty acids occurring in many tropical seeds. Data are interpreted in relation to the risk of lipid crystallization during cold storage, attempting to answer the question: what is the optimal storage temperature for the long-term preservation of orchid seeds?

Keywords: Differential Scanning Calorimetry, seed conservation, thermal analysis

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The Global Oak Pollen Bank (GOPB)

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Oak (*Quercus* spp.) seeds are not conserved for the long-term in any seed bank of the world due to their recalcitrance, i.e., their sensitivity to drying and freezing (the conditions used in conventional seed banks) [1]. While important efforts are put in research on the cryopreservation of seed embryos or other plant tissues, the implementation of these high-tech approaches is still very limited [1]. As a result, no back up copy exists of the genetic diversity of most oak species in the world. One currently unexplored route to immediately strengthen the conservation of this important group of plants is to establish a pollen bank [1, 2]. Oak pollen appears to tolerate drying and freezing, at least in the four species studied to date (which represents less than 1% of all species globally) [1]. If these attributes of pollen are shared among the 425 oak species reported – as may be the case as oak pollen is reputed to be binucleate (and most binucleate pollen is tolerant to drying) – a bank of dry pollen would be a low-tech and universal method for the long-term conservation of paternal lines within oak species around the world [2].

In this talk we introduce the "Global Oak Pollen Bank" (GOPB), a project funded by the Oak Conservation & Research Fund of the International Oak Society [2]. This project has two main aims: (1) to conduct basic research on drying and freezing tolerance in a diversity of *Quercus* species across territories and the oak evolutionary tree to confirm the universality of these traits in the oaks, and (2) to create the first pollen bank for oak species from a global perspective. The GOPB is planned as a decentralized germplasm bank that will preserve the genetic diversity of a variety of endangered oak species as well as key species in ecosystem restoration projects. In this stage it is focused in Spain (Europe) and three of the most important oak hot-spots (USA, Mexico and China). The project also aims to contribute to train the next generation of oak conservationists in cryobiotechnology (i.e., combining cryobiology with in vitro technology skills) in order to facilitate the expansion of the collection started in the GOPB into all oak species and populations living around the world.

To achieve the objectives of the GOPB, we have assembled a world-leading research team to collect, research and bank pollen from at least 50 oak species in a global context (over 10% of all species globally), including 10 of the most endangered taxa in the most important oak hotspots. So far, we have found that pollen from all species tested (4 from the USA, 4 from China and 5 from Spain) tolerate drying up to 11% relative humidity (RH) and storage at subzero temperatures after drying to 11-30% RH. Longevity studies are underway but dry storage at 30% RH seems the most suitable condition. These preliminary results set the basis for optimal oak pollen storage and are being used to create the collection conserved in the GOPB. We expect that the GOPB will not only act as a back-up of the rich oak genetic diversity but will become a fundamental conservation tool in oak restoration projects through assisted reproduction technology (ART) [1, 2].

Keywords: desiccation tolerance, freezing tolerance, pollen storage, cryopreservation, Quercus.

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Comparison of the climate change tolerance of native and non-native species used or with potential use as ornamentals

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As consequence of climate change, temperature and rainfall regimes are being modified, threaten the survival of the current gardening concept in many areas of the world. This situation highlights the need to investigate the potential of other interesting species, especially in more sensitive areas such as the Mediterranean Basin. For this reason, the aim of this study is to promote sustainable gardening through the use of adapted species. The use of native Mediterranean flora offers a good opportunity to find plants that are resistant to the current conditions of increasing temperatures and decreasing water availability. To achieve this objective, seven species belonging to three families (Amaranthaceae, Lamiaceae and Asteraceae), used or with potential use as ornamentals, were selected to compare their tolerance in the germinative phase to different levels of temperature and water stress.

Germination tests were carried out for the seven species at 6 constant temperatures between 10 and 35ºC. The effect of water stress was studied by creating a low osmotic potential environment with PEG 6000, using 9 treatments between -0.10 and -2.5 MPa. Germination percentage, mean germination time, base temperature, thermal time, base water potential and hydrotime (Tb, S, Ψb and ΘH) were calculated.

The results showed a good response to high temperature and low osmotic potential of most of the species, particularly the autochthonous species *Salsola oppositifolia*. On the other hand, the outstanding response of *Celosia argentea*, a non-native species, should wake warning to avoid it becoming an environmental problem in future years as a potential invasive plant.

Keywords: xerogardening, seed stress tolerance, climate change, invasiveness potential

Conservation of historic and endangered grapevine cultivars from the Valencian Community (Spain)

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Vitis vinifera subsp. *sativa* L. is one of the most important crops in the Mediterranean Basin. Spain, France, and Italy are the main wine making countries. Table grapes have also great economic value in Turkey, Argelia, Iran, or Italy. Grapevine varieties have initially resulted from the domestication of *V. vinifera* subsp. s*ylvestris* (Gmelin) Hegi in Western Asia and the Caucasus to yield table and wine grapevines, respectively. Human migrations, spontaneous hybridization of domesticated cultivars with wild relatives, as well as the selection of plants with mutations, give thousands of cultivars that were vegetative propagated. Nowadays, European wild populations are considered to be endangered but also lot of grapevine cultivars are in risk of disappearance. For instance, at the Comunitat Valenciana (Spain) more than 150 varieties were present previously to 1900. However, a great genetic erosion was produced after the phylloxera arrival when the number of cultivars grafted onto resistant rootstocks was drastically reduced, and in many areas, vineyards were replaced by other crops. In addition, few foreign varieties have also been widespread worldwide, decreasing variability. In 2015, we started the recovery of cultivars in risk of extinction and the development of preservation activities which include the *in vitro* culture and virus sanitation. The prospections carried out have located varieties like Cor d'Angel, Raïm del Clotet, Cardeal or Forcallat Blanc, in risk of disappearance. The varietal identification by SSR markers, has also identified new homonymies and synonymies. In addition, SSR profiles were assigned for historic varieties like Trepadell, Arcos, Montalbana, or Esclafagerres, among others. Some unidentified materials were also found. A high number of the minor varieties have chlorotype A, that is associated to a secondary domestication process occurred in the Iberian Peninsula. Ampelographic characterizations are being also performed. As a result of all these work, new materials were introduced in the germplasm collections of Generalitat Valenciana (GVA): 'Instituto Tecnológico de Viticultura y Enología' (Requena) and 'Estación Experimental Agraria de Elx'. Some minor varieties are being also maintained in the Botanical Garden of Universitat de València. Nowadays, 80 genotypes including grapevine varieties and rootstocks, are being under *in vitro* culture preservation in standard growing conditions (24ºC, 70% humidity, and 16/8h photoperiod). This germplasm can be acclimatized and transferred to soil and/or used for other research purposes, including biotechnological breeding.

Keywords: *Vitis,* germplasm*, in vitro culture, chlorotype, SSR*

Acknowledgements: This work is funded through Consellería de Agricultura, Ganadería y Pesca GVA (location, identification, and virus sanitation). Vice-rectorate for Research of UPV (PAID-11-21) funded *in vitro* preservation. We thank the collaboration of Carles Jiménez, Sara Mares, Francisco Martínez-Gil, and Camilo Chirivella.

Difficulties for *ex situ* reproduction and conservation of three relict forest species from their Iberian refuge populations

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Euonymus latifolius (L.) Mill., *Salix caprea* L. and *Daphne mezereum* L. are among the rarest forest species in the Iberian Peninsula (López González G., 2001). These are relict species from the Würmian glaciations. Their populations are very small and scarce in the Iberian Peninsula. In addition, they show great difficulties in reproduction with low rates of seed production, germination, seedling survival and slow growth. For all these reasons, the main objective of this work is the development of realistic and applicable reproduction protocols.

For this work, the sexual reproduction techniques have been evaluated by means of seed germination tests *sensu* Baskin & Baskin, 2014 (in E. *latifolius* since the rest of the species did not produce viable seeds) and asexual reproduction by means of cuttings and layering of the three species. To test the cutting capacity, this was carried out under different variables of substrate composition, previous pretreatments and presence/absence of commercial auxin rooting agent of *Salix babylonica* L. In the case of layering, this was carried out both in situ (*Daphne mezereum*) and ex situ in *E. latifolius* and *S. caprea*. The *ex situ* layering tests were carried out on specimens of wild origin cultivated in the Botanic Garden of Castilla-La Mancha.

The germination trials shown good germination results (approx. 90%, (Santiago et al. 2023). As well as the layering technique, that was highly effective in Daphne mezereum and *Euonymus latifolius* (unpublished data). However, the cutting techniques only achieved an adequate rooting result for *S. caprea.*

Keywords: *Euonymus latifolius, Salix caprea, Daphne mezereum*, germination, vegetative reproduction.

Acknowledgements: Study funded by the General Directorate of the Natural Environment and Biodiversity of the Community Board of Castilla-La Mancha (Spain).

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Ensuring plant production for ecosystem restoration and conservation of endangered species in the Valencian Community (Spain)

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Due to the extensive lack of private nurseries to produce native plants in the Valencian Community (Spain), the regional government -Generalitat Valenciana (GV)- develops this activity, both to provide plants for ecosystem restoration projects and for conservation translocations of endangered species. The first function is made by the Forest Seed Bank (FSB) line of CIEF (Centre for Forestry Research and Experimentation), mainly related to the activity of the Valencian Forest Service and own projects -i.e., LIFE Teixeres-. The second one is performed by units of the Valencian Wildlife and Natura 2000 Service (SVS), both placed at CIEF (for terrestrial species) and the Aquaculture Centre El Palmar (CAEP, for aquatic ones and helophytes). Reporting data from 2022, including the production of new plants (NP) and the maintenance of stock production (SP) from former years -species needing to be maintained for more than 1 year-, the CIEF's FSB produced 101,197 plants (156 taxa) NP and maintained 78,606 ones (62 taxa) as SP. The SVS develops two production lines at CIEF: The first one, related to protected, rare and endangered species, yielded 27,648 plants (45 taxa) NP and 13,244 plants (70 taxa) SP. The second line produces plants of unprotected species for educational or other alternative uses, producing 5,416 (69 taxa) NP and maintaining 6,740 ones (69 taxa) as SP. On the other hand, the CAEP production reached 42,845 plants (42 taxa) NP and 48,209 plants (58 taxa) SP.

CIEF and CAEP use differentiated techniques for irrigation and nursery substrata, respectively closer to the growth needs of terrestrial and aquatic plants. In the second case, in addition to plant production from seeds, cuttings and plant fragments are often used as propagation units. Adding up all the plant production of the two centers, 177,107 new plants (202 taxa) were made in 2022, and 146,799 ones (259 taxa) were maintained as stock.

Keywords: Native plant production, Forest nursery, Endangered species, Valencian Community, Spain

Acknowledgements: A significant part of the plant production works works have been co-financed by the European Union since 1992 through the programs LIFE, EAGF-Orientation, EAFRD, Interreg and ENPI/EPI.

Ex-situ conservation and propagation of wild plant species from wetlands, ponds, and temporary ponds of the Balearic Islands

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The main objective of this project is the *ex-situ* conservation of priority species (endemic ones, endangered and/or rare for Balearic Islands) of wetlands habitats as: a) Rushes and wet meadows, b) Submerged-based aquatic communities, c) Temporary ponds and d) Plant communities that cover thin substrates of shady places on the ledges of cliffs, and drips.

The first step for *ex-situ* conservation is the *in-situ* observation, then the collecting of propagation material with the best phenotypic and genotypic variability to obtain a good number of individuals and finally grow the plants *ex-situ*, in the botanic garden. At the same time, seeds from different populations have been conserved in the seedbank for future uses in restoration habitats, reinforcement, or re-introductions just in case.

The cultivation in botanical gardens allows the survival of the specie and at the same time is a tool to learn about the propagation system. In this work we will explain the approach for growing some species of the project, the problems, and the success stories.

Keywords: ex-situ conservation, living plant collection, botanical garden, seedbank.

Acknowledgements: the project has been funded by CaixaBank and Fundació Sa Nostra within the 'Call for Environment 2022'.

Exploring the germination dynamics of *Primula palinuri Petagna*, endemic species of southern-Italy

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Primula palinuri Petagna is a narrow-endemic plant species to south Italy and extends across the Tirrenic coast with peculiar adaptations to its habitat (marine aerosol, wind tolerance, etc.), many of which are little researched yet.

In this study, we compared seed abundance and size, capsule size, heat-induced germination capability, and salt response of two populations of *P. palinuri* growing seafront in the SAC Capo Palinuro (IT8050008) and more internally about two kilometres from the sea in "La Vaccuta", SAC Fascia Interna di Costa degli Infreschi e della Masseta (IT8050011), respectively.

Seeds from capsules were manually counted and were measured using image analysis software.

In the first experiment, the germination responses of two different sampling sites were evaluated at three temperature ranges: 6-15°C, 10-20°C, and 15-25°C.
Subsequently, in the second experiment, seeds from the same two sampling sites were subjected to different concentrations of NaCl (0mM, 50mM, 100mM, 200mM, and 300mM). No pre-treatment was applied to the *P. palinuri* seeds prior to the experiment.
Both germination experiments were conducted in Petri dishes containing filter paper and distilled water. The germination rates were observed and recorded on a daily basis, and the collected data were analyzed using various statistical methods.

No differences in capsule and seed sizes are shown between sampling sites.
Seed analysis revealed that high temperatures negatively impact the germination rate of both populations of *P. palinuri* suggesting a germination tendency during cooler periods. Excessive salt concentrations also reduce the germination rate in both populations but more prominently in seeds from the population located farther inland, indicating a higher tolerance to saline conditions of the sea-exposed population.

This study investigated some physiological and ecological adaptations of *P. palinuri* to its natural environment determining whether seed properties, temperature and salinity modulate seed viability and germination potential of the species. Results revealed promising insights that pave the way for a more in-depth understanding of the adaptive strategies of the species to benefit conservation and management practices.

Keywords: Endemism, Adaptations, Germination capability, Salinity tolerance

Germplasm Bank of Wild Flora of the Wildlife Service, an essential tool for the recovery of endangered species in the Valencian Community (Spain)

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Species are going extinct faster than any time in history, and this worrying trend is projected to accelerate, according to a 2021 UICN report, where approximately 1 million animal and plant species are at risk of extinction. In these sense, Spain adopted in 2011 the Strategic Plan for Natural Heritage and Biodiversity 2011-2020, actually State Strategic Plan for Natural Heritage and Biodiversity to 2030. In Valencian Community (Spain), the Wildlife and Natura 2000 Service of the Generalitat Valenciana is the organism competent for the conservation and recovery of wild species and natural habitats. These actions are carried out through the establishment of a germplasm bank and a set of living plant collections of endangered species. These collections represent an active tool, which may be the only option for some critically endangered species and ensures that this material is available for restoration and recovery efforts. In this regard, the Council of Ministers, at the request of the Ministry for the Ecological Transition and the Demographic Challenge (MITECO), has approved the Royal Decree on the conservation of forest genetic resources and wild flora (R.D. 159/2022).

The Germplasm Bank of Wild Flora depending of Wildlife Service is located in two different site, the terrestrial flora in the Centre for Forestry Research and Experimentation (CIEF) and the aquatic flora in the Aquaculture Centre at El Palmar (CAEP). The seedbank preserve 4,484 seeds accessions of 732 rare, endemic or endangered species, 3,686 correspond to terrestrial flora and 798 to aquatic. 2,082 seeds accessions correspond to protected species according to Order 2/2022. Of this conserved seed accessions, 33.4% (695) correspond to 'IE', 15.5% (323) to 'VU', 33.4% (696) to 'NCP' and 17.7 % (368) to 'W' species. Since 1990 to December 2022, 38,223,330 seeds have been collected and processed and 10,359,318 seeds have been used for different purposes, principally translocations conservation actions. In addition, more than 30 collections of mother plants have been established for species with difficulties for the *ex situ* conservation of genetic resources through their seeds. Information generated is stored in a database where data of seed viability of the conserved seeds accession and their potential use to produce plants are contemplated [1], essential knowledge to carry out endangered recovery programs. Throughout this period, 781,044 plants (364.357 terrestrial plants and 416,687 aquatic plants) have been produced and 561,508 plants (217,271 terrestrial and 344,237 aquatic plants) have been introduced in the natural environment to achieve recovery programs of protected species or habitat restoration; which of 385,307 plants were planted in Natura 2000 (110,488 terrestrial and 274,819 aquatic plants), being 209,803 protected plants species (89,988 terrestrial and 119,815 aquatic plants).

Keywords: seedbank, threatened, extinct, translocation conservation, plan recovery

Acknowledgements: Part of the seed collection and conservation works (plant production or translocation) have been co-financed by the European Union since 1992 through the programs LIFE, EAGF-Orientation, EAFRD or recently NEXT GENERATION EU funds.

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In vitro establishment and plant micropropagation for three endemisms of the Valencian Community (Spain)

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In vitro culture includes several methodologies useful for plant breeding, micropropagation, and germplasm preservation. In our work, it is used as a complementary tool of ex-situ conservation of the Valencian endemism Salvia blancoana subsp. mariolensis Figuerola, and two other endemic plants present in this area: *Iberis carnosa* subsp. *hegelmaieri* (Willk.) Moreno and Chaenorhinum tenellum (Cav.) Lange. All these materials have been provided by the Centre for Forestry Research and Experimentation, Generalitat Valenciana. From these endemisms, only C. tenellum, that inhabits in calcareous rocks and preferably in caves or on rocky ledges, is currently protected by the List of Monitored Flora Species of the GVA (DOGV, 2013). The vegetative multiplication of Salvia blancoana subsp. mariolensis, which has great value due to their medical features and synthesis of essential oils, is necessary considering their low seed production. In addition, it is harvested, along with other aromatic plants, in the Alcoià-Comtat county (in altitudes over 700 m a.s.l.), to elaborate the traditional liqueur 'herbero'. In vitro multiplication is of interests in the other two endemisms because recalcitrance or erratic germination has been found. All the three have value as ornamental plants for rockeries in gardens. For in vitro establishment, internodes and seeds were disinfested using several concentrations of bleach. Treatments with a fungicide, made previously to the bleach application, have increased the percentages of disinfested plants cultured on the woody plant medium (MW). Multiplication of plants was made by using apical and internode sections obtained from the plants in vitro established. Whereas good growth, multiplication, and rooting was obtained for C. tenellum on MW, different experiments which include modifications on salts minerals, gelling agents, and/or growth regulators have been carried out for obtaining multiplication and/or rooting in the other two endemisms. The effect of adding silver nitrate to reduce basal necrosis in S. blancoana subsp. mariolensis has been also tested. The gradual reduction of humidity has resulted in a successful transference of the three endemisms with percentages higher than 90% for S. blancoana subsp. mariolensis. DNA extractions and amplifications of ISSR molecular markers have been carried out to select those useful for studying genetic variability. Selected ISSR have been validated in individuals of four populations of S. blancoana subsp. mariolensis growing at different places in the Alcoià-Comtat county. Therefore, we can choose plants carrying genetic variability to be micropropagated and used in future reintroductions.

Keywords: *Salvia blancoana subsp. mariolensis, Iberis carnosa subsp. hegelmaieri, Chaenorhinum tenellum,* ISSR, Preservation

Influence of abiotic factors on the germination and postgermination stages of *Limonium tobarrense*

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Understanding the community assembly rules is crucial for explaining ecological patterns and, in consequence, proposing adequate management measures. Vegetative traits of different *Limonium* species are responsible that them appear within specific soil conditions of saline habitats. However, seed traits contribute to shape plant fitness and niche competition during its first stages in stressful environments. These abiotic factors might be more restrictive in the plant zonation of endemic species of the genus *Limonium*. In this framework, we assess the environmental factors related to the germination and postgermination establishment of the endemism *Limonium tobarrense* within the saline habitat to disentangle the assembly processes during its early life stage and, hence, to define optimal management and conservation measures. Experiments were performed to determine the effects of different salinities (0%, 0.5%, 1%, 1.5% and 2% NaCl) on seed germination under three combinations of day/night temperature regimes (30ºC/20ºC, 25ºC/20ºC and 25ºC/15ºC). Final germination percentage (FGP) and mean time-to-germinate (MTG) were recorded after 30 days. Besides, postgerminative experiments were performed during 3 months using the same salinity gradient (0%, 0.5%, 1%, 1.5% and 2% NaCl) under 25ºC/20ºC day/night temperature. Morphological traits were measured in each salinity treatment after the postgermination development. Our results show *L. tobarrense* germinates better in freshwater and the FGP decreases at 2%. Besides, during the postgerminative stages, the plant can withstand high salinity conditions although its growth decreases. These findings suggest that the salinity determines the germination and establishment of *L. tobarrense* in saline habitats. Thus, abiotic factors shape the local assembly of *L. tobarrense* along the salinity gradient, allowing this endemism to have its own regeneration and adult niche. In consequence, our results provide us useful information to define optimal conservation and management guidelines for this endemic specie in its habitat.

Keywords: ecological distribution, interspecific trait variation, salinity tolerance, seed germination

Seed germination behavior of the threatened monospecific endemic *Petagnaea gussonei* (Sicily, Italy), under gibberellic acid treatment

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This study investigated the germination behavior and dormancy-breaking requirements of *Petagnaea gussonei*, a Mediterranean endemic monospecific plant (Apiaceae, subfam. Saniculoideae). Considered as a palaeoendemic relict of the Sicilian Tertiary flora, *P. gussonei* is narrowly distributed across the Nebrodi Mountains (north-eastern Sicily, Italy). It is included among the top 50 threatened Mediterranean island plants, and is categorized as Endangered (EN) according to the IUCN Red List Criteria. It is also listed in Appendix I of the Bern Convention (1979), and in Annexes II and IV of the Habitats Directive. However, *P. gussonei* has been so far poorly examined with respect to its germination capacity.

Germination tests were carried out in temperature and light controlled growth chambers. Both 1% agar and blotting paper (three layers), combined with gibberellic acid (GA_3) solution, were used at different constant thermoperiods (10 and 15 °C), and at the photoperiod of 12/12h (light/dark). Each treatment was carried out with four replicates of 20 achenes put in 9-cm Petri dishes. Seeds were considered to have germinated when radicle was 1-mm long. All experimental treatments lasted 60 days. The final germination percentage (FGP) of the various experimental treatments showed significantly different values, which ranged from 14% (GA_3, 15 °C, no agar) to 32% (GA_3, 10 °C, with agar). The results suggest that the germination behavior of *P. gussonei* is not only sensitive to modest temperature oscillations (10–15 °C), but also to the presence of agar as germination medium.

Most Apiaceae species show morphological dormancy (MD). However, several species may show morpho-physiological dormancy (MPD), where an additional physiological obstacle preventing embryo growth and/or germination occurs. The significant role of GA_3 on breaking *P. gussonei* dormancy may suggest that the seeds of *P. gussonei* seem to have mainly MPD. Moreover, this study showed that *P. gussonei* seeds start germinating after 4–5 weeks, and in MPD seeds, embryo growth/radicle emergence requires a considerably longer period of time than in MD seeds [1]. Similarly, various studies showed that several species of the *Sanicula* genus, closely related to *P. gussonei*, have MPD seeds [2, 3].

Dormancy and high temperatures are undoubtedly two important factors that limit *P. gussonei* germination. The effective conservation of *P. gussonei* should be multilateral by relying on germplasm banks, and by promoting climate policies.

Keywords: *Petagnaea gussonei*, dormancy, Apiaceae, endemism, conservation

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Plant-soil microbiomes banking: a holistic approach to enhance biodiversity in plant conservation actions

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The UN's 2030 Agenda for Sustainable Development calls for the preservation of biodiversity, threatened due to habitat degradation and climate change. Actions to maintain and sustain biodiversity, including restoration of degraded habitats and population reinforcement, need a more holistic approach that takes the soil microbiome into account.

Plant–microbial interactions are key for thriving ecosystems in resource-limiting conditions, especially in Mediterranean climate where abiotic stresses are already severe. Plant beneficial microbes (PBMs) include diverse fungi, bacteria and archaea, which can occur as epiphytes and/or endophytes. PBMs can be transmitted vertically and/or horizontally, from mother plant-to-seed-to-seedlings and from seedlings to seedlings respectively. Benefits related to PBMs include the production of growth-promoting hormones, phosphorus solubilization, nitrogen fixation, antibiosis, production of indole acetic acid (IAA), siderophore production to transport iron inside the plant, production of novel secondary metabolites as well as the ability to suppress growth of plant-pathogenic microorganisms, resulting in an overall habitat resilience. The above-mentioned benefits can be of crucial relevance in habitat restoration as well as population reinforcement practices. The ex-situ plant propagation-restoration cycle ending with in-situ translocation should therefore integrate the PBMs in its lifecycle, thus ensuring that the translocated plant has acquired its natural PBMs.

The above can only be possible if already existing Seed Banks can ensure the preservation of indigenous PBMs associated with the mother plant, seeds and seedlings. The action involves the additional undertaking by Seed Banks of preserving a small soil sample associated with the species of interest from the seed collection site. The soil can be preserved in a desiccated state in glass vials duly labelled and catalogued. Such small samples will not require special storage conditions. A further more intensive step could include the axenic isolation of PBMs endophytes and epiphytes from seeds, leaves and roots and their preservation as a lyophilised 'living' collection to be readily available when required. Complimentary soil and seed banks will result in an enhanced and holistic approach to biodiversity conservation.

Keywords: Plant–microbial interactions, Plant beneficial microbes, Seed bank, Soil bank and biodiversity conservation

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Seed morpho-colorimetric analysis of Mediterranean endemic taxa belonging to *Santolina* (Asteraceae) and *Armeria* (Plumbaginaceae)

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The PRIN Project “PLAN.T.S. 2.0 - towards a renaissance of PLANt Taxonomy and Systematics” funded by Ministry of Education and University Research of Italy aims to improve the knowledge on the over 1,500 Italian endemic taxa, estimated by integrating various methodologies: morphometric analyses, chromosome number and other basic karyological features, DNA barcoding, ecological niche modelling, morpho-colorimetric analysis of seeds, also in a conservation perspective.
Morphometric analysis has become a powerful tool in botanical research, offering a quantitative alternative and/or extension to conventional procedures. In the last two decades, to overcome the manual seed discrimination system, image morphometric analysis has received considerable attention in plant research using automated systems that have the potential to replace human visual assessments. Numerous works attests for the importance of biometric features, measured with computer vision techniques in taxonomic studies to characterize and identify plant species.
Recently, several studies on *Santolina* L. (Asteraceae) and *Armeria* Willd. (Plumbaginaceae) have been carried out, aiming to evaluate and identify morphometric group similarity and to compare results with the current systematic knowledge.
In *Santolina*, the morpho-colorimetric analyses were applied to the *S. chamaecyparissus* L. complex, and in particular to taxa endemic to Sardinia and Corsica, and to taxa endemic to southern France and north-eastern Spain. In both cases, this approach, combined with other integrating methodologies, allowed recognizing populations worth of conservation interest. In Sardinia, an ESU (Evolutionary Significant Unit) was detected, whereas in southern France, a newly described subspecies, *S. decumbens* subsp. *tisoniana* Giacò & Peruzzi, is going to be assessed as critically endangered according to the IUCN criteria.
In *Armeria*, the analyses were devoted to the taxonomic study of the taxa endemic to Sardinia and Corsica, and to the subspecies of *A. arenaria* (Pers.) F.Dietr. occurring in Italy.
According to the results obtained, the use of image analysis techniques applied on seeds is confirmed as an effective tool in systematics, as well as for in ex situ conservation, given that these seeds are stored in seed banks.

Keywdors: Biodiversity, *Ex situ* conservation, Morphometric analyses, Seed image analysis

Identification of grapevine (*Vitis vinifera* L.) cultivars using morphometry analysis of seed specimens and comparison with archaeological remnants

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The identification of ancient and modern grapevine (*Vitis vinifera* L.) varieties is essential for understanding the historical evolution of grape cultivation. While ampelography was used in the past to distinguish varieties, modern approaches combine morphological and genetic analyses. However, genetic identification often fails for ancient samples. Therefore, integrating image analysis techniques with ampelography can improve the identification of ancient varieties.
The aim of our work is to initiate the creation of a comprehensive regional database of grape seed morphological traits from ancient and modern archaeological wine varieties as well as from wild grape species. Additionally, we seek to identify which seeds of modern grape varieties exhibit morphological similarities to archaeological varieties.
We acquired digital images of modern and archaeological seeds using a flatbed scanner. For each sample, 100 seeds were randomly selected from the original seed lots. The images were analyzed using image analysis software to collect morphometric data on each individual seed. Intraspecific diversity among the seed lots was investigated using Linear Discriminant Analysis.
Archaeological seeds were found to be more similar to cultivated *V. vinifera* varieties than to *V. sylvestris* populations, suggesting grapevine cultivation in southern Abruzzo during the Byzantine era. Grape seed morphology provides valuable information to explore the evolution of grape varieties over time and space. Similarities with ancient seeds suggest an ancient origin for some of the currently cultivated varieties.
Studying the evolution of grape seed morphology and, in turn, the evolution of grape varieties across time and space is of fundamental importance to viticulture and archaeology. This study demonstrates the validity of seed morphometric analysis as a tool for characterizing, distinguishing, and comparing seed groups. While the prospects offered by these analyses in the context of grape variety evolution are promising, further studies that combine genetic and morphological data will be crucial for a better understanding of evolutionary processes.
This approach could be applied to other plant species of agronomic and botanical interest as well as to different geographical areas, both extensive and isolated. Further developing this methodology, already used in germplasm banks, could lead to an effective seed classification tool, significantly improving archaeobotany and general taxonomy.
In conclusion, morphometric analysis of grape seeds proves to be a valuable resource for investigating the evolution of vine varieties throughout history. Combining image analysis techniques with genetic data will open new perspectives for studying the origins and variations of grape varieties, contributing to the conservation and enhancement of the viticultural heritage.

Keywords: Seed morphology, seed image analysis, Grapevine, Archaeological grape pips, *Vitis sylvestris*.

Acknowledgements: We thank the "Soprintendenza Archeologia Belle Arti e Paesaggio per le province di Chieti e Pescara" and in particular the former superintendent Dr. Rosaria Mencarelli for the opportunity to have been able to analyze the archaeological seeds.

The Generalitat Valenciana's combined model of seed banks to ensure the conservation of native plant diversity and landraces (Valencian Community, Spain)

Laguna, E.,[1] Picher, M.C.,[1,2] Campos, E.,[1,2] Veintimilla, P.,[1,2] Escat, B., [1,2] Ferrando-Pardo, I.,[1,2,3] Ferrer-Gallego, P.P.,[1,2,3] Albert, F.J.,[1,2,3] Barrero, R.,[1,2,3] Núñez, P.,[1,2,3] Escribá, M.C.,[1,2,3] Peña, C.,[2,3] Sebastián, A.,[2,3] Zreik, C.,[1,2] Cerdán, V.,[1,2] Martínez, J.,[1,2] Rubio, A.,[1] & Marzo, A.[1]

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The Generalitat Valenciana -GV, government of the Valencian Community- is the main responsible to collect, store and use the plant germplasm for habitat restoration and to conserve rare or endangered plant species in the Valencian territory. Both active (AC, at 0-4ºC) and base collections (BC, at -17º to -18ºC) are maintained at two units: the Centre for Forestry Research and Experimentation (CIEF) and the Aquaculture Centre at El Palmar (CAEP), whose activities started in 1992-1994.

The CIEF holds the Forest Seed Bank (AC: 1,025 seed lots, 167 taxa; BC: respectively 353 and 53), devoted to provide seeds for GV's ecological restoration projects and experimental reforestations; the section on terrestrial plants of the Germplasm Bank of Valencian Wild Flora (BGFSV) (AC: 3,686 lots, 732 taxa; BC: 850, 236) caring for legally protected, rare or endangered species, and depending on the Wildlife and Natura 2000 Service (SVS); and the Valencian Landraces Seedbank (AC: 292 lots, 208 landraces, 43 taxa; BC: 38, 38, 17), included in the seed exchange service for local farmers, maintained by the Valencian Network of Agriculture Experimental Stations. The CAEP holds the section on helophytes and riverine plants of the SVS's BGFSV (AC: 568 lots, 118 taxa; BC: 46, 28).

Each one of these 4 collections use different storage techniques, seed containers, etc. related to the seeds and lots sizes, seed orthodoxy, etc. Adding up the whole banks, GV owns 5,571 seed lots of 1,060 taxa and 208 landraces in active collections, and 1,357 lots, 334 taxa and 38 landraces in base collections. CIEF and CAEP regularly send seed lot duplicates to the Germplasm Bank of the Botanical Garden of the University of Valencia; 311 duplicates from 119 taxa have been transferred as a safety measure to ensure their long-term conservation.

Keywords: Forest seed bank. Landraces seed bank, Endangered species, Valencian Community, Spain

Acknowledgements: A significant part of the seed collection and conservation works have been co-financed by the European Union since 1992 through the programs LIFE, EAGF-Orientation, EAFRD, Interreg and ENPI/EPI.

Effect of water deficit on seed germination and growth of a Tunisian Algerian endemic clover: *T. juliani* compared to *T. squarrosum*

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Seed germination is an essential step in the life history of plants, playing an important role in the successful colonization and even invasion of new individuals. The genus clover (*Trifolium* sp.) is one of the most economically important genera in the Fabaceae family. More than 10 species are grown as manure plants or forage legumes. The Clover (*T. juliani)* is small annual herb endemic to Algeria and Tunisia, growing mostly in grasslands. The specie has suffered an extensive decline in distribution and abundance due to widespread degradation and destruction of habitat. The drought experiment was conducted in the germination stage. The effects of different level of drought stress on the seed germination and seedling growth of each component organ were analyzed. Two species were germinated in four concentrations of polyethylene glycol 6000 (PEG) and were evaluated daily (12-h light photoperiod) to determine seed germination under water stress. Germination percentage decreased with an increase in polyethylene glycol 6000 (PEG) concentration, but species germination response to PEG concentration varied significantly. We elucidated the response of different tissues and parts of clover to water stress during the seedling stage. The results showed that (1) the water content of stem of clover decreased in general by 8.75% for *T. squarrosum* and 8.64% for *T. juliani*. (2) Under different drought treatments, the radicle length for *T. juliani* (RLJ) increased by 38.75%, and hypocotyl height (HH) increased by 32.65% for *T. squarrosum* and by 61.40% for *T. juliani* respectively under water stress. (3) The fresh weight radicle of *T. juliani* increased by 60% in PEG treatments respectively. The average germination time (AGT) recorded under sufficient water decreased in drought stress; the AGT for *T. squarrosum* under drought stress is lower than the AGT for *T. juliani*. This study is helpful to understand the adaptive strategies of the coordinated growth of clover component organs under drought stress and provides a reference for the prediction of yield under climate change. After analysis of the physiological indicators, it was found that the radicle and hypocotyl of Trifolium were the most significantly changed parts. The resulting data, especially the drought tolerance, may have great potential for further research of the legume family and for rapid advancements in clover breeding. Finding a suitable method to increase seed germination rates of endemic plants is critical to saving them from extinction.

Keywords: Endemic clover, *Trifolium juliani*, germination, drought, seedling growth.

Acknowledgements: This research is partially supported by the TREFLE project (“Together for Restoration of Ecosystems with Engaged Local Farmers in Dyr el Kef, Tunisia”). We would like to thank Edouard Jean, the Director of the project for his support and facilities to the research activities, to Pr. Zeineb Ghrabi from INAT, for helping in species determination and facilities to visit her herbarium. This study is part of the program on Conservation and evaluation of local genetic resources of forage and pasture legumes of the Laboratory of Animal and Forage Productions of INRAT.

Unravelling the invasive capacity of *Nicotiana glauca* Graham, growing in diverse areas, through the knowledge of optimal germination conditions and seed longevity

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Introduction: *Nicotiana glauca* Graham, a native species from South America, was introduced in the 19th century as an ornamental plant in Europe. Nowadays, it is naturalised on the Mediterranean and South Atlantic coast, mainly in anthropised environments, and is classified as highly invasive in the "Atlas of Invasive Alien Plants in Spain", especially in the Canary Islands [1]. [2] established seed as the natural way of plant propagation and dispersal. Moreover, [3] confirm its germination capacity under a wide range of temperature conditions. This aspect supports its invasive nature.

Objectives: The aim of this study is to evaluate the invasive capacity of *N. glauca*. Thus, the germination response in a wide range of temperatures and its persistence in the soil seed bank were assessed.

Material and methods: In order to check the reproductive success of this species under specific climatic conditions, a study of seed germination was carried out. The seeds were collected in 14 different locations distributed in 5 countries (France, Italy, Morocco Portugal and Spain). Germination capacity was analysed in different temperature conditions: 5, 10, 15, 20, 25, 30, 35, and 25/15°C, with a photoperiod of 12/12h. Percentage, mean germination time (MGT) and thermal time for each studied population were calculated. In addition, the loss of viability in the soil bank was evaluated under environmental conditions, using seeds from two populations with different climatic conditions.

Results and conclusion: The results showed different seeds competitiveness in relation to the temperature depending on the population origin. Regarding seed longevity, a persistent seed bank in the soil was stated, with only small differences between the populations. These data provide useful information about the real threat of this species to the native flora and vegetation in these territories. Type or paste your text into this file. Use Arial font, 14 point for the Author names and 12 point for the content of the abstract and the keywords. Remember to keep the page margins the same as is set here which is 2.5 cm all round.

Keywords: *Nicotiana*, germination, seed longevity, invasiveness, competitiveness

References:

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3rd Thematic Session

In situ and integrated conservation

In situ and integrated conservation of *psammophilous* habitats (Villasimius, Sardinia). Author: Gianluigi Bacchetta.

Chair

Joan Pérez Botella

Since 1999, Joan has been providing technical assistance in flora management to the Conselleria de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica.

The work that he carries out focuses on the evaluation of the state of conservation of the plant micro-reserves network; census and monitoring of natural populations of protected species and those from reintroduction work, design and supervision of conservation actions for threatened flora species, management of populations of invasive alien species, maintenance of GIS (Geographic Information Systems) with georeferenced information obtained in the field, as well as technical support for various issues raised by the competent public administration in environmental matters.

He has also participated in various projects such as those financed by LIFE funds "Program for the creation of the Botanical Microreserves network of the Valencian Community", "Conservation of priority habitats in the Valencian Community" and "Management and enhancement of three habitats of high mountains", by different ministries "Classification, cartography and evaluation of Spanish pastures", "Biscutella L. (Brassicaceae) in the western Mediterranean: taxonomy, systematics and phylogeography", "Spatial genetic diversity and gene flow in Tamarix: approximation ecological and molecular to the system of reproduction, dispersion and colonization in the N.P. Tablas de Daimiel" or by the Universitat d'Alacant "Botany and plant conservation".

Since the 2009-10 academic year he has been hired as an Associate Professor at the Universitat d'Alacant, where he teached laboratory and field practices in various subjects (Economic Botany, Malherbology, etc.). Currently he teaches practices of the subjects of the second year of the Degree in Biology, "Botany" and "Plant Biodiversity", occasionally collaborating in research projects of the "Botany and Plant Conservation" Research Group.

He has published various scientific articles, mainly related to the management of endangered flora and invasive alien species, as well as attended different scientific conferences related to the same subjects.

Conservation of Valencian Flora. Plant Microreserves and beyond

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The Valencian initiative for the conservation of our wild flora through the creation of Plant Microreserves (PMR) is well known and has inspired other initiatives in Spain and Europe. But beyond the creation of these small protected areas, the Valencian Wildlife Service (VWS) develops other actions to achieve the objective sought: stop the loss of biodiversity and recover what was lost. In the presentation, actions carried out and their result will be reviewed:

Catalogues of threatened flora: The first Catalogue (2009) included 396 species. Since then, 2 reviews have been approved (2013: 389 species; 2022: 411 species) based on the assessment of the conservation status of each species.

The Natura 2000 brigades: Flora conservation on the ground is carried out mainly by 15 field teams. Over the years, effort in direct actions on species has decreased in percentage, to increase that carried out on habitats.

Ex situ conservation: Since 1994, the VWS has picked up 4.484 seed lots of 850 species, and germination or propagation protocols have been established. Seeds are kept ready to use for recovery plans, habitat restoration, etc.

Recovery plans: Only a few have been approved. For 3 of them, using a pragmatic approach, the proposed objectives have been achieved in 2023.

The Biodiversity Data Bank of the Valencian Community (BDB): The BDB currently contains 2.6 million data, with more than 2.0 million of flora, The BDB is much more than a data repository, since, being official, it entails preventive measures on projects that may affect plants.

Monitoring Programs: Up to 1.030 Monitoring Units have been stablished for threatened species, subjected to periodic censuses.

Collaboration: The VWS actively seek the participation of entities and citizens in plant conservation. Establishing an alliance, particularly at the local level, is essential for success.

In summary, despite more than 35 years since the first initiatives, and changes in structures and people, the conservation of wild flora in the Valencia seems quite resilient and prepared for the future.

Regarding improvement, a greater scientific evaluation of conservation actions is required, as well as development of more communication actions and adaptation to the coming changes, both climatic and social

Keywords: Valencia, Plant micro-reserves, Integrated conservation

Acknowledgements: To all the enthusiastic VWS workers who have worked for decades in the conservation of the Valencian flora, and specially to Emilio Laguna.

Conservation for Cyprus flora and habitats: from scattered and fragmented conservation actions to holistic management

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Cyprus hosts a rich and diverse biodiversity that is truly captivating. Despite its relatively small size, Cyprus is home to a remarkable number of plant species and habitat types, many of which are endemic. The varied habitat types, including forests, wetlands, and coastal areas, provide a habitat for numerous species, making Cyprus a biodiversity hotspot. However, like many other Mediterranean areas, Cyprus faces challenges such as habitat loss, invasive species, and climate change impacts, which require concerted efforts to be effectively addressed.

There are records for biodiversity conservation activities in Cyprus since the 19th century. However, these activities were scattered and fragmented and therefore they were lacking a comprehensive vision and unified strategy. They often resulted in limited impact and failed to address the complex interconnectedness of ecological systems. In the resent years, there has been a shift towards a holistic approach in conservation, which recognizes the interdependence of species, habitats, and ecosystems. This is reflected in the Biodiversity Conservation Strategy of Cyprus covering the period 2020 – 2030, which is in line with the respective EU Biodiversity Strategy 2030. This approach promotes collaboration among diverse stakeholders, such as scientists, policymakers, local communities, and organizations, fostering synergistic solutions. In addition, it emphasizes long-term sustainability and adaptive management, paving the way for a more effective and resilient conservation agenda.

The current work provides information on the biodiversity of Cyprus and the most important conservation actions (both in situ and ex situ) since the establishment of Department of Forest and first Forest Law (1879). It concludes with a running LIFE Integrated Project, which aims at the effective management of the Natura 2000 network in Cyprus and the conservation of the island's biodiversity in a holistic manner.

Specifically, the LIFE Project 'Pandoteira', entitled 'Managing the Natura 2000 network in Cyprus and shaping a sustainable future' aims to achieve and maintain a favourable conservation status for habitats and species of community importance, particularly of those included in the Habitats and Birds Directives, through actions in the Natura 2000 network of Cyprus. The project seeks to fill knowledge gaps for species and habitats, improve the governance of the Network, exploit ecosystem services, tackle the issue of Invasive Alien Species and elaborate and implement action and management plans for species and habitat types. It also aims to positively influence land users, owners, local population and other stakeholders in understanding the importance of the Natura 2000 network, so that it becomes known and well accepted among the citizens, in general, and the stakeholders, in particular.

Keywords: LIFE project, Habitats Directive, Natura 2000 Network, conservation actions, holistic approach.

Integrated Conservation approach for endemic species in Lebanon

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According to the last published flora of Lebanon that was completed in the early sixties, floristic richness of Lebanon is estimated at 2607 vascular plant taxa, of which 93 are strictly endemic to Lebanon.

Conserving species rely primarily on their *In-situ conservation*. In Lebanon, a new categorization system for protected area that defines criteria for the establishment and management of each category has been prepared in 2012. Four categories were proposed and the first draft of the protected areas law was based on this system. These four categories are: Nature reserve, Natural Park, Natural site and monument and Hima (community based natural resources management under the supervision of the municipality). These 4 categories differ by their surface area, landownership, the strictness of the protection and by how these protected areas are managed. The most rigorous conservation mode is the natural reserve status where land use practices are restricted and buffer zones of at least 500 m are to be secured.

The endemic species that we usually protect are usually geographically restrained and are spread in an areas that are less than 20 ha. Our approach was very similar to the Plant Micro-Reserves (PMRs) concept that was a pioneer project in the Valencian Region – Spain. PMRs are small sites with a high degree of naturalness and legally protected to ensure the conservation of rare, endemic or threatened plant species. Therefore, the BCI team through the Saint Joseph University, has drafted a law to include a new category of Protected Areas in Lebanon: The PMRs whose main aim is a single species conservation.

Conservation strategies are varied and necessary for the protection and preservation of the biodiversity in every ecosystem. In-situ techniques focus on conserving the selected species directly in their natural habitat, where *Ex-situ* approaches focus on taking plant material outside their localized areas to be tested in specially designed conservation laboratories.

Many plans have been made using one of these techniques taking them into consideration when applying conservation action plans on threatened and endangered species, but rare are the studies made using both techniques together. Hence the importance of the quasi in-situ technique, which combines both approaches of plant conservation to create a technique that accompanies the endangered species during all of its natural life cycle using conservation protocols both on-site and in botanical laboratories.

The BCI has been implementing a *Quasi-In situ* technique that focuses on a reintroduction into the archeological site from *Ex-situ* genetic resources, some endemic plant species compatible with the presence of ruins and belonging to the same bioclimatic zones will be implemented These are herbaceous species (geophytes) without a deep root system. The areas where these plants were reintroduced with the agreement in partnership with the managers of the DGA, under their responsibility. These introductions will have a twofold objective: the conservation on already protected sites of these plants species which would not require a constraining maintenance since they would develop under the same abiotic conditions as their place of origin, and which would allow at the same time the awareness of the big public and local community to these endemic plants that are an integral part of our cultural heritage.

Keywords: Conservation, Reintroduction, *Quasi-In situ* conservation, Seed bank, Plant microreserve, endemic species

Sustainable conservation of critically endangered ecosystems and plant species in Palestine with the focus on *Iris lortetii* var *samariae* (Sawsan Nablus): an ecological study

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Iris lortetii var. *samariae* (Dinsm.) Feinbrun is one of the few endangered endemic Palestinian plants in its only habitat in the world in the Nablus Mountains region (State of Palestine). The plant flowers are among the most beautiful flowers of the royal iris. *Iris lortetii* Barbey ex Boiss (Iris of the North) has been included among the Endangered Plant Species of the IUCN Red List, also, the variety *I. lortetii* var *samariae* (Sawsan Nablus) was included among the Red List of Endangered Plant Species in State of Palestine. However, no recent systematic study has been conducted to assess the protection status of Sawsan Nablus. The current study aimed to assess the plant protection status according to the IUCN standareds, by studying plant communities, their sizes, occupancy area, the extent of distribution, and identifying the threats they are exposed to, which enables us to take the necessary practical measures and actions to preserve the plant. In addition to presenting appropriate suggestions to decision-makers to take legal protection measures to conserve this plant and other critically threatened plants and ecosystems.

The study area was selected based on the information available in the literature and the databases of the GBIF for the period between 1980-2019. A field survey of iris communities in Nablus mountains was conducted during the periods March-June 2020-2022. The coordinates & locations of plant communities were recorded, followed by calculating the Area of Occupancy (AOO) and Extent of Occurrence (EOO). Distribution maps of the plant old sites (1980-2019) and its current sites (2020-2022) were prepared. Threats to Sawsan Nablus communities were documented by direct observations, and communication with the local community. The modified forced seed propagation method was used to increase the available propagation material for plant conservation.

The plant AOO found to be 68 square kilometers. Our results showed a continuous decrease in the population size of the main plant communities, in the number of its sub-communities, the area of occupation, the extent of its distribution, and the area and quality of habitats. As a result, the plant was considered endangered (EN). The study also showed that the communities of Sawsan Nablus are exposed to several threats, most notably the destruction of plant natural habitats through roads construction, the conversion of natural lands to agricultural, urban sprawl and mining, in addition to the small sizes of plant communities, pollution, tourism and entertainment activities. These threats have caused the destruction of plant communities and resulted in the extinction of plant from some sites. The continued exposure of Sawsan Nablus to these threats, may lead to a sharp decrease in the numbers of its communities, and its exposure to extinction at the end. Almost all communities of Sawsan Nablus grow on private natural lands (none is located in a protected area). This potentially poses a direct threat to the plant due to the destruction of natural habitats as a result, e.g., converting these lands into agricultural or residential lands. Therefore, to protect this critically endangered plant, BERC, in coordination with the EQA, the MOA and the local community, has set up a network of conservation sites using the “Quasi in situ conservation” method, dedicated to the conservation of biodiversity in natural unprotected areas, and integrated in the protected areas network. Iris populations were either transferred from threatened areas to these safe havens or from seedlings produced from seed germination in BERC labs. The BERC team succeeded in germinating Sawsan Nablus seeds using a modified protocol of the forced germination method, with a germination rate of 80%, which is considered a success in exploiting an untapped natural resource in terms of seeds, which provide a large numbers of iris seedlings that can be used to enrich plant populations in safe havens and in the plant’s natural habitat.

Keywords: Sawsan Nablus, Iris lortetii var samariae, Nablus mountains, Palestine

Acknowledgements: This research was partially funded by the Critical Ecosystem Partnership Fund (CEPF).

Overview of conservation activities on threatened plant species in Serbia with special focus on *Cardamine serbica* and *Dracocephalum ruyschiana*

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The vascular flora of Serbia comprises more than 4200 taxa (Stevanović, 2022). There are no official national Red lists or Red books, except the Red Data Book of Flora of Serbia 1 (Stevanović, 1999). Conservation activities on threatened plant species mainly include passive protection, rarely followed by population monitoring, or the development of the methodology for in vitro propagation.

Cardamine serbica Pančić (Brassicaceae) is described by Josif Pančić (1884) near Perućac, Mt. Tara in W Serbia. Beside that single locality in Serbia, distribution range of the species comprises several scattered populations in Montenegro and Bosnia and Herzegovina. Survival of the population in Serbia was very much questionable, since only c. 20 individuals were recorded in 2018, with only one being in flower that year. Thus, comprehensive ecological study of the species and its habitats throughout the range were done accompanied by concrete conservation activities. Five years later, the current situation shows that implemented conservation measures combining in situ and ex-situ methodology led to the improvement of habitat quality, significant increase in the number of individuals, and enlargement of occupying area. Further activities are on the way to secure and support these trends.

Dracocephalum ruyschiana L. (Lamiaceae) is threatened species within all European countries except Russia (Ericsson et al., 2011). For Serbia, it was categorized as Extinct from its single reported locality in Vlasina (SE Serbia) (Diklić, 1999). However, during extensive field research, Lazarević et al. (2009) discovered one small population of this species in Pešter Plateau (SW Serbia) on the both sides of the state border between Serbia and Montenegro. The population was assessed as extremely small consisting of c. 200 flowering specimens, and threatened by increase in shrub and forest vegetation, as well as planned highway that should pass through this area. Since this is the only known population of *D. ruyschiana* in Serbia and the whole Balkan Peninsula, urgent conservation measures are needed. Necessary activities are on the way in order to determine the right *ex-situ* and *in-situ* measures for this species.

Keywords: translocation, reinforcement, monitoring, critically endangered, ecology

Acknowledgements: The research was supported by the Science Fund of the Republic of Serbia, grant number 7750112 “Balkan biodiversity across spatial and temporal scales – patterns and mechanisms driving vascular plant diversity (BalkBioDrivers)”, and the Ministry of Environmental Protection of the Republic of Serbia and the National Park Tara through project “Revitalization of population of *Cardamine serbica*”.

A Novel Socio-ecological Approach for Assessing the Impacts of Pastoralism on Floral Diversity

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While grazing has been historically important to rural communities in Lebanon, it is now considered a threat to the country's plant life. From the 120 Lebanese plant species red-listed as Critically Endangered, Endangered, Vulnerable or Near Threatened, over 90 are believed to be imperiled by livestock ranching and farming. Yet many endemic plant species in Lebanon have managed to survive under pastoralism for millennia. Conversely, in this Mediterranean country, most local plant extinctions are attributed to residential and commercial development as well as human intrusion and disturbance. The Sannine-Kneisseh Important Plant Area (IPA) a part of the Rihane-Chouf-Ammiq-Sannine Key Biodiversity Area (KBA), hosts three concentrated encampments of seasonal semi-nomadic pastoralists and visited by transhumant shepherds. This species-rich area is subject to high levels of grazing in summer. Unlike the rest of the KBA, the IPA lacks large scale conservation initiatives. Conservation activities in the IPA are restricted to afforestation efforts that are often contested by transhumant shepherds who claim historic rights to the land. In order to characterize the impact of pastoralism on floral diversity, pastoral governance systems in the area were identified and mapped through quick surveys. In parallel, floristic surveys were carried out throughout the IPA, encompassing areas subject to different forms of pastoral governance (100 plots in 2017 and 40 plots in 2022). In total, 362 taxa belonging to 56 families were identified constituting 3299 records. As the vegetation is asymmetrically consumed by goats and sheep, classification methods that rely on abundance measures were deemed unreliable to unveil patterns in species richness. The *diffval* package, a new tool developed for the analysis of vegetation data, was used to obtain classifications based on presence and absence of differential taxa. Following an optimization procedure, different number of groupings were explored maximizing patterns of differential taxa, and the resulting solutions were analyzed against environmental gradients. This approach can potentially facilitate the identification of critical areas for conservation as well as degraded areas that may require intervention to address the needs of both people and biodiversity. In the case of the Sannine-Kneisseh IPA, plant richness showed a strong dependence on environmental parameters as well as on pastoral governance system. A Negative Binomial Generalized Linear Model (NBLM) supported this, indicating that *Rabh'hum* lands have a lower plant richness in comparison to landlordship and customary governance systems.

Keywords: pastoralism, governance, grazing, plant diversity

Land stewardship and plant conservation in Menorca: 15 years of experiences

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The Mediterranean mosaic landscape is one of the most valued natural aspects of Menorca, both by residents and visitors. Its conservation depends on the maintenance and persistence of agricultural activity, mainly when this is done using traditional techniques. Often, the modern agricultural techniques ignore sustainability and are more aggressive with the natural environment, thus causing a landscape deterioration.

In the past 15 years, the GOB Menorca has been developing a land stewardship farms program (https://www.gobmenorca.com/custodia-agraria) which aims to highlight the role of farmers as a primary sector and as managers of the territory and recognizes them as main actors in the preservation of Menorcan nature and the protection of biodiversity.

A key aspect in this program is the knowledge of the natural values of the farms. For this reason, a comprehensive floristic inventory is made for each new farm incorporated into the program. The habitats of conservation interest and the endangered plant taxa are located and the areas where there may be threats or degradation processes are delimited on cartography. The result is a floristic catalogue and maps showing points and areas of conservation interest, which are included in the report *Inventory of natural values in farms with land stewardship*. This document is given to owners and farmers so that they become aware of the importance of their farm's natural heritage and biodiversity.

Since 2009, 44 farms, distributed throughout the island have been surveyed, this has meant generating more than 10,000 georeferenced floristic records, among them nine taxa have been new for the vascular flora of Menorca or the Balearic Islands.

The field explorations in the farms have made it possible to confirm or locate new populations of threatened species: *Asplenium azomanes* Rosselló, Cubas & Rebassa, *Daphne rodriguezii* Teixidor, *Fumaria sepium* Boiss. & Reut., *Medicago rugosa* Desr., etc., data that have served to evaluate the state of conservation towards less threatened categories.

Three main conclusions from these 15 years of floristic surveys in agrarian custody:

i. In situ explorations are essential to assess more precisely the conservation status and the threat levels of the species.

ii. Contacting and exchanging information with owners and managers (farmers) can provide information of interest in conservation.
iii. Generating data and providing it appropriately to owners and managers is a good awareness tool.

Keywords: endangered flora management, habitat conservation, communication, land owners, field explorations

Vegetation, Culture, and Cultivation: Crop Wild Relatives in Israel

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A unique project entitled “Vegetation, Culture, and Cultivation: Crop Wild Relatives in Israel” was founded recently in Israel to ensure in-situ conservation of highly diverse Mediterranean species of important crops wild ancestors. Israel contains some of the widest variety of plant species found in the world. The region is recognized as the center of genetic diversity. It is characterized by the abundant presence of crop wild relatives of grains (wheat, barley, oats), legumes (peas, lentils, chickpeas), fruit trees (plum, pear, fig), vegetables (garlic, carrot, cabbage), aromatic plants (sage, fennel, hyssop), and productive plants (flax, clover, alfalfa). The ex-situ conservation of Israel’s CWR is a well-established task conducted by the National Gene Bank following Barazani et al. 2008, 2017. Almost 95% of Israel’s CWR in species diversity, and about 50% of the genetic diversity has been collected and conserved in the last 15 years. The new project aims to create a “toolbox” for the in-situ conservation of CWR by identifying hot spots of CWR distribution and creating management instructions for area-based conservation.

Moreover, we are considering in-situ conservation from a broad perspective of as many species as possible rather than creating conservation areas per target species. A MaxEnt model was built for each CWR species based on annual rainfall, temperatures, soil type, and more. Based on the GIS data per species created by the model, we categorized different interface management recommendation areas at different levels of conservation according to the number of potential species and their GP rank. In addition, a unique reserve integrates historical narratives based on botanic-archaeology evidence, LandRaces uses in the area, and conservation interfaces. By that, the most important and abounded areas will statutorily be protected to define as a reserve for CWR. The reserve will be the basis for proposing a World Heritage Tentative Listing linking culture and nature. Other areas will be used as protected gardens or for collecting seeds for ex-situ conservation and integrated into national open space systems.

Keywords: Crop wild relatives, in-situ, Model, GIS, culture, nature

Protection of Globally Threatened Pear Species - an Integrated Conservation Example from Armenia

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The territory of Armenia is remarkable for its rich flora and habitat diversity. The country forms part of one of the most ancient areas of origin and development of agriculture where crop wild relatives are found in great number of forms. Wild pears of Armenia are of special interest and conservation importance. 12 of 32 pear species of Armenian flora are national endemics and 10 are globally threatened.

The focused study of populations of threatened endemic pear species in Armenia began in 2016. The work included field surveys in Vayots Dzor and Syunik provinces – the areas with highest concentration of wild pear genetic diversity. The target species were *Pyrus gergerana*, *P. daralagezi* and *P. voronovii*. Further studies let to identify the "hotspots" for *Pyrus* sp. diversity in Armenia. The following program on protection of globally threatened wild pears was aimed at in-situ conservation of five globally threatened endemic pear species: *P. gergerana, P. sosnovskyi, P. tamamschianae, P. hajastana* and *P. daralagezi* through their populations' restoration by reinforcement and monitoring activities. The seeds of the target species were collected and used for their reproduction in the nurseries, established in the framework of the project. Part of the collected seeds was stored in the Seed Bank of the Institute of Botany, National Academy of Sciences of Armenia. Some saplings were added to the living collection of Yerevan Botanical Garden. The project represents the first ever attempt of plant conservation translocation in Armenia.

Local communities were actively engaged into the work through Pear Caretakers and backyard nurseries initiative. The project team workes closely with the Ministry of Environment of the Republic of Armenia and shares the project results locally and internationally.

The distribution area of threatened pear species partially overlaps with the protected areas, Important Plant Areas and Key Biodiversity Areas. So, conservation of wild pear populations contributes not just towards protection of genetic diversity within the genus, but also supports protection of the threatened ecosystems of Armenia.

Keywords: endemic pears, crop wild relatives, flora of Armenia, IPA, *Pyrus* sp.

Acknowledgements: The project "Protection of threatened pear species and securing viability of their populations in Armenia" (2020-2023) is implemented by the "Armenian Society of Biologists" NGO with financial support of the Fondation Franklinia. The projects "Scoping wild pears in Herher sanctuary", "Scoping wild pears in southern Armenia" and "Identification of the pear species and their distribution in the Herher state sanctuary" (2016-2018) have been implemented by "Nature Rights Protection" NGO with financial support of Fauna & Flora International within the framework of the Global Trees Campaign.

Drones as a tool for the census of aquatic macrophytes in the Valencian Community

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The Valencian Community is a place with aquatic ecosystems of great biological importance. Since 1999, the Wildlife Service & Natura 2000 Network, as the competent body in the conservation and recovery of wild species and natural habitats, has carried out a conservation program of the taxa of wild aquatic flora including the so-called “structural species”, necessary for the restoration of aquatic habitats, such as those included in the Valencian Catalogue of Threatened Flora Species (CVEFA) (Decree 70/2009; Order 2/2022).

The works are coordinated by the Conservation of Threatened Aquatic Flora team of the Aquaculture Center of El Palmar. One of the most important *in situ* actions that have been carried out is the census of the listed species, with greater or lesser periodicity according to the degree of threat.

The censuses of the submerged aquatic species are carried out calculating the area occupied by the species. The size in the middle of the meadow is the value that is taken as a census reference measure. The censuses have been carried out since 2012; the data collection has been manual. A geographic positioning system (GPS) is used and the perimeter of the spot is travelled on foot or by boat, depending on the depth of the lagoon, geo-referencing it by taking waypoints as it is travelled.

In 2023 the census of some threatened taxa has been carried out with drone. The technique consists of taking the data in the field with the use of the aircraft to take an aerial photo with a sufficient scale to be georeferenced later using the appropriate GIS software.

This paper describes the results of the different works carried out with drone in 2023 among which are a) the censuses of threatened macrophytes such as *Nymphaea alba* or *Ceratophyllum submersum*, both in risk of Extinction, b) the monitoring campaigns of invasive alien species present in the wetlands of the Valencian Community and c) some of the monitoring works on the conservation status of the macrophyte meadows in some areas of the N2000, such as in the L’Albufera Natural Park in Valencia.

Keywords: aquatic flora, wetlands, conservation, Natura 2000 network, GIS

Actions for the conservation of two recently described threatened endemic tree species in wetlands of West Crete, Greece

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Two tree species in the Prefecture of Chania in Western Crete with a very restricted distribution have been relatively recently described as new Mediterranean plant species. These are *Salix kaptarae* Cambria, C. Brullo & Brullo and *Tamarix minoa* J.L. Villar, Turland, Juan, Gaskin, M.A. Alonso & M.B. Crespo. The first one was described in 2019 and the second in 2015. The type locality of *T. minoa* is protected by the Greek Presidential Decree 229/19.06.2012 which concerns the protection and promotion of the small coastal wetlands and by Greek Law 3937/2011 as an endemic taxon; the entire population of the species is located within the Natura 2000 area GR4340010 (Drapano- Paralia Georgioupolis - Limni Kourna). The other species *S. kaptarae* is also protected by Law 3937/2011 as an endemic taxon and one of the two subpopulations of it is located within the Natura 2000 area GR4340006, near the lake of Agiá.
The two species were selected for conservation after applying and harmonizing criteria for the development of conservation priorities for threatened plant species in the Prefecture of Chania. The Mediterranean Plant Conservation Unit of CIHEAM-MAICH in collaboration with the Forest Directorate of Chania implemented various actions to conserve and highlight the tree species within the framework of the national research project: “Development of methodology for the enhancement and protection of populations of threatened plant species of Crete - Pilot application in the Prefecture of Chania”. The project actions included among others: action plans for long term conservation, mapping and assessment of natural populations, development of reinforcement protocols, small forestry works and constructions for the promotion and protection of the species. In addition, efforts have been made to preserve genetic material of the plants outside their natural environment (in the Forest Nursery of Chania and in the Nursery and Seed Bank of CIHEAM-MAICH). Finally, informative material was produced to raise awareness among residents and visitors.

Keywords: *Salix kaptarae*, *Tamarix minoa*, seed germination, reinforcement protocol, education - public awareness

Acknowledgements: The project was funded by the national Programme “Protection and Upgrading of Forests 2019” of the Green Fund.

Biochemical responses to salt stress in Linum maritimum and Thalictrum maritimum: implications for plant conservation

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Conservation of plant diversity is crucial for maintaining ecosystem resilience and function, particularly under stress conditions. This study aimed to investigate the responses to salt stress of two coastal plant species, *Linum maritimum* and *Thalictrum maritimum*, analysing their biochemical and ion regulation mechanisms.

Adult plants of *L. maritimum* and *T. maritimum* were subjected to different concentrations of sodium chloride (NaCl) for six months to induce salt stress responses. Chlorophylls, carotenoids, proline, and MDA contents were determined spectrophotometrically, and ion accumulation was measured using 410C flame photometer.

Under salt stress, both *L. maritimum* and *T. maritimum* exhibited significant changes in their biochemical profiles. In both species, salt stress decreased chlorophyll *a*, chlorophyll *b*, and carotenoid contents in shoot tissues. Concurrently, proline levels increased, indicating osmotic adjustment. MDA content, indicative of lipid peroxidation, also increased, suggesting the salt-induced generation of oxidative stress. Sodium accumulation was observed in both root and shoot tissues, whereas potassium content remained relatively stable.

Despite the general decrease in pigments and carotenoids, both species demonstrated adaptive responses to salt stress, such as proline accumulation and control of ion transport. Under stress, these metabolic and ion regulatory processes play critical roles in maintaining cellular homeostasis and protecting against oxidative damage.

Understanding the responses of *L. maritimum* and *T. maritimum* to salt stress contributes to design and implement plant conservation strategies. These coastal plant species possess adaptive mechanisms that enable survival in saline environments, highlighting their ecological importance and potential for habitat restoration projects.

Keywords: Abiotic stress, adaptive mechanisms, antioxidants, biochemical analysis, ion accumulation.

Conservation actions of the Valencian flora (Spain) through the funds of the European Union: EAFRD (European Agricultural Fund for Rural Development) and Next Generation

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The Wildlife and Natura 2000 Service of the Generalitat Valenciana is the organism competent for the conservation and recovery of wild species and natural habitats in the Valencian Community (Spain). Since 2017, *ex situ* conservation actions have benefited from financial support from the EAFRD, within the framework of Operation 8.5.3 "Conservation and development of the Natura 2000" [1]. In addition, the Next Generation EU funds were set up with the aim of alleviating the effects of the social and economic crisis caused by the coronavirus pandemic.

Operation 8.5.3 carries out investments to improve the conservation status of the flora and fauna species in Natura 2000 sites were declared, through multiannual investments. Currently action in execution is: "Investments to increase the environmental value of forest ecosystems 2021-2023". Among these investments are the *ex situ* production of protected and threatened flora species included in the CVEFA (Valencian Catalog of Threatened Species), destined for actions included in plans and programs for the recovery and conservation of threatened species in the natural environment [2]. Between July 2021 to December 2022, a total of 32.027 plants have been produced, 22.447 corresponding to species included in the "Endangered" category (70,1%), 3.003 plants in the "Vulnerable" category (9,4%), 705 to "Protected not catalogued" species (2,2%) and 5.872 to "Watched" species (18,3%). 4.849 plants have been yet translocated to the natural environment.

Regarding to Next Generation EU Funds, the actions are framed in Program 442.99, Objective 4.1. Production of terrestrial and aquatic flora for the restoration of habitats of community interest in the Natura 2000 in the Valencian Community", with a duration of 44 months (August 2022 - March 2026). The aims of this project are the processing and conservation of at least 200 seed accessions or other propagules, and the production and cultivation of 60.000 plants. Between August to December 2022, 19 seed accessions of 14 species have been processed, and 4.383 plants have been produced.

Keywords: endangered flora, conservation translocation, Valencian Community.

Acknowledgements: Plant production to obtain seeds has benefited from the financial support from the European Agricultural Fund for Rural Development (EAFRD) in the framework of Operation 8.5.3 "Conservation and development of the Natura 2000" as part of the Rural Development Program of the Valencian Community 2014-2020 (Spain).

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Conservation of the endemic species of the genus *Allium* (Amaryllidaceae, Allioideae) in Evvia island (W Aegean, Greece)

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The genus *Allium* L. is one of the largest monocotyledon genera, currently comprising about 900-1200 species. The diversity of *Allium* in Greece seems inexhaustible. The 55 species of the genus that were known from the country in 1980 have been increased to 116 species (127 species and subspecies) today, distributed into 11 sections, declaring *Allium* as the largest genus of vascular plants in Greece. Most Greek endemic species have extremely narrow distribution ranges, and they are possibly threatened, assigning a huge responsibility to the country for their effective conservation.

Evvia island constitutes an important diversity center of the genus *Allium* in Greece. Thirty *Allium* spp. are known from Evvia; among them seven species endemic to the island. Investigation of the conservation status of the endemic *Allium* species of Evvia and identification of effective management measures for their *in situ* conservation is the main aim of a research project funded by the Natural Environment and Climate Change Agency (N.E.C.C.A.) through the Hellenic Foundation for Research and Innovation (H.F.R.I.) (Project no. 014858). The project mainly focuses on the Critically Endangered species *A. runemarkii* and *A. iatrouinum* distributed in southern Evvia, an area facing multiple environmental challenges. The local endemics *A. abanticum*, *A. apergii*, *A. calamarophilon*, *A. dirphianum*, and *A. karistanum* are also included in this study.

The methodology for all studied species includes: (a) investigation of the geographical distribution and an attempt to locate new sites in areas with suitable habitat characteristics, (b) population size estimation, (c) identification of the threats each species faces, and (d) conservation status assessment. The ecology and the reproductive characteristics, i.e., fecundity and relative reproductive success of *A. runemarkii* and *A. iatrouinum* will also be studied. Certain conservation measures for each species will be proposed based on the results of the field studies and the following analyses. Study results are about to be communicated to all national and local authorities involved.

Keywords: *Allium*, endemic, Greece, diversity, Evvia island

Conservation status of *Crepis pusilla* (Sommier) Merxmüller (Asteraceace: Cichorieae, Crepidinae) in Malta

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The Maltese Dwarf Hawksbeard, *Crepis pusilla* (Sommier) Merxmüller, is an annual plant in the tribe Cichorieae. It was first described from the Maltese Islands as *Melitella pusilla* [1] and subsequently transferred to *Crepis* by Merxmüller [2]. Up to 1967 it was only known from the Maltese Islands but has since been found in other Mediterranean locations. Following its discovery in 1906, the species was noted from four sites in the Maltese Islands by 1909 [3] but, for at least the past 50 years, has only been known from a single site. In the only remaining location (Dingli, SW Malta), the plant is restricted to a single country path. Detailed searches in similar habitats over several years did not indicate any further populations. Currently available data suggest that the local IUCN conservation status of *Crepis pusilla* is "Critically Endangered" [CR B1ab(i,ii,iii,iv) + 2ab(i,ii,iii,iv)].

The authors undertook a detailed survey of the remaining population during the Winter/Spring 2023 growing season, making ten visits during the period between 1 March 2023 and 23 May 2023. During this survey, the number of plants was enumerated, their size measured, and reproductive state noted. The spatial distribution of the plants was determined precisely relative to an internal frame of reference using ground surveying augmented by UAV-assisted imagery. During this period, the temperature displayed a gradual warming trend (mean shade temperature: 14.1°C to 19.3°C; maximum: 26.7°C on 30 April). Approximately 54.3mm of rain in seven rainfall events (> 1.0mm) were recorded.

The results indicated that the population in 2023 consisted of 27 plants situated in a linear extent of approximately 60m along the path. Plants were first noted on 1 March 2023, although identification was uncertain due to confusion with young *Cichorium spinosum* and *Plantago coronopus*. The identity of the plants was only definitively confirmed during flowering. First flowering was detected on 4 April and peak flowering was noted between 11 to 17 April, when approximately 75% of the plants were in this state. By early May most of the foliage had withered and had disappeared completely by 23 May. The reproductive effort of the plants was estimated by calculating the number of seeds produced by each plant, based on a sample of five plants, and assessing the germination characteristics of the seeds. Preliminary measurements suggest that each plant produces c. 150 achenes although the sample was too small to assess variability across the whole population. Preliminary germination trials in vitro suggested a germination rate between 80-100% and further trials are programmed as part of a broader investigation into the rarity of the species. These surveys and experiments will be repeated over several years, allowing the authors to propose a data driven conservation action plan for the species in Malta.

Keywords: germination, population assessment

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Elaboration of Action Plans for Mediterranean flora species in Cyprus

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The LIFE Integrated Project "Pandoteira" aims at the sustainable and effective management of the Natura 2000 network in Cyprus. One of the main objectives of the project is the elaboration and implementation of Action Plans for selected species and habitat types. This presentation describes the methodology adopted for both the selection of the targeted species / habitat types and the elaboration of their respective Action Plans.

The Action Plans focus on four plant *taxa* (*Astragalus macrocarpus* subsp. *lefkarensis*, *Phlomis brevibracteata, Crepis pusilla* and *Ophrys kotschyi*), and ten freshwater and coastal habitat types (92C0 - *Platanus orientalis* and *Liquidambar orientalis* woods, 92A0 - *Salix alba* and *Populus alba* galleries, 92D0 - Southern riparian galleries and thickets, 3170 - Mediterranean temporary ponds, 6420 - Mediterranean tall humid grasslands of the *Molinio Holoschoenion*, 1310 - *Salicornia* and other annuals colonizing mud and sand, 1210 - Annual vegetation of drift lines, 2110 - Embryonic shifting dunes, 2230 - *Malcolmietalia* dune grasslands and 2240 - *Brachypodietalia* dune grasslands with annuals).

The Action Plans for the targeted plant taxa provide background information on their ecology and biology, as well as relevant conservation actions already undertaken in Cyprus. Moreover, it includes detailed and up to date information on the species exact locations and population size and an assessment of their conservation status based on relevant IUCN criteria and taking into consideration the new data recorded through this LIFE project. For each plant taxon, the desired Favourable Conservation Values (FRVs) were set. Based on the threats and pressures identified for each taxon and considering their specific needs, key objectives were set for securing their conservation. In order to achieve the FRVs set and meet the key conservation objectives, concrete conservation measures are proposed. For each conservation measure included in the Action Plans, guidelines are indicated relating to the timeframe, methodology and the exact locations in which they will be implemented. Many of these measures will be applied within the framework of the LIFE Integrated Project.

Keywords: Habitats Directive, conservation measures, Mediterranean flora, Mediterranean habitats, *in situ* conservation

Ensuring the preservation of endemic critically endangered Senecio bertramii Post in Mount Lebanon: distribution, population size, habitat, threats and conservation

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Senecio bertramii is known to occur exclusively on the slopes of Mount in the district of Bcharre, in the North Governorate of Lebanon. The entire valley is referred to as Qadisha Valley, famous for its topography characterised by steep sided cliffs. It was identified as an Important Plant Area (IPA) and Key Biodiversity Area (KBA) according to the IUCN criteria. The highest plateaus of Mount Lebanon mountain range overhang this valley.

The vulnerability of the species was assessed as Critically Endangered (B1ab(iii)+2ab(iii)) based on very restricted EOO and AOO (4 km²). Prior to this project, there was no information about the species, its habitat, its ecology, precise distribution, population size and specific threats. In June 2022, three weeks of exploration were conducted during the flowering season of the species. An area of 73 ha was thoroughly surveyed, revealing a very limited population size of around 100 individuals. The species is found in grasslands and shrublands dominated by *Astragalus spp.* shrubs. The individuals form clumps with several stems. Agricultural activities and overgrazing are the main threats to the species.

During the project, half of the site on which the population was observed was completely destroyed to create agriculture terraces. The land was purchased in the fall of 2021 and earth-moving operations were carried out in December 2021 by the new landowner, just a few days after our discovery. This tragic event highlighted the importance of engaging in communicate with landowners. We identified and contacted the other landowner who owns the area where the remaining individuals are located.

Fortunately, he agreed to protect the individuals present on his land and allowed us to reinforce the population by planting seeds. In October, 50 seeds collected in August sprouted and are currently awaiting transplantation on the land. We are currently developing an action plan aimed at the preservation of the species. The dissemination aspect of the project included a video presenting the species, its habitat and the threats, as well as a drawing created by a local artist to represent the plant.

Keywords: *In-situ* conservation, conservation translocations, integrated conservation strategies, endemic plant, Levant

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Gavdos Island – Crete, Greece - Endangered Plants Recovery Project

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Gavdos is a small Greek island with an area of about 30 km2 and it is located at the southernmost point of Greece and Europe. The flora of Gavdos is particularly remarkable for its affinities to North Africa and especially to Cyrenaica of Libya. On Gavdos, 490 taxa have been recorded until today, from which about 70% are also present in Cyrenaica, while 10 taxa are included in the Red Data Books of Rare and Threatened Plants of Greece. The two most endangered taxa of Gavdos are the annual therophyte *Bupleurum gaudianum* Snogerup, endemic to this small island and also 'Vulnerable' according to the IUCN Red List, and the annual hygrophilous plant considered 'Critically Endangered', *Callitrice pulchra* Schotsman, which grows in very characteristic karstic rock pools of Gavdos island, named 'arólithi', a specific type of the prioritized for conservation habitat of "Mediterranean temporary ponds". These two taxa were in the focus of a pilot project that was implemented in the context of the wider project "Mediterranean Island Collective: Cooperation for Nature Conservation in the Mediterranean Islands" under the coordination of the PIM Initiative and partially funded by the MAVA Foundation.

Among other deliverables of the Gavdos pilot project, Action Plans for long term conservation were elaborated for each of the two above endangered species, aiming to address any threats to the plant populations by long term monitoring and proposing appropriate management measures. Permanent monitoring plots have been established and specific monitoring protocols for each of the two species have been developed and applied for the first time, initiating a long-term monitoring procedure that aims to improve the knowledge of the biology and ecology of both plants, to assess the trend of their subpopulations and to record the threats they face. For *B. gaudianum*, a translocation protocol elaborated during this project is proposed to be applied in case a decrease in population size is recorded. For *C. pulchra*, several measures are proposed as alternatives to the declining traditional management of rock pools and against the main threats related to this particular habitat. Other measures proposed by the Action Plans for both taxa include ex situ conservation in a seed bank, cooperation actions for the sustainability of the conservation actions, public sensitization and active involvement of the local people through citizen science initiatives. At the end of the project, an informative booklet about all the threatened plants of Gavdos and Gavdopoula islet was published in English and in Greek, and a Memorandum of Understanding for the conservation and management of plant diversity in the area of Gavdos is to be signed between CIHEAM-MAICh, IUCN/SSC/MSPG and the Municipality of Gavdos.

Keywords: threatened plants; in situ / ex situ conservation; monitoring; collaborative management

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In situ conservation actions for the endangered plants in Cap de Creus Natural Park (North-eastern Iberian peninsula)

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The Cap de Creus Natural Park was created in 1998 as the first marine-terrestrial natural park in Catalonia. It is located at the north-eastern of the Iberian Peninsula, next to the Spanish-French border. 10781 ha are protected in the terrestrial part, and 3092 ha in the marine part, summing up 13873 ha. The Park is a very interesting point for plants, because it is a rocky area of the Mediterranean coast that has not been urbanized. In addition, its situation between the mountain at the end of the Pyrenees mountain range and the sea, with a mixture of siliceous and calcareous soils, forests, cliffs and meadows, gives it peculiarities that are difficult to find elsewhere.

Despite this, there are many important historical pressures, such as tourism, intensive human use (mainly agricultural and livestock) and recurrent wildfires. There is a total of 27 protected plant species in the natural park: 2 lichens, 2 bryophytes, 5 ferns, and 18 phanerogams (3 of which are marine). 18 of these taxa are included in the catalogue of threatened flora of Catalonia, and 6 in the Spanish catalogue of threatened species. Species listed as “endangered” are *Seseli farrenyi*, *Erodium foetidum* ssp *foetidum, Asplenium trichomanes* ssp *inexpectans* (only in the Catalan catalogue), *Asplenium marinum* (only in the Catalan catalogue), and the rest of the species are listed as “vulnerable”. Only *Seseli farrenyi* has a draft recovery plan, which is about to be approved by Catalan government soon. The presented results are fruit of the work of an interdisciplinary team of researchers and managers of natural protected areas and flora. *Seseli farrenyi* is a strict endemism of the natural park, so that it is the species that has received more efforts and actions for its conservation, such as: annual monitoring of its natural populations and demography since 2010 to 2023; research on its biology (e.g. polinization); obtaining and preserving seeds ex-situ; ex-situ germination and planting; in situ translocation actions such as planting seedlings and seeds; elimination of invasive alien flora in order to improve habitat conservation; public use management actions (e.g. divulgation and access restrictions) in areas where the species is present. *Erodium foetidum* ssp *foetidum* has also been monitored annually since 2020, and habitat conservation actions have been taken: such as the removal of invasive alien species, selective clearing in areas where higher shrub vegetation thrived.

Asplenium trichomanes ssp *inexpectans* has a single individual in the natural park. Annual monitoring has been carried out since 2018, other individuals of the same subspecies in the area have been ruled out, and detected predators that were affecting it have been eliminated. For *Asplenium marinum* and the other threatened species, over the last 4 years, mapping and biomonitoring have been carried out, censuses of individuals and the area of distribution within the natural park has been established. During this work, the bibliography was revised in order to find out the historical citations of the various species, which were visited to check if they still existed. As a result of these field work, some species have also been found in places where they had not been cited before. For example, it promoted discovery of a new population of *Seseli farrenyi* which has quadrupled the number of total individuals (from 200 to more than 800). In parallel, numerous works have been carried out to control and eradicate invasive alien flora since 2010 on more than 20 different species. Precisely, within the framework of these actions, the LIFE medCLIFFS project has been running since October 2022, which seeks to improve the state of conservation of the habitat of community interest 1240 “Cliffs from Mediterranean coasts colonized by vegetation, with endemic tripe (*Limonium* spp)” and three threatened species (*Seseli farrenyi, Limonium geronense* and *Limonium tremolsi*) through the control of these species of invasive alien species.

Keywords: Management actions, conservation, protected, in situ, ex situ, habitat

Limonium perplexum: an example of a taxon with an achieved Recovery Plan

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Limonium perplexum (Sáez, L.&Rosselló) is an herbaceous (perennial to annual) species which only lives on two small sites of a low coastal cliff in Serra d'Irta (Peníscola, Valencian Community, Spain) . It is part of the permanent chasmophyte communities exposed to salt-laden sea spray (*Crithmo-Staticetea*). Population size has been observed to fluctuate between 30 and 690 individuals. The sites are affected by collapse risk caused by marine storms. Sea level rise due to climate change is also a threat.

The species has been included in Valencian regulations by Decree 70/2009 (DOCV no. 6021, 26/5/2009), by Order 6/2013 (DOCV no. 6996, 4/4/2013) and currently by Order 2/2022 (DOCV no. 9285, 24/02/2022), within the maximum category 'In Danger of Extinction' of the Valencian Catalogue of Threatened Flora Species. It is also catalogued as 'In Danger of Extinction' in the 'Spanish Catalogue of Threatened Species' (Royal Decree 129/2011; BOE no. 46, 23/2/2011).

Furthermore, since 2015 has a Recovery Plan published by Order 1/2015 (DOCV no. 7451, 27/1/2015). The work for the achievement of this Plan is carried out by the Wildlife Service and Natura 2000 Network (Generalitat Valenciana).

The objective of the Recovery Plan is to downgrade the threat category. Three requirements are necessary during 5 consecutive years: at least a total of 250 individuals; a minimum of 6 populations and at least 6 UTM grid 1x1km.

To save this species and to achieve the recovery plan 31 new locations have been planted throughout 2005–2023 along de mediterranean sea coast beetween 40.16; 0.18 and 40.33; 0.37 (EPSG: 4326). Propagation and cultivation tasks were carried out in the nursery of the Center for Forestry Research and Experimentation (CIEF, Generalitat Valenciana).

After 15 years of *in situ-ex situ* work since 2018 *Limonium perplexum* meets all requirements of the Recovery Plan. In the year 2022 the count was 1232 individuals, 20 populations and 20 squares (1x1km).

But sea storms and rising sea levels make the coastline regressive. Due to climate change, rainfall is expected to be lower and more irregular, which is a negative factor for the species: this causes the interannual population size to fluctuate and may lead to local extinctions. Thus, the risk of extinction of the species continues to be present.

Although it has been 5 years since the Recovery Plan was completed, the competent authority continues working to ensure long-term survival of the taxon.

Keywords: *Limonium perplexum*, Recovery Plan, Endangered species

Success in Recovery plans in the Valencian Community: an example of collaboration of different actors with a common goal

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The first Recovery Plan in the Valencian Community (Spain) was published in 2008 for *Silene hifacensis* (Decreto 40/2008). This plan was revised and updated in 2015 (Order 01/2015 Recovery plans for endangered species *Cistus heterophyllus*, *Limonium perplexum*, and *Silene hifacensis*). Among the objectives proposed to improve the state of the conservation of the species stand out the 3rd article, which underlines: “reach the population amount that justify changing his threat category from Endangered to Vulnerable”.

Since the Recovery plans approval, a work strategy of a collaboration and cooperation network of different types of institutions and entities was been created. This team is coordinated by the Wildlife and Natura 2000 Service of the Generalitat Valenciana. These collaborations have been essential for the active conservation of these species due to the complexity of the goals proposed in the conservation regulations.

Currently, a total of 31 *Cistus heterophyllus* populations have been created, distributed in 25 grids of 1 Km², with 4,826 plants translocated [see also 1]. In the case of *Silene hifacensis* a total of 87 populations have been created, distributed in 33 grids of 1 Km², with 2.6 million of seeds and 993 plants translocated [see also 2]. As a result of these successful actions, for *Silene hifacensis* the main goal of the recovery plan has been achieved. Due that this species is protected at national level, the Generalitat Valenciana has obtained the approval of the national authorities to change in a close future the legal status of this species in continental Spain to Endangered to Vulnerable [1,2,3].

There are 41 institutions and entities that have participated in the development of the Recovery plans for these two species. The Recovery plans and the collaborations are in line with the Biodiversity Strategy of the Valencian Community 2030, working on the different goals, and addressing the Goal 15 of the 2030 Agenda, which refers to the conservation of terrestrial ecosystems.

Keywords*: Cistus heterophyllus*, *Silene hifacensis*, recovery plan, conservation, endemism.

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The Threatened Plant Monitoring Scheme of the Valencian Community (Eastern Spain): a long-term project to assess the population trends of threatened species

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Demographic monitoring of threatened species allows us to assess both population's trends and their conservation status. The Threatened Plant Monitoring Scheme of the Valencian Community (Eastern Spain) started formally in 2009 to achieve these goals. The program includes 158 plant species located in 1,030 monitoring plots, called monitoring units. These plots are mapped and population censuses are carried out every one to three years for each of the threatened flora species, according to its protection category, population dynamics or biotype.

We used the statistical program TRIM to analyse the population trends of the species. The advantage of this software is that it allows estimating models of population change from incomplete time series of censuses. Population trends were classified into categories of increase, decline, stability, or uncertainty. In addition, the percentages of interannual change of the population of each species were integrated into multi-species change indices to assess the trend of sets of species grouped by a taxonomic, legislative or ecological link.

Population trends of 121 species, 79 of them included in the Valencian Catalogue of Threatened Plants (VCTP) and 42 classified as 'Non-catalogued Protected Species', the next lower level of protection in the regional normative, have been analysed. The results show minimal population fluctuations during the first years of monitoring of the species, with a general trend of stability or increase between 2002 and 2013. A pronounced and widespread decline was recorded in 2014, coinciding with an extraordinarily dry year, with a marked lack of rainfall and a prolonged persistence of the arid period. This steep decline marks the beginning of a regular cycle of recovery-decline, but always with population values lower than those of the reference baseline year do.

Multi-species analysis has been applied to species grouped according to the protection level (catalogued vs. Non-catalogued Protected Species), biological (Biotypes) and ecological criteria (habitat type). The analysis shows that climatic habitats have a positive trend during most of the analysed period and that edaphic habitats have negative value for the same period. Finally, we used population trend models to reassess the permanence, exclusion or modification of the protection categories of species in the VCTP, which was updated in 2022 accordingly.

Keywords: Conservation status, Demography, Endangered species, Flora, TRIM

Threatened coastal plant species of Catalonia: improving knowledge and ex situ conservation

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Much of the coastline of Catalonia is urbanized for tourism purposes and many coastal habitats have disappeared or are very deteriorated. Conservation status is critical for species such as *Achillea maritima* (L.) Ehrend. & Y.P.Guo, *Phleum arenarium* L. or *Stachys maritima* Gouan, which are critically endangered at regional level. The Fauna and Flora Service of the Generalitat de Catalunya, in 2019, entrusted the Marimurtra Botanical Garden with a project whose main objective was to improve knowledge about conservation status and ex situ cultivation for nine taxa of vascular flora under threat: *A. maritima*, *Convolvulus siculus* L. subsp. *siculus*, *Elatine macropoda* Guss., *Erodium foetidum* (L.) L'Hér., *Jacobaea aquatica* (Hill) G.Gaertn., B.Mey. & Scherb., *Maresia nana* (DC.) Batt., *Phleum arenarium*, *Reseda hookeri* Guss., *Sarcocornia perennis* (Mill.) A.J.Scott.

The project included five actions: reviewing know populations, collecting seeds to store them in a germplasm bank, collecting herbarium specimens, searching for populations in ex situ cultivation and compilation of technical information on ex situ cultivation. For *Reseda hookeri* two additional actions were established: habitat characterization and a proposal of localities to create new populations.

Throughout the project, 32 localities were visited to verify the existence of populations. The result was positive in nine, in the other 23 the species could not be located or could not be visited. Seeds were collected from all taxa, except for *S. perennis*, this species also raised doubts about its taxonomic identity.

18 institutions were contacted to find out if they had reproductive material and if they had developed ex situ cultivation experiences. Nine of the institutions responded to the queries, another seven did not respond but information is available for their germplasm bank in ENSCONET (http://ensconet.maich.gr/), for the remaining two no information was get in return. While herbarium material was located for all taxa, seeds deposited in germplasm banks could not be located for two species: *E. macropoda* and *E. foetidum*.

For *R. hookeri* in situ explorations showed up that their individuals were more numerous than previously thought. Habitat characterization and vegetation surveys allowed to select some localities to create new populations.

Overall, this project has served to improve knowledge about the behaviour and conservation status of endangered coastal plants. For one of the species: *A. maritima*, this information has already been used to develop a new ex situ conservation project.

Keywords: coastal flora, ex situ conservation, Catalonia, human pressure, habitat characterization

First observation of *Pleurodirus fairmairii* (Kiesenwetter, 1852) damages on *Cistus heterophylus* subsp. *carthaginensis*, an Ibero-Balearic endangered endemism

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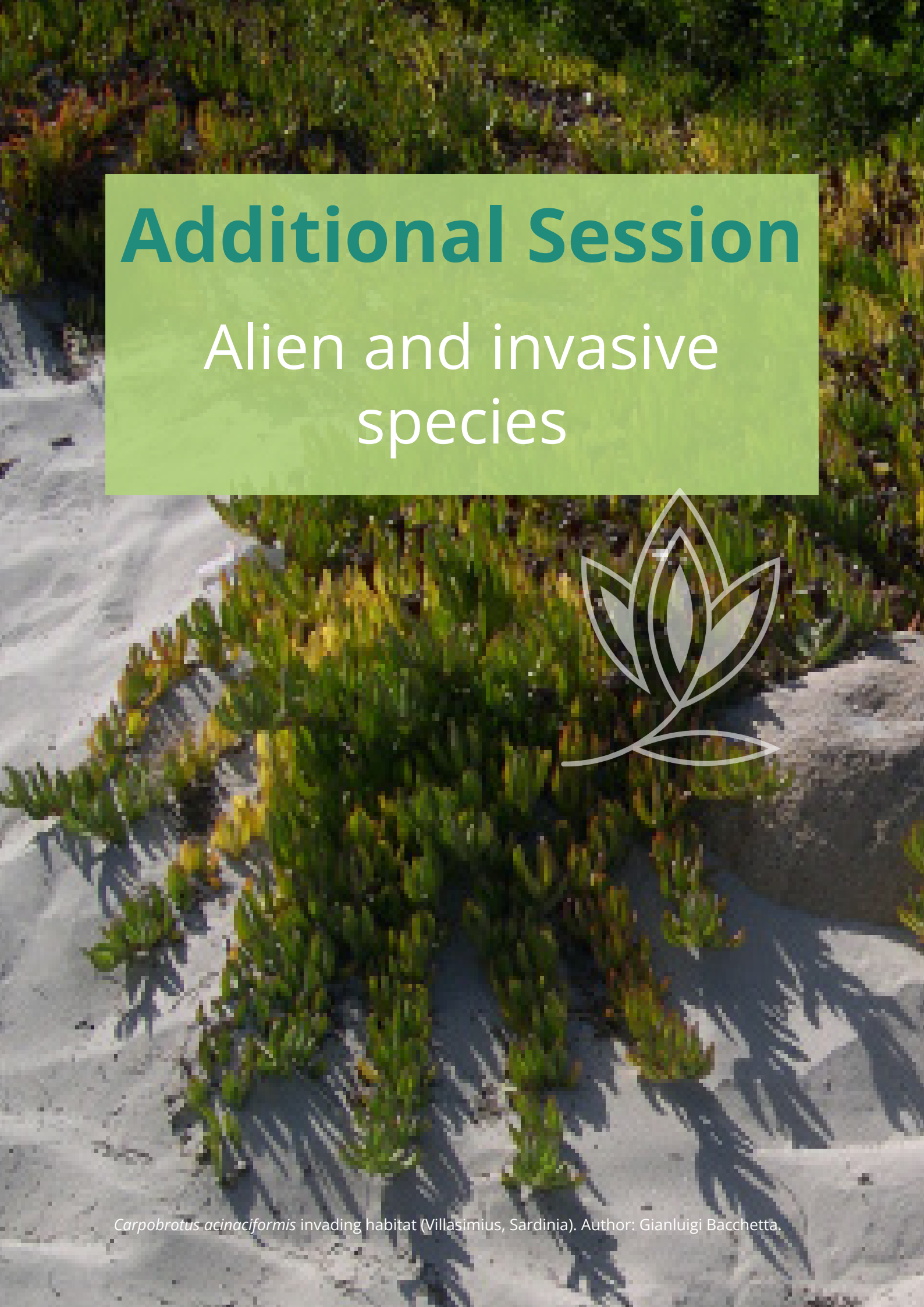
Cistus heterophyllus subsp. *carthaginensis* (Pau) M.B. Crespo & Mateo (Cartagena's rockrose) is a taxon belonging to the family Cistaceae. It is an Iberian endemism catalogued as "Endangered" in the Spanish Catalogue of Threatened Species. Its current distribution is limited to the Spanish provinces of Murcia, Valencia and the Balearic Islands, but populations with non-reintroduced natural specimens are only known in Murcia and the Balearic Islands. The last Valencian wild specimen died in February 2022, but their seeds served to reintroduce populations in its environment. However, the genetic variability of the populations is so low that any environmental factor could cause a significant decline in the populations and even accelerate the extinction of the taxon.

This paper reports for the first time the occurrence of the weevil *Pleurodirus fairmairii* on plants of *C. heterophyllus* subsp. *carthaginensis* and describes the important damage it causes on leaves, stem, buds, flowers and fruits. It is the first report of the weevil as a pest species, and the first biological data of this species. A short description is given, including the genitalia, that is studied for the first time.

Keywords: pest, host plant, endangered species, Curculionidae, weevil.

Additional Session

Alien and invasive species



Carpobrotus acinaciformis invading habitat (Villasimius, Sardinia). Author: Gianluigi Bacchetta.

Chair

Anna Nebot

PhD in applied Botany. From the beginning of her professional career, she has worked on biodiversity conservation, mostly on endemic flora of the Mediterranean. She has also conducted international research on Cycads. After various stays in labs in Italy, England, and Thailand, in recent years she has been working at the Botanical Garden of València. Currently she is working on a Spanish national project entitled “Flora (native and invasive alien species): improving knowledge of the conservation status”.

Management of invasive *Carpobrotus* spp. in Mediterranean island ecosystems: experiences from projects RESTO CON LIFE and LIFE LETSGO GIGLIO

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Biological invasions represent one of the most dramatic threats to biodiversity. The species from the *Carpobrotus* genus are well-known invasive plants native to South Africa, whose impacts have become particularly important on small Mediterranean islands. Due to these features, these species have been targeted by several projects of control. Within this contribution, we report the experiences of control of *Carpobrotus* spp. conducted in the Tuscan Archipelago within the EU LIFE projects RESTO CON LIFE, on the island of Giannutri, and LIFE LETSGO GIGLIO, on the island of Giglio, focusing on the dynamics of vegetation recovery after the interventions.

In both projects, it was adopted an integrated approach with manual removal and covering with mulching sheets. At Giannutri, the intervention areas included a mosaic of rocky cliff coastal vegetation including the habitats of the Vegetated sea cliffs of the Mediterranean coasts and *Salicornia* and other annuals colonizing mud and sand, and disturbed areas with loose soil close to the cliffs. At Giglio the habitats most affected by the presence of this species include the Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp., the Halo-nitrophilous scrubs (*Pegano-Salsoletea*) and the Low formations of *Euphorbia* close to cliffs. In both islands we surveyed the changes occurring to vegetation due to the control actions, adopting a Before-After-Control-Intervention design on permanent square plots of 2 meters of side, in invaded and uninvaded areas, in each of the habitats mentioned.

At Giannutri, the results obtained from five years of monitoring using permanent plots showed that *Carpobrotus* spp. exerted strong impacts on the invaded plant communities. The control methods proved to be effective in the suppression of the mat formed by the invasive species and led to a positive response of native vegetation. Nevertheless, the recovery of native plant communities differed depending on the type of substratum, taking longer on rocky cliffs due to the harsher conditions. Moreover, the recovery of native vegetation seems to be driven by nitrophilous species. At Giglio, the preliminary results clearly show impacts on plant alpha. Invaded communities also showed a severe change in species composition with a strong homogenization of the floras of the three habitats. Preliminary results of the first vegetative season after the main intervention show a recovery of native species richness mainly for the Low formations of *Euphorbia* close to cliffs.

Keywords: invasive alien plant, restoration, eradication, plant community, plant ecology

A multi-taxa approach to assess the impacts of the alien *Carpobrotus* spp. on natural communities in a small Mediterranean island

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Carpobrotus species are mat-forming succulent plants considered as invasive alien species in the Mediterranean habitats. Their detrimental ecological impacts on natural vegetation and soil have been widely documented, being them responsible for relevant changes of vegetation and soil parameters. However, their impacts on the other communities are poorly understood. Therefore, it is fundamental to consider different taxa to thoroughly evaluate the impacts of *Carpobrotus* spp. on natural communities. This approach is particularly interesting in small Mediterranean insular contexts, since i) different natural habitats of conservational interest are threatened and ii) because the effects of the invasion process are particularly unpredictable in a limited geographical area. We assessed the impacts of *Carpobrotus* spp. following a multi-taxa approach on priority habitats of Giglio Island, a small Mediterranean island of the Tuscan Archipelago (Italy) aiming to provide comprehension of ecological processes in act. In 2023 we surveyed Mediterranean garigues of rocky cliffs in 18 randomly selected 4 m^2 quadrat plots: 6 in contexts still invaded by *Carpobrotus* spp., 6 in patches where the species had been previously eradicated (in early 2022), and 6 in natural uninvaded habitat. In each plot we sampled: vascular plants, bryophytes, ants, soil microarthropods, molluscs, and soil microbiota. Moreover, we measured soil parameters. Preliminary results have shown a differential response of the taxonomical groups to the impacts of *Carpobrotus*. First, the negative impacts on vegetation and soil have been confirmed. Second, communities of arthropods and microbiota showed an important change in composition in invaded habitats, due to strong changes in vegetation and soil. Third, we found that bryophyte and mollusc communities were more represented in invaded contexts, probably in relation to the new microhabitats formed by the monospecific mat of *Carpobrotus*. Finally, after one year from the eradication of *Carpobrotus*, we recorded an initial colonization of ruderal plant species and changes in the soil characteristics (e.g., soil moisture, litter). Hence, we found that *Carpobrotus* significantly alter the biodiversity of natural Mediterranean communities and cause complex patterns of variation when considering multiple groups of organisms.

Keywords: biodiversity, community ecology, biological invasions, conservation, vegetation

Modeling invasion risk maps for alien plants: application in Mediterranean Sea cliffs with endemic species

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LIFE medCLIFFS is a five-year project co-funded by the LIFE Programme of the European Union, which aims at improving the management of invasive plant species on coastal areas in order to restore its natural habitats. The project is specifically focused on the habitat of community interest of Vegetated Mediterranean Sea cliffs with endemic *Limonium* spp. (HCI 1240). Project actions are mainly taking place in the Costa Brava and in the Cap de Creus Natural Park (NE Spain), one of the areas with coastal cliffs most affected by the problem of invasive plant species in Spain.

One of LIFE medCLIFFS objectives includes the adaptation of a model that was developed and tested by Froese et al. [1] for evaluating the risk of invasion, and which was aimed to allow a rapid response against invasive plant species. The use of spatial risk models permits us to predict where invasive plant species are most likely to spread, establish and persist in the environment, and this approach has been already applied in projects of similar nature such as RAPID LIFE (2017-2020, UK). These models tell us which sites and species present a higher risk of invasion, and can be exploited to help land managers make better decisions on prevention, early eradication or containment interventions. The method considers that habitat suitability (i.e. invasion risk without considering propagule pressure) and habitat susceptibility (i.e. invasion risk considering propagule pressure) are influenced by risk factors that reflect the environmental and biological conditions needed for the invasive species to grow and spread.

In a first phase we are focusing this method on the invasive *Opuntia* spp., *Carpobrotus* spp. and *Gazania rigens* affecting the Cap de Creus Natural Park and its surrounding areas. The obtained risk maps will be overlapped to those of endemic and threatened species that are found in the study area (*Limonium geronense*, *L. tremolsii* and *Seseli farrenyi*). Based on the result of the risk assessments, comprehensive reports for each species are being elaborated and delivered to the field technicians working on HCI1240 of Costa Brava to improve their management.

Keywords: invasion risk models, citizen science, invasive alien species, endemic and threatened species, coastal habitats

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Monitoring the effects of the conservation efforts on impacted habitat through the control of feral ungulates on three islands of the Tuscan Archipelago: Montecristo, Giglio and Capraia islands

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On a global scale, it is known that wild or feral ungulates can conspicuously modify the environment they live in. Commonly, significant impacts are visible on grassland and shrub areas, caused by trampling and the modification of the dynamics of renewal of natural populations due to the removal of young seedlings and shoots, which could also have long-term repercussions on both local flora and fauna. The aforementioned impacts are also observed on the islands of the Tuscan Archipelago that host alien ungulates populations, particularly mouflons and feral goats. Mouflons are currently present on the Giglio and Capraia Islands, while a feral goat population considered of historic value is present on Montecristo Island. This study focuses on the effects of the conservation efforts on the impacted habitat through the eradication or exclusion of the ungulates on these islands, assessed through the monitoring of damages to local vegetation. Indeed, on the three study sites we could compare differential stages of ungulates management control. On Montecristo Island, as part of the LIFE project “Montecristo 2010”, an exclusionary fence was constructed around a limited portion of the island to prevent the impacts of feral goats on native vegetation. Instead, on the Giglio and Capraia Islands, vegetation monitoring has been carried out since 2020, however, only on Giglio Island, efforts to eradicate mouflon from the island have begun, as part of the project LETSGO GIGLIO. Each year, the impacts linked to ungulates were monitored through the survey of randomly extracted transects carried out in holm oak woodland, tall scrub and low scrub/garrigue habitats on the three islands.Specifically, on Montecristo, transects were extracted on both sides of the fence. In each transect, all individuals of woody species were counted recording any evidence of grazing according to a simple four-level impact assessment scale, and a subdivision between adult individuals, shoots, and seedlings. We also evaluated the impacts on the herbal layer and soils. This contribution will show the results of the monitoring carried out to date, highlighting that the greatest impacts observed in habitats protected by the “Habitats Directive” (Dir. 92/43/EEC) and especially for the Mediterranean shrublands and holm oak forests (hab. 9340 *Quercus ilex* and *Quercus rotundifolia*). On Giglio island, the first two years of monitoring were carried out before the intervention on the mouflon population, giving an important view of the initial condition of the vegetation affected by the grazing. On all islands, the results show a greater load of grazing in correspondence to where the most of population is located, with a distinct predilection for the consumption of *Quercus ilex, Arbutus unedo* and *Erica sp.* shoots and less impact on the vegetation where the presence of low scrub and garrigue is more significant, highlighting the potential impact on the renovation of the most evolved woody communities. However, during the most recent monitoring campaign carried out in May 2023 on Montecristo, it is visible how, outside the exclusionary pen, the herbaceous species are heavily damaged and the soil is highly altered and often bare, while within the enclosure the abundance of herbaceous species was greater. Furthermore, we found a visible diminishing of damages to vegetation on Giglio Island, which could confirm the effectiveness of the actions carried out to date.

Keywords: invasive, conservation, ungulates, islands

Vademecum: A general guide to invasive alien species eradication and habitat restoration in Natura 2000 sites – the Malta experience

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In the 1970s, the Maltese Islands experienced a "green plan" with the introduction of a number of fast-growing exotic species some of which proved to be invasive alien plant species (IAPs) such as *Acacia* and *Agave* spp. Other IAPs such as *Cardiospermum* and *Cenchrus* (*Pennisetum*) spp were casually introduced in Natura 2000 sites as garden escapees or from landscaping works. Over the past half century, more IAPs have been introduced with at least 50 different species presently recorded from Malta. Unfortunately, some of these have ended up in Natura 2000 sites threatening the indigenous biodiversity with all its consequences.

Through the project SiMaSeed, several actions have been undertaken in order to control IAPs in Natura 2000 sites as part of the rehabilitation process for disturbed natural habitats. Based on Maltese experience, a vademecum has been developed which may assist different Mediterranean stakeholders dealing with conservations. Following site evaluation and necessary permit applications, an eradication plan has to be drafted based on the vulnerability index assessment of the IAPs present. The plan may also involve test plot trials before the actual IAPs removal and biomass clearance. Our strategy involves plans at an early stage for indigenous plant propagation typical of the site to replace the void left from IAPs removal. Biotic and abiotic constraints such as shallow soil, site exposure and drought are taken into consideration as well as synchronising seedling transplanting to the start of the rainy season. The inoculation of seedling substrate with indigenous plant-beneficial microbes that help rapid seedling establishment has been tested with positive results. A crucial step is an aftercare and site monitoring programme to ensure prompt removal of re-sprouted invasives and healthy growth of transplanted seedlings. Though we have encountered failures and stumbling blocks, we have registered success on a number of fronts. Our ultimate aim remains to remove IAPs with maximum efficiency and the least effort in terms of time and expense as well as to re-establish the native flora communities on disturbed sites.

Keywords: disturbed habitats, eradication plan, vulnerability index, indigenous plant propagation, plant beneficial microbes, native flora communities.

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Assessment of the impacts of *Opuntia stricta* on vegetation and invertebrates in a small Mediterranean island

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The extensive use of the *Opuntia* genus as food and ornamental plant has made it one of the most widespread in the Mediterranean basin. Especially, in the small Mediterranean island, Capraia (Tuscany Archipelago, Italy) the invasive alien species, *Opuntia stricta*, is the most pervasive one. In particular, its distribution threatens some important N2000 habitats, such as 5330 “Thermo-Mediterranean and pre-desert scrub”, 5320 “Low formations of *Euphorbia* close to cliffs”, 1240 “Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* sp. pl.” and 6220 “ Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*”.

Although its socioeconomic and vegetation impacts have been fairly documented, there is a paucity of studies on the micro invertebrate community and on soil chemistry. Therefore, in order to have a more comprehensive view of the impacts of this species at various levels in Capraia Island, our study aims to assess the impacts of this IAP not only on plant communities, but also on native microinvertebrates, and soil chemistry.
We created an experimental design that involved natural and semi natural areas surrounding Capraia port. We randomly launched 12 square plots of 4 m^2, 6 in the invaded area and 6 in the uninvaded area. All these plots were located within habitats of conservation interest and at least 25 meters apart from one another. For each of them, we recorded data on plant species occurrence and abundance and collected soil samples for analysis of moisture, density, skeleton and potential production of CO^2, N_2O and CH_4. In addition, we sampled ants using pitfall traps, collected soil samples for the characterization of micro-arthropod communities through the Berlese funnel method and further detected soil microbiota analysis.

For what concern the preliminary vegetation results, they show significant impacts on the composition of plant species but not as regards the diversity indices. Instead, preliminary results on soil physico-chemical properties and microbial activities show that there is a greater difference at the spatial level rather than between invaded and uninvaded areas. Hence, the invasion of *O. stricta* seems not to significantly change the soil characteristics, and probably also the soil fauna.

Keywords: alien species, cross taxon, soil analyses, habitat, plant ecology

Changes in the distribution and dissemination of exotic plant species in the main habitats in Majorca island

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The constant arrival of exotic plants into areas outside of their original distributional range and their expansion to the natural ecosystems, is one of the more important environmental problems affecting plant conservation. Due to the current globalization and the increase of urbanization, the number of introduced species is rapidly increasing (Bonnamour et al. 2021). On other hand, climate change is rapidly modifying environmental features, giving new opportunities for alien plants to naturalize and eventually become invasive (Torres et al. 2021). This risk is especially noticeable in island ecosystems. The studies that analyze the differences that have occurred over time in the colonization of exotic plants are particularly useful to detect the habitats that are most affected (mainly those more vulnerable) and to know the species that have shifted their status, for instance, from subspontaneous to naturalized or even invasive.

Within the framework of a larger project on landscape changes and their influence on ecosystems, we replicated a study conducted in 2005 about invasion rates by exotic plants in different habitats of Majorca island (Moragues, 2006). objective to quantify the changes that have occurred in the last two decades. The island of Majorca was divided with the UTM 10 x10 km square grid (54 squares). In each square, three surveys of exotic species were carried out in each of the most characteristic habitats (crops, ditches, scrub and forests, stone walls, dunes, wetlands, torrents and rocky coast). The closest sampling points were separated by at least 1 km. In each survey, the abundance of each species was also noted according to the DAFOR scale.

A total of 1,047 surveys were carried out, and approximately 240 exotic species were identified. The square grids with a greater presence of exotic plants corresponded to those located in urbanized coastal areas. On the contrary, the agricultural areas in the center of the island and the most conserved areas of the mountains were the least affected by the presence of exotic plants. This pattern is similar, but more exacerbated, to the one obtained in 2005. Torrents and ditches were the habitats were greater number of exotic species in a greater abundance were found. Meanwhile, dune systems and wetlands were the habitats with the least number and least abundance of exotic species. It should be noted that scrublands and rocky coast areas, which are vulnerable habitats, presented intermediate (although relatively high) levels of exotic invasion. It is noteworthy that this last habitat is now much more affected by exotic species than in the former reference work. It is very likely that this situation is due to the increase in gardening associated with urbanization and, consequently, the increase in pruning waste that is abandoned in natural areas.
Keywords: Invasive plants, Global change, Insularity, Vulnerable Ecosystems, Urbanization

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Ecological and morphometric study of the genus *Carpobrotus* in the Western Mediterranean Basin

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The genus *Carpobrotus* N.E.Br., which belongs to the family Aizoaceae, has more than a dozen species that are native to the Southern Hemisphere (Oceania, South America and, more importantly, Southern Africa). However, several of these species have naturalized outside their native range as a result of being used as ornamental plants, as well as for stabilization of coastal dunes, becoming invasive all across the Mediterranean Basin, posing a great threat to biodiversity. As of today, there are three species within this genus that are considered invasive (*C. chilensis, C. edulis* y *C. acinaciformis*), which are known to produce hybrid forms and result in a taxonomic complex that is hard to tell apart from the parental forms. Therefore, the taxonomy and biogeography of the genus *Carpobrotus* remains unclear and under discussion.

Western Mediterranean Basin has numerous populations of this genus, that, despite being initially assigned to *Carpobrotus edulis*, most recent studies suggest that they could belong to different species and, probably, to the hybrid forms between them.

In this study we analyzed various morphological characteristics of the reproductive and vegetative organs in order to: (i) tell if there are differences between populations, (ii) describe entities based on these characteristics and (iii) see if there are differences in the ecological niche of different morphotypes.

Keywords: alien species, morphometry, ecological niche, taxonomy

How a LIFE project can improve the floristic knowledge: new distribution data on the alien flora of the Costa Brava (NE Spain)

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The Costa Brava is a coastal strip of ca. 250 km that stretches from the French-Spanish border to Blanes (Girona Province). It is known for its rugged coastline, as it is mostly made of sea cliffs in clear contrast to other nearby coastal areas characterized by long sandy beaches. Unfortunately, the Costa Brava has become a hotspot of plant invasions (probably the most important in the entire Iberian Peninsula) as a result of the interaction of various factors, including the abovementioned complex topography, the anthropization of the natural environment, and the huge tourism development.

In order to prevent new introductions of alien plants and to improve the management of the invasive species already present, a project within the LIFE Program of the European Union is underway. The initial phase of this project (LIFE medCLIFFS; https://lifemedcliffs.org/es/) required the design of a set of transects (around a hundred) of 0.5–1 km in length distributed throughout the Costa Brava; these small strips of coastline are being monitored by volunteers with the aim of early detection of new invasive plants and monitoring the different species already observed.

As a result of the fieldtrips derived from the design of the transects, which were carried out during the first half of 2022, we were able to detect up to 20 alien species not observed previously in the Costa Brava, some of which being novelties even at a continental scale (*Agave parryi*, *Cocculus laurifolius*, and *Heptapleurum arboricola*). We also provide updated information on other invasive species that were already present on the Costa Brava but for which our observations significantly change the knowledge about their distribution range and invasion status in this area.

Keywords: floristic novelties, human transformation, invasive alien species, sea cliffs, volunteers

Invasive alien plants in wetlands: the importance of collaborations for implementing common strategies

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Invasive alien plants are one of the main causes of biodiversity loss and species extinction and their spread is currently favoured by climate change and globalisation, which in parallel reduces the resilience of several habitats. The distribution of invasive plants is not homogeneous in all the world, certain regions are more affected than others, or, in a certain region, invasive species could turn out to be more abundant in certain habitats. Among the different invaded habitats, wetlands are the most susceptible to biological invasions. The comparison of these traits is essential for the study of invasive alien species in different wetlands of Mediterranean Basin.
The aims of this study is to understand which are the most invasive species in wetland habitats, with particular attention to the areas belonging to Mediterranean islands, and the threats that such species represent to these areas, in order to prioritize and homogenise *in situ* management actions across the Mediterranean. This work will make a valuable contribution to development of task 1.4 “Identification of new IAS control processes and, where possible, eradication in Sardinian wetlands” within WP1 Protection and Valorisation of wetlands systems of the National Recovery and Resilience Plan (NRRP) Spoke 09 “Environment protection and valorisation”.
The necessity of promoting more effective collaboration among different institutions from the Mediterranean is crucial in order to exchange good practices develop common strategies to eliminate/control the threat of invasive alien plants.

Keywords: good practices, invaded habitats, *in situ* conservation, Mediterranean networks

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The Role of Ecophysiological Studies on Invasive Plants Tolerance to Abiotic Stress in Conservation Programmes

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Invasive species have been recognised for several decades as one of the main challenges to threatened plants, second only to habitat loss. Already at the beginning of this century, 57% of threatened species were reported to be negatively affected by non-native competitors. Invasive alien species (IAS) compete with native species, alter food webs, nitrogen and hydrological cycles and, thus, disrupt the functioning of ecosystems and the services they provide. The risks posed by IAS are now well understood and documented. However, the establishment of IAS worldwide is not slowing down, and is even expected to increase despite prevention measures.

Climate change effects and plant invasions are closely related. The risk of biological invasions is very high in the Mediterranean region, where climate conditions may be drastically affected by global warming. IAS frequently exhibit high levels of stress tolerance in addition to their capacity to outcompete native flora. These traits, along with effective dispersal techniques, are crucial to guaranteeing their continued global expansion, particularly in regions affected by climate change. The ability of plants to withstand abiotic stresses such as drought, salt, and high temperatures is based on the activation of defense mechanisms, such as the regulation of the cellular osmotic pressure through ion transport and the change in osmolytes concentration, the inactivation of reactive oxygen species (ROS) to face oxidative stress, by the activation of enzymatic and non-enzymatic antioxidant machineries. Therefore, the analysis of the limits of tolerance to abiotic stresses of invasive plants and the efficiency of their response mechanisms may help predicting their potential invasiveness; and thus, becoming a side tool to improve decision making in conservation programmes of native vegetation.

The main source of plant invasions is anthropic activities, whether related to ornamental horticulture as most IAS plants were introduced intentionally with ornamental purposes, or by non-deliberately means, such as by dispersion (e.g., ships, planes, etc). This is the case of the Natural Park of L'Albufera (Valencia), where several IAS may be problematic, such as the garden escapees, such as *Cortaderia selloana*, *Lantana camara*, or *Oenothera biennis*. Moreover, dunar vegetation is highly threatened by the noxious invader *Carpobrotus edulis*, but also by other species with a high tolerance to drought, such as those of the genus *Alloe*. In saltmarshes, besides *Arundo donax*, the most problematic invader from long time ago is *Spartina patens*, which represents a major threat for the vegetation of these "mallades". Finally, there prosper some invasive woody species such as *Acacia saligna* or *Eucalyptus camaldulensis*.

In this review we will analyse the tolerance to abiotic stress of some of the above mentioned species. The majority of these IAS have an outstanding tolerance to environmental constraints, especially to drought and salinity. Most of them activate several aspects of the biochemical mechanisms that allow them to flourish and compete under stressful conditions.

Keywords: Invasive species, abiotic stress, acclimatization, climate change

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Understanding *Carpobrotus* sp.pl. (L.) N.E. Br. Invasions: Stress Tolerance and Genetic Diversity Insights

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Conservation priorities for the coastal flora and habitats throughout the Iberian Peninsula require understanding the threats posed by invasive species. The invasion of natural areas by biological organisms is a significant factor leading to declining biodiversity and disrupting ecosystem services. The current climate change can exacerbate this situation, further intensifying its effects.

One of the most dangerous invasive species worldwide is *Carpobrotus* sp.pl. (L.) N.E. Br. It is an invasive clonal succulent plant native to South Africa, belonging to the Aizoaceae family and has become widely distributed worldwide. Its prostrate growth form enables rapid expansion and colonisation of coastal dunes, rocky coastlines, and sea cliffs. Introduced as an ornamental plant and for soil stabilisation, *Carpobrotus* exhibits fast growth and low resource requirements, making it a successful invader, particularly in Mediterranean-type climates. Its competitive ability is also based on its tolerance to stress factors such as salinity and drought.

Numerous studies have documented the negative impact of *Carpobrotus* invasions on native communities, resulting in reduced local richness and diversity. The plant interferes with the germination and survival of native species, alters soil conditions, and modifies ecosystem processes. Understanding the mechanisms of its invasion and ecological impacts is crucial for developing effective conservation strategies. For this reason, the research aims to address the conservation priorities for altered coastal flora and habitats, focusing on *Carpobrotus* species and its invasiveness. In this study, two genetic clusters - Cluster A, from A Lanzada (Pontevedra) and Cádiz (Cádiz) and Cluster B, from Samil (Pontevedra) and La Marina (Alicante) - composed of two populations each from different climatic areas (Atlantic and Mediterranean), were included. Plants were collected from their natural habitats, transplanted to a greenhouse, and allowed to acclimate before being subjected to four concentrations of NaCl (0, 250, 500, and 800 mM), four levels of drought, and a combination of both. A total of 16 treatment conditions were implemented over 50 days, with seven replicates per treatment in the four populations studied.

To evaluate tolerance mechanisms to abiotic stress, physiological parameters and different biomarkers, such as photosynthetic pigments and malondialdehyde, associated with stresvvvvvs were evaluated. Additionally, metabolomic profiling analysis allowed the examination of metabolic variations within *Carpobrotus* populations across treatments and between populations. This analytical approach offers valuable insights into the physiological reactions of the plant and facilitates the identification of stress biomarkers and vulnerabilities. Moreover, a meticulous examination of root plasticity at the microscopic level was conducted to better understand the adaptation process.

The experimental results demonstrated that all tested populations exhibited relative resistance to drought and salinity, as evidenced by their survival over a 50-day period of stressful treatments. However, both stressors adversely affected the growth of all populations to varying degrees. Growth inhibition was evident through reduced fresh aerial weight, water content, length, and number of whorls, particularly under high salinity conditions. Notably, Cluster B, Samil, and La Marina populations displayed significant and similar growth inhibition, suggesting a genetic basis for stress acclimatisation in these cases. In contrast, the responses of Cluster A populations (A Lanzada and Cádiz) to stress conditions differed according to growth parameters, indicating that genetic factors may not play such a significant role. Across all populations, a strong correlation was observed between malondialdehyde, a marker of lipid peroxidation, and growth parameters, indicating the presence of oxidative stress under stressful conditions but with distinct patterns.
The metabolomic assays revealed a distinct separation of the plant metabolome among the four *Carpobrotus* populations. Cluster A demonstrated a greater influence of amino acids and organic acids, while cluster B exhibited a higher impact of sugars and alcohols. Finally, root plasticity is different when the treatments are contrasted with the control, with a heightened impact on plants exposed to salinity.

The findings emphasise the importance of genetic diversity in the invasion process and stress acclimatisation and highlight the need to consider genetic variation and plasticity in managing invasive species. Overall, the presented studies shed light on the ecological impacts, stress tolerance, and genetic and phenotypic diversity of *Carpobrotus* populations. They provide valuable insights to optimise conservation efforts and improve management strategies to mitigate the threat of invasive species. By understanding the mechanisms of invasion, ecological impacts, and stress responses of *Carpobrotus*, effective actions can be implemented to protect altered flora and habitats from the detrimental effects of this invasive species.

Keywords: Invasive species, salinity, drought, adaptation mechanisms, genetic plasticity, phenotypic plasticity abiotic stress

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4th Thematic Session

Ecological restoration of Mediterranean habitats

Dune restoration (El Saler, Spain). Author: Emilio Laguna.

Chair

Jordi Cortina

Jordi Cortina-Segarra (Barcelona, 1963) is full professor at the University of Alicante (Spain) and Chair of the European Chapter of the Society for Ecological Restoration (SER Europe). Biologist (Univ. Barcelona, 1986), and Ph.D. in Biology (Univ. Barcelona, 1992). Post-doctoral studies at Colorado State Univ. (1992).

His research focuses on dryland ecology, including degradation processes and restoration. His current focus is on participatory systematic restoration planning. He has authored 197 papers, including 83 in SCI journals, and currently teaches undergraduate and graduate courses in modelling and restoration ecology. He has supervised 13 Ph.D. thesis and 16 M.Sc. thesis.

Habitat restoration in the Valencian Community

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The Valencian Community (23,260 km^2) is home to 68 habitats of community interest, of which 18 priority. DG Environment of the Generalitat has carried out habitat restoration projects, with the financial support of EU funds as shown below:

-Generalitat: 2.090.811€ (246 ha; 2 projects)
-ERDF: 6.864.034,87€ (4.601 ha; 22 projects)
-EAFRD: 2.026.832€ (70 ha; 1 project)
-Next Generation: 1.502.289€ (399 ha; 3 projects)

The final goal of these projects was to prevent or mitigate impacts derived from the conjunction of rural abandonment and climate change (forest decline, forest fires, habitat loss and homogenization) as well as biological invasions.

Restoration works can be grouped into the categories that follow:

- Promotion of habitat resilience. Silvicultural works that reduce competition for resources, increase vigor and reduce vulnerability to forest fires. Works benefitted 2.639 ha of:

  - Alepo pine and scrub: 359 ha
  - Sclerophyll scrub and grassy formations: 1.077 ha
  - Quercus forests: 219 ha
  - Black pine forests: 812 ha
  - Endemic *Juniperus thurifera* forests: 172 ha

- Eradication of exotic plant communities in coastal dunes. 921,48 ha from which all invasive alien plants (61 species in total, of which 15,2 ha occupied by *Carpobrotus* ssp and 308t of *Agave americana*) will be removed.

- Restoration of native riparian vegetation in riverbanks invaded by *Arundo donax*. 68,4 ha of giant cane beds (36 km of riverbanks) at 6.4M€. A tarping protocol allows permanent eradication without herbicide use. After tarp removal plantations with ca. 15 riparian species speed recovery of native vegetation.

- Restoration of *Juniper* forests (Habitat Code 9560) affected by forest fires. 30.333 *J. thurifera* saplings have been planted in 341 ha of continental highlands. Survival and growth rate of *J. thurifera* saplings was high: 8% of mortality after 4 years in 2–4-year-old plants. 46% of mortality in 5-year-old plants.

- Recovery of a Mediterranean temporary pond. A temporary pond (Habitat Code 3170) restored to its original shallow profile. The intervention made it possible to recover flooding and desiccation cycles and its ephemeral biological communities.

Keywords: habitat restoration, Natura 2000, exotic species, climate change

Using a multidisciplinary approach for phytoremediation of abandoned mine site: the case study of Sardinia

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Past mine activities in Mediterranean area have left important scars on environment and have had hazardous consequences for human health. In this frame, phytoremediation is a viable and sustainable technology for reducing the dispersion of metal(loid)s and recovering these environments. As for the complexity of remediation activity, a multi-disciplinary approach involving botany, mineralogy, (geo)chemistry, microbiology and environmental engineering is desirable.

Among the various Mediterranean mine areas, Sardinia was one of the most productive mining regions in Europe throughout the 20th century. However, after mine closure, large quantities of waste materials were left abandoned with very few remediation actions. Over the last 15 years, several studies concerning the applicability in phytoremediation of different native *taxa* were carried out, like on *Helichrysum microphyllum* subsp. *tyrrhenicum*, *Juncus acutus*, *Pistacia lentiscus, Pinus halepensis, Scrophularia canina.* This approach was applied, for instance, on *P. lentiscus* and *H. microphyllum* subsp. *tyrrhenicum,* through: sampling field campaigns, *in situ* and *ex situ* experiments (including bioaugmentation-assisted one), mineralogical investigation and germination tests under metal(loid)s stress [1, 2]. We demonstrated that these *taxa* are suitable for phytostabilization, limiting the accumulation of metal(loid)s into roots and employing an exclusion mechanism mediated by biominerals formation into plant tissues. Moreover, survival of *P. lentiscus* in polluted substrates can be improved through bioaugmentation and by the implementation of soil amendments. Finally, seed germination tests on *H. microphyllum* subsp. *tyrrhenicum* showed the high germination capability even under high concentration of Zn, Pb and As.

In conclusion, the application of a multidisciplinary approach can help to plan and optimize phytoremediation. This same approach can also be applied in other Mediterranean mining contexts, and with different plant species (i.e: *Iberis integerrima*, *Linum mulleri* for Sardinian mining context).

Keywords: metal tolerance, metallophytes, mine waste, mine environments, phytostabilization

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RESALAR project: Coastal ecosystems restoration in the Southeast of Spain

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RESALAR is a habitat restoration initiative that aims to recover 16 hectares of coastline in the Southeast of Spain in the call for aid to support large transformative projects of scientific-technical nature for the promotion of the bioeconomy and the contribution to the ecological transition.
Within action A3 “Restoration and stewardship of sandbanks” actions will be carried out to control and eliminate invasive alien plant species (IAS), mainly acacia trees, in two of the few sandbanks of La Manga del Mar Menor (Murcia) that are still free of buildings. To do this, the acacia trees will be mechanically removed. Subsequently, the soil will be covered with high-density plastic blankets in order to eradicate both the rhizomes and the seeds. After the removal of the plastic blankets, seedlings will be eliminated by hand with the support of volunteers and the planting of native plants will take place. Periodic transects will be carried out to evaluate the effectiveness of the action that will red alert of invasive alien species. The action is carried out in five hectares located in the Maritime Terrestrial Public Domain plus one hectare of the Cartagena City Council. The main aim of this activity was to improve the conservation status of *Asparagus macrorrhizus*, an endemic plant living in the sandbanks in the surroundings of Mar Menor which has lost more than 50% of its potential habitat in the last 50 years. In addition, the marine wild carrot *Echinophora spinosa*, a threatened plant species classified as Vulnerable in the Region of Murcia will benefit from this habitat improvement.
At present, a large part of these actions have already been carried out with volunteers from schools and local communities. Control of early detection of IAS has been carried out above all, carrying out transects on different days at different times and removing the regrowth of seedlings by hand. With the volunteers, the reintroduction of autochthonous dune species, previously produced in the nursery, has also been carried out. To date, 1,891 native plants have been planted. Moreover, the necessary aftercare will be carried out, including irrigation. Once the dune system is stabilized by the planted vegetation, they will serve as a barrier against storms, which are becoming stronger and more frequent in this area, and will also retain the rise in sea level due to climate change.
On the other hand, through action A1 “Recovery of the salt activity in the eastern sector of the Marchamalo saltpans” an abandoned coastal wetland will be recovered, by removing mud from salt ponds, currently clogged, and putting the salt circuit into operation. This will make it possible to recover the characteristic natural ecosystem associated with the maritime saltpans. This includes the recovery of two hectares adjacent to the saltpans with the presence of exotic plant species that will be removed, favouring the development of habitats of community interest like 1420 -Mediterranean and thermo-Atlantic halophilic scrubs (*Sarcocornietea fruticosi*), and 1430 Halo-nitrophilous shrubs *(Pegano-Salsoletea*).

Keywords: saltpans, exotic flora, endemic plant, voluntary work

Acknowledgements: The Regeneration of saltpans and sandbanks project in the Mar Menor (RESALAR) has the support of the Biodiversity Foundation in the call for aid to support large transformative projects of a scientific-technical nature for the promotion of the bioeconomy and the contribution to the ecological transition 2021 within the framework of the Recovery, Transformation and Resilience Plan (PRTR), financed by the European Union - NextGenerationEU.

Drone-based assessment of hydrological microsite-scale processes conditioning post-mining restoration success

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Post-mining restoration activities in dry climates may depend on features related to topographic characteristics, hydrological processes, and vegetation development, which mainly determine functional recovery in these ecosystems. The combination of different restoration techniques to re-establish vegetation, such as planting holes and seeding, implies the interspersion of bare-soil areas with vegetated areas in early plant development stages, which may result in an associated mosaic of hydrologic functioning. Within the LIFE TECMINE Project monitoring plan, we conducted a drone-based assessment to disentangle the role played by microsite-scale hydrological processes promoted by restoration actions (i.e., planting hole slope, sink volume capacity, individual catchment area, Flow Length Index) in enhancing soil protection and vegetation development on the hillside scale. Based on two contrasting restoration scenarios (Steep hillside and Smooth hillside), the obtained results found that topographic hillside slope conditioned micro-topographic processes on the planting hole scale and, therefore, determined vegetation development in plant cover and height terms. However, the differences found in the relative influence of each ground parameter measured on the microsite scale on plant development highlight the importance of implementing suitable restoration techniques specific for each restoration scenario to maximize restoration efforts in early stages. By addressing the role of hydrological processes on the microsite scale, our study contributes substantially to prior knowledge, which identified the importance of other relevant factors for ecosystem development and post-mining restoration success and demonstrated that high-resolution drone images can be a very useful tool for assessing restoration actions on a large scale.

Keywords: ecological restoration, high-resolution images, LIFE TECMINE Project, planting hole, source-sink dynamics.

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Seed banking for landscape mitigation and biodiversity recovery in landfill sites

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Habitat restoration and plant diversity recovery require the availability of appropriate genetic resources to be used for plant translocations. Wild seed banks represent a well-recognized strategy to conserve genetic diversity, which can supply exemplary collections of native seeds resilient at local geographic scale and significantly fulfil the need of certified plant material.

Landfill sites strongly interact with biodiversity at local level, having direct or potential impacts on flora and fauna and their habitats. Thus, landfill sites offer many opportunities, during and after exploitation, for the restoration of natural habitats especially in rural and peri-urban areas. Old landfills, earlier than the land protection laws, can lie close to high value natural areas, and affect local biodiversity through habitat degradation and bio-connectivity loss. This is the case of the municipal solid waste landfill of Palermo (NW Sicily), still operational but next to a SAC area.

In order to mitigate the significant impacts on the N2000 site and its specific conservation targets, a nature-based intervention was planned and started in 2023 in a 20 hectare area just around the landfill, aimed at: improving the local flora with typical species of garrigue and maquis, and endemics of steppe grasslands and limestone rocks; favouring woody cover by applied nucleation with holm oak vegetation patches; enhancing soil bio-permeability and ecological connectivity pivotal to local fauna.

The project operationally involves 3 types of intervention in 3 different landscape units, flora and fauna being yearly monitored at any operational stage:

1. Evergreen shrub nuclei: nucleation patches with *Quercus ilex* formations.
2. Dry-Stone Wall Terraces: old remains recovered and intended to host tree-spurge formations with rocky endemics among wall crevices.
3. Biodiversity sanctuaries: patches with endemic herbs and orchids in a widespread rocky area to preserve and improve steppe grassland habitat (6220*).

The seed bank activities at the Sicilian Plant Germplasm Repository of Palermo University (SPGR/PA) are the baseline operating procedures for these ecological mitigation measures.
Starting from wild seed harvesting at local scale and selecting high-quality seed samples for both propagation and direct sowing, the seed bank provides the required plant material (seeds and plantlets) and ensures the genetic diversity of founding material mix.

Finally, after capping, the landfill dome will be vegetated with dry grasslands species and the germplasm currently collected and stored in the SPGR/PA seed bank will again represent the reference plant material for the intervention.

Keywords: biobanks, ex-situ conservation, habitat restoration, plant diversity, rubbish tip

The importance of permanent plots within conservation areas to monitor biodiversity changes: the Bioclima network initiative

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Climate and global change effects on biodiversity are multifaceted, complicating the definition of the most appropriate conservation measures. Short- and medium-term data are often considered to define conservation areas, but such data might be insufficient because of irregular observations over time and space giving contradictory results. For this reason, monitoring biodiversity through networks of permanent plots is a priority, despite the difficulties to secure long-term financing schemes to support these initiatives. In this contribution we will first analyze the importance of surveying permanent plots of vegetation to assess the complex effect of climate and global change on biodiversity across different trophic levels. We discuss the importance of initiatives focused on observing changes in biodiversity across different type of organisms and through their phenological stages. Then we will introduce the Bioclima network initiative, which established >60 permanent plots across different type of habitats typical in the Valencian region across >10 natural parks, and include data of plants and microbial diversity. Finally. we will discuss an ongoing study focusing on the distribution of plant and microbial diversity across habitats and parks, in order to discuss possible approaches in the definition of protected areas. Specifically, although interactions between plants and soil microbiota are key drivers of biodiversity and ecosystem function, it remains unclear how much plant compositional changes can be associated with compositional changes of the microbiota. Through the Bioclima network, we associated diversity indices (alpha and beta) from the soil microbiome (estimated via DNA analysis) with plant data, over 59 permanent plots established in natural parks of the Valencian Community. The results indicate some co-variation of the alpha diversity of plant species, bacteria and fungi and between fungi and plants, but, overall, a general independence between these diversity components. On the other hand, a change in vegetation (beta) clearly implied a change in microbial composition, especially in bacterial functional groups, while fungi and bacteria seem to be more associated with each other. Despite these covariations, a certain independence has been noted in the response of the diversity and composition of plants and microbiota to environmental variables (geographical and edaphic), especially in fungi. The results suggest that, although a change in vegetation implies a change in microbial composition, the protection of microbial biodiversity cannot be maximized by preserving only a diversity of habitats and vegetation types: other environmental factors modulate the distribution of the microbiota. That is, not everything is everywhere, requiring a diversity of habitats along spatial and environmental gradients to maximize the regional microbiological pool. The analyzes of functional and phylogenetic diversity, under evaluation, will help to further clarify the patterns detected and the conclusion reached by the project.

Keywords: Permanent vegetation plots, temporal series, conservation, biodiversity, multi-trophic, soil microbial diversity

Zero-emission water-distribution networks to assist the ecological recovery of Mediterranean forest ecosystems impacted by extreme weather events

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In Europe, coastal ecosystems are increasingly exposed to degradation/deterioration processes. As a result, many habitats and species have 'unfavourable', 'vulnerable' or 'near threatened' conservation status. Even best-case scenarios revealed relentless worsening conditions for biodiversity and ecosystem maintenance/functioning under the pressure of direct and indirect drivers, including climate change. Concrete actions to restore declined habitat types can no longer be postponed. The time for a more comprehensive integration of existing methodologies and solutions in the restoration, conservation and management practices is now ripe.

LIFE PRIMED, an EU project founded by the programme "LIFE", applied both traditional and innovative measures to deliver water resilience to declined forest ecosystems in the Natura 2000 sites of Bosco di Palo Laziale (Italy) and Nestos Delta (Greece), notably 'Pannonian-Balkanic turkey oak-sessile oak forests' (habitat 91M0), 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior'* (habitat 91E0), and 'Mediterranean temporary ponds' (3170). These habitat types have been increasingly exposed to climate change, landscape degradation and inappropriate forest and water management.

An interdisciplinary team of botanists, zoologists, foresters and environmental engineers designed a hydraulic system to rebalance the water supply on target habitats, mitigating the effects of irregular rainfall regimes over the year. The distribution network is based on a drainage trench that intercepts rainwater and is then stored in an underground tank. In case of excessive water scarcity in the topsoil, a solar power pumping system frees this supplementary amount of water that flows by gravity through the distribution network, ensuring no use of carbon-based energy.

Numerous cases of forest dieback induced by water-related phenomena have been reported across the Mediterranean area over the last three decades. Increasing aridity and extreme weather events are among the most impacting drivers of these processes that should be addressed holistically. The Nature-based Solutions applied by PRIMED delivered a transnational, interdisciplinary, ecosystem-based holistic reference to promote replication in other dysfunctional/deprived or poorly managed and semi-natural areas.

Keywords: restoration ecology, nature-based solutions, Natura 2000, LIFE programme, Habitats Directive, declined Mediterranean forests

A dry grassland restoration project on the Euganean Hills: an in situ and ex situ integrated approach to Natura 2000 habitat type 6210 conservation

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The orchid-rich semi-natural dry grasslands represent biodiversity hotspots of high conservation value, due to the large set of endangered species they host. In the Euganean Hills, a Mediterranean oasis on the Po Plain, they cover 13% of the almost 20,000 hectares. They are a historical component of the cultural landscape, locally called "vegri". As in most parts of Europe, different drivers, mainly agricultural practices, threaten their conservation. Soil and exposure are very suitable for planting new vineyards, so they are prone to conversion, even if they are protected by EU legislation.

A new pilot project of conservation of habitat 6210 on Mount Cecilia, based on the combination of ecosystem restoration and reinforcement of selected orchid populations started in 2022, in an area of 8 hectares, with patches in different conservation status. The floristic GIS cartography gave a very detailed distribution of the individuals of the species of high conservation interest, linked with their reproductive success assessment. The phytosociological surveys along with the vegetation mapping allowed to classify the patches according to their conservation status and to define times and methods to be adopted, even in the light of the phenology of the priority species (flowering period of orchids, breeding period of European nightjar).

During winter 2022 the Regional Agency carried out mechanical clearing and cutting in three stands, aimed at the restoration of *Spartium junceum*-encroaches grasslands, the elimination of the invasive black locust and the elimination of a *Fraxinus ornus* thicket. Seeds of the structural species *Bromus erectus* and *Chrysopogon gryllus* (collected by brush harvest), and the target group of the orchids (by hand collection of capsules) have been collected from the open grasslands as donor sites, for the restoration of the grasslands in the patches where the cuttings lead to bare soil.

In the Botanical Garden of Padua, germination tests on the 2 grasses have been used to assess seed quality and to predict seed and seedling performance in the field. Orchid seeds collected in spring 2023 will be propagated in vitro and used for the reinforcement of Euganean populations, dramatically endangered by the wild boars. These ungulates plough the ground, uproot and eat greedily the hypogeous organs of hundreds of individuals. In order to increase the awareness of the multiple values of this habitat type local authorities, public and private stakeholders and local communities have been and will be involved through public workshops and seminars.

Application of different strategies for the eradication of *Cardiospermum grandiflorum* from a Natura 2000 disturbed valley site in Malta

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Cardiospermum grandiflorum is a widespread invasive species, which has drastic, negative impacts on plant communities and the overall ecology of valley habitats where it tends to invade. By forming dense covers, it smothers underlying vegetation, reducing the light intensity reaching ground level. Ecological restoration therefore calls for the prior eradication of this invasive species.

The invasive ability of *C. grandiflorum* is related to its vegetative spread, as well as its long-distance seed dispersal from inflated balloon-shaped capsules. Five different intervention strategies were adopted for the eradication of this invasive alien plant (IAP) from test plots located on the valley bed of Wied Babu l/o Zurrieq, Malta. These included (i) removal of seed capsules when dry, (ii) removal of seed capsules when wet, (iii) uprooting of seedlings, (iv) severing of the main stem only and (v) severing of the main stem and uprooting of rooted section of the main stem and root apparatus. These strategies were compared to an all treatments combined strategy, as well as untreated controls.

Two intervention strategies, namely (iv) severing of the main stem only and (v) severing of the main stem and uprooting of rooted section of the main stem and root apparatus reduced the canopy of IAP by 10% and 48% respectively after 4 weeks from intervention. Removal of the smothering effect of the IAP resulted in more light penetration and the recovery of underlying indigenous vegetation. Dehiscence studies indicated that only 6% of seed capsules dehisced on collection when wet from dew or rain, compared to 48% of capsules which dehisced when collected dry. Biomass removal requires significant effort, especially in severely invaded locations, and is not often attainable. In this study, the main biomass was left to wither without further disturbance after ensuring that seed capsules and the severed root apparatus had been collected. The timely removal of seed capsules when wet and uprooting of seedlings, combined with severing of the main stem and removal of the root apparatus, was found effective to reduce spread and further IAP recruitment.

Keywords: invasive alien species, Natura 2000 sites, eradication strategies, dehiscence studies, light intensity studies

Are urban rivers areas of interest for the conservation of riparian flora? The case of the Manzanares River in the city of Madrid

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While river courses located outside the metropolitan contexts suffer prolonged dry cycles due to the effects of climate change, urban rivers such as the Manzanares River maintain stable flows even in dry periods. Indeed, the permanent contributions of the sewage treatment plants of the cities constitute the base flow of many courses located in Mediterranean metropolitan areas. This circumstance favors the maintenance of high number of taxa that benefit from the hydrological stability of urban fluvial areas. Considering the specific case of the Manzanares River as it flows through the city of Madrid, in addition, the restoration project developed from 2016 onwards has favored its rapid regeneration. This is largely due to the opening of the locks of the eight dams that fragmented the course.

Currently, the flora of this riverbank is made up of 588 taxa that occupy an area of less than 60 ha along 13.58 km of riverbed. Of all of them, 185 species could be considered of special interest due to their threat category, sparse distribution on a local and regional scale, or because they were cited for the first time in the region in this urban river section between 2022 and 2023. The recovery of this sector of the river has also generated an important environmental corridor that connects the middle and upper areas of the region with the lower levels.

The research work that started in 2021, has made it possible to appreciate how some characteristic elements of high and medium altitudes have begun to colonize the urban river section. Some have even crossed the threshold of the city, downstream. This communication shows the current location of high number of these elements by UTM grids of 1 km^2, with references to their level of abundance. Besides, the eco-landscape context of the recovered river is analyzed and management measures for the urban fluvial space are proposed. These works have appreciable intrinsic value. In addition, they will make it possible to monitor the dynamics of the fluvial flora downstream of the metropolitan territory in the future.

Keywords: urban flora, urban biodiversity, river restoration, urban rivers

Acknowledgements: To the river maintenance workers. For their interest and support in the conservation of the flora of special interest in Manzanares River.

Ecological and spatial characterisation of “Mediterranean temporary ponds” (habitat 3170*) in the Lazio Region to support ecological restoration, conservation, and management practices

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Wetlands are considered the most diverse and fragile ecosystems on the planet. In Europe, Mediterranean temporary ponds are one the most degraded and threatened habitats, with an ‘unfavourable’ conservation status according to Art. 17 of the EU Habitats Directive (92/43/EEC). In addition to direct and indirect human threats, habitat misinterpretation due to scarce knowledge represents another conservation issue. This work aimed at improving the spatial and ecological understanding of the habitat in the Lazio region by: i) verify the comprehensiveness of the current network of Natura 2000 for the habitat; ii) identifying the environmental factors influencing the distribution of its keystone species; and iii) predicting the potential distribution of habitat communities within the whole region.

Floristic data from the ‘Atlas of the Vascular Flora of Lazio’ were first retrieved to get information on the spatial distribution of habitat keystone species. The occurrence data of the species were divided into cells, and a thematic map was made in GIS to display the abundance of the species. The boundaries of Natura 2000 sites were overlapped on the map to check their spatial coherence with the keystone species distribution. Climatic and soil-related environmental variables were finally modelled with the occurrence data to justify the frequency of species. The potential species distribution was also attempted by introducing an environmental suitability model over the whole study area.
Occurrence data analysis for habitat 3170’s keystone species delineates a network of Natura 2000 sites not entirely consistent with the actual habitat distribution, revealing many species not included in the Natura 2000 network. Seasonality and temperature of the warmest period, precipitation of the wettest period, coastal plain soils, artificial soils, and pH appear to be among the most significant environmental variables influencing the plant communities in the study area. The potential distribution map indicates that the habitat would be more suitable in coastal-flooded lands or innermost urbanised areas of the region.
Due to the peculiar complexity of the vegetation structure and transitoriness of the plant communities, the interpretation of this habitat is often tricky. This has implied reporting challenges and minor effectiveness of conservation measures in some EU countries. The regional-level approach of this study resulted in promising outcomes that would deserve more in-depth analysis for the benefit of competent authorities and practitioners.

Keywords: Mediterranean temporary ponds, habitat distribution model, Habitat’s directive, habitat misinterpretation, Natura 2000.

Effects of extreme abiotic stresses on coast wetland grasses from the natural park of L'Albufera (Valencia)

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Mediterranean ecosystems are threatened by habitat degradation, pollution and invasive species; and thus, the risk of deterioration is magnified especially by the effects of climate change and anthropogenic activity2. Among the effects of climate change, drought and soil salinization are the abiotic stresses that have the greatest impact on plants. Mediterranean wetlands are both key biodiversity hotspots and fragile environments. On the one hand, these areas support high numbers of endemic species and procure shelter to transient species. On the other hand, these ecosystems represent a wealth by providing important ecosystem services1. Therefore, due to the changing environmental conditions, new or emergent extreme abiotic stresses can produce drastic effects, such as the risk of salinization, by the intrusion of saline water into the wetland as a consequence of a sudden rise in sea level3. Thus, the most sensitive species to salt may become extinct and new, more tolerant species may invade these habitats, destabilizing the ecosystem balance.

The natural park of L'Albufera (Valencia) is an important representative coastal wetland ecosystem. Several Poaceae species play key ecological roles in different niches across the park, e.g., dune fixation, water purification, carbon fixation, providing feeding and habitat for other species, etc. We have investigated the potential effects of drastic abiotic stresses (salt and water stresses) on three of these representative species: Imperata cylindrica and Phragmites australis, which are a known halotolerant species which became invasive plants in Atlantic North America coast wetlands; and Saccharum ravennae, a species with economic relevance and which is tolerant to diverse environmental stresses.

The research of the mechanisms used by wetland plants to cope with abiotic stresses and the plant-microorganism-abiotic stress interaction will provide valuable information on the resilience of these ecosystems against the effects of climate change as well as for biodiversity conservation management.

Keywords: Mediterranean ecosystems, climate change, abiotic stress, Poaceae.

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Environmental restoration and enhancement using plants suitable for the remediation of polluted mine sites

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Mining activities represent an important source of disturbance and environmental contamination which often leaves a landscape with extreme conditions for the development of natural vegetation including soil impoverishment due to a high concentration of metal(loid)s and scarce organic matter. In such damaged systems, investigating how to restore the natural dynamics of vegetation is useful for recreating long-term and self-sustaining ecosystems.
Sardinia is one of the few regions in Italy with historical mining activity documented since the Bronze Age period where different metalliferous and industrial minerals were extracted from the deposits. With the cessation of mining activities, abandoned mines and related waste materials persist in these areas, from which various metal(loid)s are dispersed into the environment, affecting the terrestrial and aquatic ecosystems of the surrounding areas, and being also a hazardous risk for human health. In particular, the area that falls within the Sulcitano-Iglesiente biogeographic sector has a heavy environmental legacy in terms of altered landscapes that require the identification of effective reclamation interventions and sustainable technologies for their recovery.
Considering the extent of the area and the presence of several vascular plant species of high conservation and phytogeographic interest, the use of native plants for reclamation was identified as the most suitable solution. Different plant taxa have been found suitable for phytoremediation, such as *Cistus salviifolius*, *Helichrysum microphyllum* subsp. *tyrrhenicum*, *Pistacia lentiscus*, *Pinus halepensis*, *Scrophularia canina*, but several more need to be investigated.
The actions of NRRP e.INS. (WP2) find among the strategic objectives the promotion of human health through environmental restoration, indicating the need to recover and make usable large portions of the territory currently burdened by pollution from mining activities. The study of the floristic composition of the mining plant communities in terms of species richness, number of endemisms and habitats that characterize these territories will make it possible to plan the restoration of abandoned mines by selecting taxa useful for phytostabilisation.

Keywdors: Ecological restoration, *Ex situ* conservation, NRRP, Phytostabilization

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From an irrigated crop to a riparian forest: water footprint reduction and habitats restoration

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Currently, it is estimated that riparian forests occupy only about 6 % of the banks of the Segura River (SE Spain) [1]. Expansion of agricultal lands, alien species and the modification of riverbanks by channeling works account most of the lost by native riparian forests. Within the framework of the FLUVIATILIS project, we propose the conversion of a plum tree orchard on La Huertecica farm (3.4 ha) into a riparian forest (habitat 92A0, about 1,000 ha in the Region [2]), a habitat of community interest with small remaining in the Region of Murcia and those that exist usually present with a clear structure very far from that of the optimal forest. For this objetive, we will plant 3,566 seedlings (407 Populus alba, 226 Populus nigra, 179 Tamarix gallica, 46 Salix atrocinerea, 221 Fraxinus angustifolia, 483 Ulmus minor, 221 Celtis australis, 450 Nerium oleander, 484 Rhamnus alaternus, 450 Sambucus nigra, 135 Coriaria myrtifolia, 132 Rosa canina and 132 Pistacia terebinthus). This will make possible to connect remaining patches of riparian forest. The farm is located between the Segura and the Moratalla rivers and it is part of the Cañaverosa Nature Reserve (Natura 2000 Network). The intervention includes the leasing of private property using land stewardship formula to allow the change of use. In addition, the project will contribute to recover various ecosystem services by reducing the demand for water for irrigation (34.000 m^3 yr^{-1}) and creating a carbon sink (3,574 t of C in 40 years [3]).

Keywords: riparian, ecological restoration, habitats of community interest, land stewardship

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Land stewardship as a tool for forest management and plant conservation in Mediterranean environments. The case of Finca Buixcarró in the Valencian Community (Spain)

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There is currently a strong scientific and technical interest in the study of vegetation, as well as in its protection and enhancement. Thus, private participation in the conservation of land and natural areas is conceived as a complementary tool to public protection. So, the main objective of this work is to describe the current situation of a private estate under land stewardship management, focused in habitat management, species conservation, training and research activities, as well as environmental education and awareness , in order to carry out a proper integrated management of the territory.

The Reserve of Buixcarró is a natural area of 658 hectares located in the Valencian Community (Spain), in the south-eastern sector of the Serra de Mariola National Park (UTM 702000N-4288000E). In 2003, a non-profit foundation (Fundación Victoria Laporta Carbonell) was created to recover environmentally the state, after the succession of several fires and many years without management. Since then, FVLC has been working to improve the ecosystems and preserve habitats and species. Land stewardship has made it possible to manage a degraded natural space with management problems and with the aim of self-sufficiency. The research tasks include: 10 research projects, 8 agreements with Institutions, Universities and Educational Centres, 9 scientific articles have been published, 489 plant species have been cited in the plant inventory with a total of 37 species catalogued with some degree of protection (habitat directive, national or regional catalogues), 18 odonates, 56 birds, 13 mammals, 6 amphibians, 120 nest boxes for forest passerines (occupied by 7 species) and up to 6 nest boxes for nocturnal birds of prey, as well as 15 nest boxes for forest bats. Regarding environmental education/awareness: 10 beekeeping workshops (120 participants), nature photography workshops (350 participants), 8 mycology workshops (120 participants), 15 interpretation activities within the framework of the Fauna and Climate Change project (nest box placement, scientific bird ringing, study of micro-mammals, coleopteran "bioblitz", interpretation of nocturnal nature and light traps for butterflies and moths (500 participants) and environmental education itineraries (4. 800 schoolchildren), field practices (300 university students), training in specific forestry modules (400 students)). Finally, sub-products obtained: 80 kgs of organic honey per year, in the future we expect a good production of organic pistachios and two informative publications.

Keywords: biodiversity, environmental management, land stewardship, non-profit foundation, Serra de Mariola,

LIFE TECMINE: Innovative techniques for mine restoration in Mediterranean environments

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The LIFE TECMINE project aims to improve the restoration of open pit mines in Mediterranean forestry environments by combining different innovative restoration techniques. These techniques were applied to a siliceous sands, kaolin and clay quarry in 13 hectares at the Fortuna mine located in Ademuz (Valencia, Spain). These restoration techniques have been:

1. Land restitution (Geomorphological recovery) which is the process of designing and building landforms that mimic the morphology and dynamics of natural landscapes in this area. The geomorphic restoration method applied was GeoFluv Method implemented by the Natural Regrade™ software and will provide long-term stability.
2. Soil reconstruction was tackle through soil input and stabilization using colluvion-type substrate and mixtures of mine waste and organic matter from activities such as forestry and water waste treatment.
3. Establishment of an appropriate vegetation cover through techniques that optimise the use of rainwater, such as the use of micro-catchments combined with reforestation and seeding of herbaceous species to stabilize the soil surface. We have planted about 9,000 seedlings, including 31 different species of trees and shrubs representing up to eight different habitats from the Nature 2000 network, three of which are priority habitats.

After four years from implementation, the following main results have been achieved:

- The new landscape morphology is stable and functional in the medium term.
- Erosion capacity has been reduced and the infiltration has been increased compared to the conventional restorations, i.e. berm and talus model.
- Organic amendments applied to sterile substrates have positive effects on soil fertility. We also found an average survival rates of 75% and plant growth up to 3 times higher than the original size of the seedlings after two and a half years.The local origin of the seeds and acclimatisation of the seedlings to the abiotic conditions of the area ensure proper adaptation and development of the newly planted vegetation.

The TECMINE project has shown that it is possible to implement more efficient and sustainable restoration models, thus contributing to more responsible mining. The results obtained in this project has enabled other mining companies from Sweden, Colombia and Cuenca (Spain) to replicate the model in their restorations. Currently, Generalitat Valenciana is working on other mine restoration projects applying the TECMINE techniques in 15 mines located in Valencia region.

Keywords: Mine restoration, GeoFluv™, ecological restoration, quarry reclamation

Long-term assessment of ecological restoration activities in desertification prone Mediterranean areas: a study case from Sicily

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One of the most worrying consequences of climate change and deep human impact in semi-arid Mediterranean areas is the increasing desertification risk and the related processes of soil degradation and loss of plant cover and biodiversity. Under such conditions, active restoration tools are generally needed to reverse these otherwise irreversible changes. In similar contexts, interventions were carried out within the “Macalife” Project (LIFE 04/NAT/IT/000182) in the Special Area of Conservation “Macalube di Aragona”, in southern Sicily (Italy). Here, intensive agricultural practices, unregulated grazing and frequent wildfires have seriously threatened several local plant communities. Furthermore, plant establishment is locally hampered by a long-lasting drought period, clayey and salt-rich soils, and periodic soil movements resulting from sedimentary volcanism. Interventions were addressed to restore the most important plant communities corresponding to several habitats of community interest according to 92/43 EU Directive, like the Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea* (6220), and the halo-nitrophilous scrub *Pegano-Salsoletea* (1430) and to improve the conservation status of some endemic and endangered plant species like *Tripolium sorrentinoi*. All the target species used for reinforcement actions carried out during the project were propagated through local nurseries, using seeds exclusively collected from individuals occurring on site, and some woody plants were also inoculated with symbiotic microrganisms (plant growth-promoting bacteria and mycorrhizal fungi). We assessed the effectiveness of interventions more than 10 years after the last monitoring activities. Particularly, we evaluated the increase of plant cover and/or the number of individuals and the mean height of the target species (*Lygeum spartum*, *Tripolium sorrentinoi*, *Atriplex halimus*, *Salsola oppositifolia*, *Salsola vermiculata*, *Suaeda vera*, etc.) characterizing some of the habitats occurring in the nature reserve. The very promising results from monitoring activities suggest that the use of local plant germplasm and proper propagation techniques may allow restoring native Mediterranean habitats under desertification threat.

Keywords: biodiversity, Habitat Directive, land degradation, Macalube, microorganisms

NewLife4Drylands – Remote sensing oriented Nature-Based Solutions towards a new life for drylands: Restoration Plan for Asterousia Mountains' area

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Land degradation and desertification are two constantly intensifying phenomena, which affect large land areas of Southern, Central and Eastern Europe with huge environmental, social and economic impacts. One of the main drivers of desertification is climate change, affecting particularly the Mediterranean regions. Drought intensity and frequency are expected to increase with global warming in southwestern parts of Europe, whereas an opposite trend is projected for north-eastern Europe. Methods to combat desertification are usually adapted to the climatic, geological, social and economic conditions of each region and are based on natural processes and the experience of past generations, which are abbreviated as Nature Based Solutions - NBS.

"NewLife4Drylands" is a LIFE Preparatory Project co-funded by the European Union under the LIFE programme. It started in January 2021 and it will end in June 2024. The project aims to study the evolution of land degradation and desertification through satellite monitoring of specific indicators, and analyze various natural and man-made parameters that affect and change the natural landscape of the region. It is also foreseen to produce a Restoration Plan for the pilot area of Asterousia, Crete, Greece, with the most suitable Nature Based Solutions (NBS) for the area that will not be binding, but will serve as an advisory and scientific tool for local authorities and government agencies to deal more effectively with desertification in the region and enhance the resilience of ecosystems, the environment and local communities.

Six European areas (in Greece, Spain and Italy) affected by land degradation and desertification, which either have NBS and restoration activities ongoing or are aiming for producing a Restoration Plan (such as the area of Asterousia Mountains in Crete, Greece), have been selected. NewLife4Drylands will select a set of well-known indicators, such as spectral indices used as proxies for monitoring vegetation, water content, drought degree, primary production etc. Moreover SDG's sub indicator 15.3.1 (Proportion of land that is degraded over total land area) will be implemented at local scale.

Based on such indicators, NewLife4Drylands project will define a monitoring model and a protocol able to connect NBS and remote sensing indicators which will provide a guide for the identification of specific measures of restoration of drylands to be used as a support in decision making for adaptive management of restoration actions in drylands, improving ecosystems services provision and related economic issues, including local resources to mobilize and new green jobs.

Keywords: land degradation, desertification, nature-based solutions (NBS), restoration, remote-sensing indicators

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Plant diversity and conservation of temporary ponds in southern Italy and Malta: a priority habitat in decline

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Temporary ponds are classified among the most biologically and biogeographically interesting habitats of the Mediterranean region. They are characterised by a relatively small area of occupancy, as well as extremely variable ecological conditions. Mediterranean temporary ponds are particularly vulnerable to climate and land use change, affecting their hydrology and consequently the survival of the peculiar plant communities there growing. These habitats are characterized by the dominance of therophytes, geophytes and small hemicryptophytes with a short life cycle. In southern Italy (Apulia, Sicily) and Malta, temporary ponds are quite well represented and comprise high floristic value often including endemic or threatened species, such as *Damasonium bourgaei, Elatine gussonei*, *Eryngium pusillum, Isoëtes sicula, I. todaroana, Middendorfia borysthenica*, *Molineriella minuta, Myosotis sicula, Pilularia minuta, Ranunculus lateriflorus, R. fontanus, R. ophioglossifolius, Sisymbrella dentata, Solenopsis laurentia* subsp. *hyblaea, S. mothiana, S. gasparrinii, Teucrium campanulatum, Zannichellia melitensis,* etc. For these reasons, temporary ponds are included in the priority habitat list (Code 3170* – Mediterranean Temporary Ponds) according to the Habitats Directive (Dir. 92/43/EEC). From the phytosociological viewpoint, this hygrophilous vegetation is referred to the *Isoëto-Nanojuncetea* class, gathering the pioneer ephemeral dwarf-cyperaceous vegetation in periodically flooded freshwater habitats of Eurasia. With our contribution we aim at improving the knowledge about the ecological conditions affecting the floristic composition of these plant communities, as well as provide updated information on their conservation status. The main objectives of this research are: (1) to give a complete overview of the distribution of the temporary ponds in southern Italy and Malta (2) to provide an overview of their ecological diversity and floristic composition; (3) to evaluate the effects of ecological features/edaphic features of the growing site on the species richness; (4) and finally to evaluate the conservation status of the temporary ponds on the basis of the occurrence, frequency and abundance of the diagnostic species of the *Isoëto-Nanojuncetea* class vs trivial species.

Keywords: amphibian plants, conservation, *Isoëto-Nanojuncetea*, rare species, vegetation.

Plant diversity in Mediterranean olive groves

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The global biodiversity is being threatened by various anthropogenic factors, such as land use change and climate change. Since the 1970s, resulting of the Green Revolution from the 1960s, the agricultural production has tripled, but its productivity decreased because of the damage caused to the soil by intensification. This also contributes to harm the biodiversity because of the increase in the use of pesticides and mineral fertilizers, as well as the destruction of habitats. Though, the biodiversity can be very helpful to agriculture by providing ecosystem services like pest regulation or soil fertility. A strong biodiversity makes ecosystems more resilient facing stresses. This is why some agricultural practices promoting the biodiversity such as organic agriculture are encouraged. The Mediterranean Basin is the third richest of the 36 biodiversity hotspots in the world. Agriculture is a fundamental activity in the Mediterranean and helped form typical landscapes such as olive terraces. The culture of olive trees is emblematic of the Mediterranean. *Olea europaea* has been cultivated for 6,000 years in the Mediterranean and today worldwide in the regions hosting a Mediterranean climate. The Mediterranean basin is the first producer of olives and olive oil in the world. Olive groves have other advantages than food production; they can be cultivated on sloped and arid areas unsuitable for another crop, they limit erosion when in terraced systems and shelter a rich biodiversity. They host a lot of endemic, rare and/or threatened plant taxa that are becoming threatened because of the rise in the crops' competitivity, the use of herbicides and fertilizers and deep tillage damaging stockage organs. These actions also promote the installation of invasive species such as *Oxalis pes-caprae*. According to the bibliography, 4 main types of olive grove management exist: traditional (terraced area and limited use of inputs), conventional (relying on inputs to increase production and profit), organic and abandoned. These management types, along with the climatic conditions, landscape, and soil type, seem to impact the biodiversity of olive groves. In the technical itinerary of olive production, the control of the ground cover under the trees can be challenging. As keeping the ground cover promotes biodiversity and soil fertility, limits erosion and eases the mechanical engines' passing, it also becomes competitive for water and nitrogen with the olive trees. It can be managed by mowing, tilling, grazing, or using herbicides, or a combination of these techniques. A recent study showed that information is lacking concerning the role of arboriculture as sustainable habitats for the wildlife. This is why this study aims to describe and evaluate the plant diversity existing in the Mediterranean olive groves, to enhance practices that will promote this rich diversity. Bibliographic research has been conducted, resulting in only 42 published papers from the following countries: Greece, Spain, Italy, Portugal, Turkey, Croatia, Albania, and France. All available data from different areas in the Mediterranean, together with authors' data by field samplings in Greece, have been included in a database and analysis concerning taxonomic and functional diversity of plant taxa occurring in olive groves according to the management type will be analysed and discussed.

Keywords: *Olea europaea*, agroecosystems, biodiverity, management practice

Ecological restoration strategy and techniques for recovering vegetation cover after mining activity under Mediterranean conditions

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Extensive research has been conducted on quarry restoration strategies, however, failures are still common. In arid regions such as the Mediterranean Basin, successful vegetation restoration efforts require appropriate species selection and restoration techniques that contribute to soil protection and to restoration of vegetation covert. In this context, we developed the LIFE TECMINE project, which focuses on demonstrating innovative restoration practices for clay mine reclamation under harsh conditions. This communication focuses on the vegetation restoration strategy. Several key steeps were considered to establish new plant covers and soil protection against degradation processes. These steeps involve the analysis and determination of the best suitable Nature 2000 plant communities to be introduced in the area, to apply the best restoration techniques adapted to the Mediterranean climate, to include organic manure to increase soil fertility, and other complementary restoration techniques. Results showed an excellent recovery of the area in terms of plant survival and soil protection, but also in terms of ecosystem functionality such as plant biodiversity and soil fertility when compared to older and classical mining restoration.

Keywords: ecological restoration, ecosystem functioning, quarry reclamation, Geofluv™, LIFE TECMINE project, Mediterranean vegetation, stress-tolerant species.

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Restoring Mediterranean Wetlands. The new policymaker's playbook for sustainable management and ecosystem restoration by 2030

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It is time to face the devastating impact wetland losses and degradation have created. Over 48% of Mediterranean Wetlands have been lost since 1970, creating impacts on the water cycle, which affect our drinking water supply, food security, health, jobs, recreation and tourism. Improved planning and understanding can increase wetland resilience, water quality, and restore vital ecosystems. By committing to partnerships that use integrated restoration strategies and nature-based solutions, policymakers and funders have the opportunity to shape our future.

A handbook was created to guide policy makers in developing and implementing wetland restoration initiatives in order to support and encourage actions across the Mediterranean basin. This handbook was prepared in the framework of the project "Strengthening the restoration of Mediterranean Wetlands for nature and people" and it was coordinated by WWF Spain, MedWet and Tour du Valat in partnership with PIM Initiative and MEDSEA. The project is part of the Wetlands-Based Solutions initiative and shares experiences from experts in the field with different case studies. It shows how to integrate restoration using Nature-based Solutions and how to set clear objectives, identify priorities and implement continuous monitoring and evaluation. The handbook also outlines some dimensions of knowledge transfer and upscaling. Various tools, methodologies and checklists for planners are included in the book to ensure a holistic view of the restoration process. It is available in English, Spanish and soon in French [1,2]. An online training for wetland managers and practitioners was organized by Tour du Valat in 2022 and it is free available online with the aim of upscaling wetland restoration across the Mediterranean [3].

Keywords: wetland, restoration tools, transfer and upscaling, case studies, monitoring

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Roman forest: a project for the ecological restoration of peri-urban and historic areas

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Roman Forest [1] is a 30-hectare renaturation project in the municipality of Cartagena (SE Spain), which includes a 2 km green corridor that will allow the connection between two towns. This corridor is intended to prevent urban expansion and increase the connectivity of green areas of high historical, ecological and social value. At the renaturation project will be used native species of trees and bushes like *Tetraclinis articulata, Pistacia lentiscus, Olea europaea, Arbutus unedo, Rhamnus lycioides, Lavandula dentata*. The remaining natural vegetation (*Rosmarinus officinalis, Thymus hyemalis, Helianthemum sp.pl.* will be preserved. Citizens will enjoy a large area of natural land, which will bring greater well-being and balance to the area, with new paths adapted for walking and enjoying nature. Citizen participation consists of a volunteer and environmental education program, decision-making from co-governance and exchange of exotic species for native plants for private gardens, among others. Among the citizen participation activities that will take place are the conditioning of land, the removal of rubble and waste, the improvement of existing green areas, the replacement of exotic flora with native species, the recovery of roads, the creation of feeding areas and refuge for fauna and the creation of new recreational spaces.

Keywords: Green infrastructure, alien species, citizen participation, habitats restoration, ecosystem services

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The use of native succulent *Chenopodiaceae* (*Amaranthaceae* sensu APG) to treat marine aquaculture wastewater in the Mediterranean area

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The sector of aquaculture contributes almost 60% of the global production of aquatic organisms and this percentage is estimated to increase to more than 70% by 2030 due to the growing demand [1]. The variable and/or uncontrolled release of nutrients into the environment, such as nitrogen and phosphorus, in open systems facilities, could represent a risk for environmental effects such as eutrophication. For these reasons, in accordance with the Water Framework Directive of the European community (2000/60/CE), land-based aquaculture farms are increasing, suggesting more efficient methods for the treatment of nutrient-rich saline wastewater.

The treatments of eutrophic waters include physical, chemical and biological methods: physical and chemical methods could be expensive and produce secondary pollution. On the contrary, traditional biological methods are cheaper and have less impact on the environment, but they require large surfaces.

Ecological Floating Beds (EFBs) are a relatively new technology that is receiving increasing interest in the last decade, presenting the advantage of low installation and maintenance costs and do not require additional soil consumption as they can be installed on existing bodies of water [2]. These consist of artificial floating rafts on which emerging rooted macrophytes are grown.
The roots develop on the substrate of the raft and on the underlying water, providing a large surface area for the development of the microbial biofilm, responsible for most of the purification process.

EFBs have very rarely been used for the treatment of saline (or hypersaline) waters, and there are no case studies in the Mediterranean basin. Halophilic plants combined with EFBs technologies can play an important role in the purification of these waters and investigating this possibility is the aim of this project.

The study area is represented by a small settling basin linked to the sea, receiving wastewater from a land-based marine fish farm (flow-through) located in Petrosino (Trapani province), in the western part of Sicily, bordering the Natura 2000 site “Paludi di Capo Feto e Margi Spanò” (ITA010006).
The proximity to this site, the characteristics of the water and the surrounding environment determined the choice of plant species to be used, and these were propagated starting from material coming from the farm site.

The first step of the study aimed to evaluate, for the first time, the growing capacity of three halophilic Mediterranean plants of the genera *Salicornia*, *Sarcocornia* and *Salsola* in EFBs in highly nutrient-rich sea water-like saline water. To verify this, rooted plants were placed in April 2023 on floating rafts. Morphometric measurements were periodically carried out on these and weight increases were recorded.

Salsola seems to be disadvantaged when grown under these conditions in comparison with individuals growing in open ground. *Sarcocornia* and especially *Salicornia* instead have shown a good growth response and so a second step will evaluate the removal of nutrients due to the accumulation in the plant tissues of these species and the efficiency of the whole system in reducing water eutrophication.
As already described in South America [3], *Sarcocornia* and *Salicornia* therefore seem to be useful, in constructed wetlands or floating beds for treatment of effluents of land based marine fish farms. However, considering their life cycle characterized by a winter rest period, tests with other species are desirable in order to obtain good performances also during the cold period.

Keywords: Constructed wetlands, Ecological Floating Beds, halophytes, *Salicornia*, *Sarcocornia*

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Trend in the last 20 years of the pastoral value in two high altitude herbaceous habitats in the Maiella National Park

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High-mountain habitats are essential for the biodiversity conservation, not just for plants but for all linked species as well, especially in climate change scenarios. A vegetation resurvey was conducted to evaluate the high-altitude vegetation's pastoral value for the Apennine chamois (*Rupicapra pyrenaica ornata*) and its vulnerability over time. The research was conducted in the Maiella National Park (Central Apennine) at an elevation ranging from 2400 to 2793 m a.s.l resurveying 31 permanent plot installed in 2003 and resampled in 2020. Three different vegetation types were considered: apennine stripped grasslands, represented by *Sesleria juncifolia* grasslands (12 plot); wind edge swards, characterized by meso-xerophile and relatively continuous *Carex myosuroides* grasslands (13 plot); vegetation of the micro-dolines *Ranunculo pollinensis-Nardion strictae, Trifolium thalii* community (16 plot).

The comparison revealed a considerable loss of biodiversity for the apennine stripped grasslands and wind edge swards in terms of both the number of species and their cover. This decrease in biodiversity, which has been observed in other mountains as well, is most likely the result of a combination of increasing summer temperatures and decreasing summer rainfall during the previous few decades. Thermophilization appears to occur more slowly in these extremely stressful situations than it happen worldwide.

On the other hand, for the *Trifolium thalii* community we found a decrease in the number of species but an increase in coverage as well as their pastoral value. We have also recorded an expansion of thermophilic herbaceous species well adapted to living on grasslands at lower altitudes such as *Trifolium pratense, Taraxacum apenninum, Trifolium noricum*. Similar greening processes have been observed in other alpine ecosystems and have been interpreted as an effect of climate change and, in particular, as a reduction in winter cold stress.

As a whole, we notice a decline in species richness across all vegetation types, but when soil moisture is a limiting factor, we also notice a decline in vegetation covering. However, we have found an increase in species coverage and a rise in thermofilic plants in the microdoline vegetation, where we have favorable edaphic conditions. This process may be influenced by the rise in soil biological activity brought on by global warming, the atmospheric nitrogen deposition as well as the grazing of wild ungulates that alter the structure and cover of the vegetation through grazing and the supply of nitrates due to excrement.

These studies contribute to our understanding of the ecological processes taking place in natural alpine ecosystems and serve to direct management and conservation strategies for plant and animal biodiversity, whose population dynamics are closely linked to an appropriate coverage of plant species [1].

Keywords: climate change; plant diversity loss; re-visitation study; thermophilization; *Rupicapra pyrenaica ornata*.

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Vegetation reinforcement in a new and anthropised park: the case of Inwadar National Park, Malta

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Inwadar National Park (INP), formally designated as "Il-Park Nazzjonali tal-Inwadar", comprises a coastal tract covering approximately 0.95 km^2 of land along the northeastern coast of Malta. INP is designated as a "Special Area of Conservation of National Importance" and is part of the National Ecological Network. The land cover in INP is predominantly rural, comprising agricultural parcels, many of which are under active cultivation. The land is terraced along the slope leading down to the shoreline. Natural plant communities are fragmented and mainly comprise a coastal scrubland on which a ruderal flora characteristic of habitat disturbance is superimposed. Former agricultural areas are undergoing a secondary ecological succession.

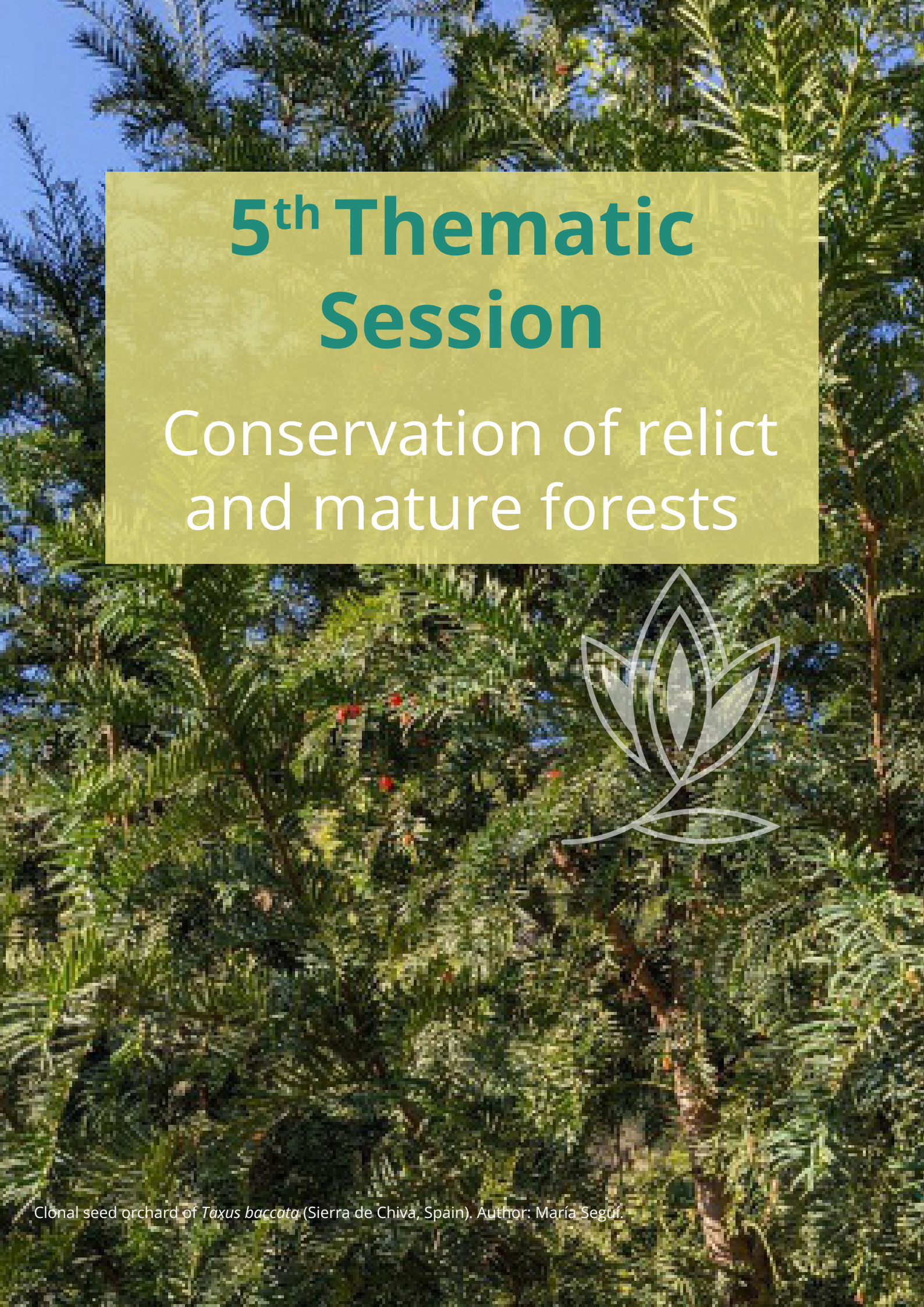
The present study proposed targeted reinforcement of characteristic vegetation as part of a broader restoration strategy for INP. Four indigenous species from the coastal community were used for this purpose: *Limbarda crithmoides*, *Suaeda vera*, *Jacobaea maritima* subsp. *sicula* and *Crithmum maritimum*. Cuttings and seeds from wild plants in INP were collected in late 2021 and cultured in the laboratory for fourteen months. During this time the growth requirements and patterns of plants and seedlings, as well as the germination requirements of their seeds, were investigated. Peak growth of seedlings was recorded at a constant temperature of 25˚C and in diurnal cycles of temperature between 23.5-15˚C. Topsoil samples were also collected from 15 points throughout INP and analysed for electrical conductivity, pH, nitrate, phosphate, and organic matter. The granulometry and water retention capability of the topsoil samples were also characterised. These parameters were correlated against distance from the shoreline and land use patterns. An orthomosaic, Digital Elevation Model, and 3D model of INP were also constructed to aid analysis of these data and interpretation of the results.

The patterns of variation of most soil parameters were not monotonic, and only electrical conductivity and nitrate content showed a trend that was significantly different from random, both decreasing with increasing distance from the shoreline. Soil texture was consistent with a fine sand on the Wentworth scale, with little variation throughout INP. Approximately 60 plants were relocated into selected 'intervention areas' in INP, and their 'state of health', based on a visual assessment and chlorophyll concentration measurement of leaves, was recorded at regular intervals. Mortality of the introduced plants was approximately 80% after nine weeks post-introduction. This was attributed to environmental stress. However, a spike in mortality was recorded after a major storm, followed by a long dry period. Lowest mortality was noted in *Limbarda crithmoides*. It is recommended that the most feasible land use for restoration or reinforcement are the disturbed bands in the coastal zone, as this would recreate the natural ecological zonation of vegetation.

Keywords: conservation areas, vegetation restoration, germination trials, soil analysis

5th Thematic Session

Conservation of relict and mature forests



Clonal seed orchard of *Taxus baccata* (Sierra de Chiva, Spain). Author: María Seguí.

Chair

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He has been working at the Centro para la Investigación y la Experimentación Forestal (CIEF) in Valencia since 2004 on issues related to habitat restoration and flora conservation.

He has been coordinator of forest habitat restoration projects financed with funds from the LIFE program in which a forest management perspective for the naturalization of forest stands and species diversification is emphasized.

Other fields of action are related to germplasm management in seed banks and nursery plant production for ecological restoration projects.

He is also a member of the board of the Spanish Bioengineering Association where he participates in training projects and dissemination of bioengineering techniques for soil conservation and restoration of degraded areas.

Conservation of relict and mature forests: towards an integrative approach that takes genetic diversity into account

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Mature forests, i.e. those that have evolved over the last few centuries without human intervention, are extremely rare in Europe, particularly in the Mediterranean region (<2% of wooded area). Rich in biodiversity, these mature forests are generally scattered in isolated areas where logging is no longer profitable. Their protection and conservation are therefore crucial, and management programs need to be put in place to enable more forests to reach maturity. Promoting the resilience of these ecosystems will require the conservation of all compartments of biodiversity: ecosystem, species and genes. This is particularly important for forests of the Mediterranean Basin, where the heterogeneity of the environment, evolutionary history and, more recently, human impact have all helped to structure biodiversity. At the genetic level, diversity gradients have been observed on a broad geographical scale, combined with regional and sometimes local structuring in response to environmental gradients that can give rise to specific local adaptations. These patterns of genetic diversity are a reminder of the importance of reasoning conservation programs at a local territorial scale. Taking genetic diversity into account is a strategic research priority, given its fundamental role in ecosystem adaptation and resilience. Current studies on mature forests are beginning to integrate genetic indicators with the biodiversity indicators traditionally used. Understanding the ability of mature forests to evolve, compared with anthropized forests, should eventually make it possible to identify priority areas for conservation and to implement action plans that combine the free evolution of forests towards maturity and human action that encourage forest adaptation while allowing timber harvesting.

Keywords: mature forests, conservation, genetic diversity, resilience, adaptation

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LANBIOEVA methodology as a tool for the conservation, management and planning of vegetation landscapes. The example of Quercus petraea forests in the North of the Iberian Peninsula

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Over the last 35 years, the Lurraldeon research group has applied the LANBIOEVA (Landscape Biogeographical Evaluation) methodology to more than 200 plant vegetation types around the world to inventory and evaluate to get correct protection, management and planning. The aim is to offer the land manager a set of valuation criteria. The methodological first step is the inventory of 10 representative plots of each plant grouping, noting the species coverages and the global cover of each taxon in the three-dimensional space of the plot. Species are organised into three main physiognomic groups: trees and shrubs, bushes and climbers and herbaceous species; also taking into account their stratification in 4 vertical ranges. Data on natural, cultural, structural and possible threat criteria are also taken. The second step, the valuation phase, is applied to each one of the inventoried groupings: 1) the Conservation Interest (INCON) is obtained and calibrated according to natural, structural and cultural criteria, providing information on the intrinsic attributes of the flora and vegetation; 2) the Conservation Priority (PRICON) is designed for managers' use, parameter next to INCON in the protected areas definition and ranking, focused on determining the conservation urgency. It is evaluated according to the degree of threat to the vegetation concerned, calibrated about three parameters: demographic pressure, accessibility-traversability and alternative threats. For example, we have applied the method to 47 plots of *Quercus petraea* oak forest located in the northern and central sector of the Iberian Peninsula: in the Basque Country (Garrastatxu, Kolitza, Pikandi) and Navarra (Garralda) and Aragón (Moncayo). These are relict formations, scarce and finicolous in some of the locations. Statistical analysis shows that there are differences between the 5 localities. The INCON values for the 3 locations in the Basque Country range from 180.75 to 201.08 points, the Navarra one obtains 212.20 and the Aragón one180.55 points. The average PRICON values for those of the Basque Country range between 1308.60 and 1951.50 points, Navarra 1883.40 and Aragon 2096.60. Both INCON and PRICON values show high scores, highlighting the need to conserve and manage this forest remnant without delay and appropriately.

Keywords: LANBIOEVA, relict vegetation, Conservation Interest, Conservation Priority, northern Iberian Peninsula.

Role of animal component in Ecological restoration- Best practices in Mount Lebanon

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Longevity of species populations depends largely on interactions among animals and plants in an ecosystem. Predation and seed dispersal are among the most important interactions necessary for species conservation and persistence, and diet analysis is a prerequisite tool to evaluate these interactions. Understanding these processes is crucial for identifying conservation targets and for executing efficient reforestation and ecological restoration.
Deciphering predator-prey relations within an ecosystem, as well as investigating seasonal food web variation throughout the year, provides powerful insights into the ecosystem's structure and dynamics at the population and community levels
Seed dispersal by foraging frugivores (endozoochory) or scatter-hoarding granivores (synzoochory) is one of the most studied plant-animal mutualisms. In fact, many plant species utilize animals to disperse their seeds and to reproduce, and reciprocally, they represent an important food resource to the animal throughout the year. This process is essential for the regeneration of many vegetation types. It also ensures the sustainability and integrity of the ecosystems. Thus, it is essential for managers involved in reforestation and wildlife conservation activities in forests to know which plant species each animal consumes, and for which species it disperses seeds. Regarding animal conservation, managers need to know which plants each animal relies on for its survival throughout the year. Despite the importance of a diverse set of interspecific interactions for forest regeneration, many reforestation projects have been conducted using monoculture plantations including one or only a limited number of species.

In Lebanon, reforestation initiatives have mainly involved monoculture plantations of the cedar of Lebanon, *Cedrus libani*, and the stone pine, *Pinus pinea*. Although these plantations have been productive, it may be more effective to plant species that sustain vertebrates, in particular seed dispersers including mammals. This strategy accelerates the natural regeneration process of plants and increases ecosystem resilience by attracting wildlife species to the forests, thus helping the forest to recover naturally.
The animal component in the ecological restoration projects is very often overlooked, even though the role of animals acting as pollinators or seeds dispersers is obvious. By collecting scats and analyzing their seed content, we get direct evidence of seeds dispersal. However, the identification of animals from their scats is sometimes as challenging as the identification of plant species depending on their seeds. Subsequently, applying DNA analysis on scats ought to be very informative in terms of building the food web of the forest by identifying what the animals consume during each season.
The DNA sequences obtained from such material are identified by comparison to a reference library of animals and plants of the Eastern Mediterranean countries. A total of 18 mammals' species were recorded and information about their diet were obtained. Many of these animal species are endemic for the region and/or threatened especially in Lebanon [1]. This work helped us assess species richness and therefore to apply direct conservation and management strategies toward species of interest. In Lebanon, carnivores were found to be a major group of frugivorous and seed dispersers. Planting these species will help to attract wildlife to Lebanese forests and to preserve Mediterranean biodiversity. This work supports the dogma of restoration ecology, that a variety of native species should be planted in order to promote and preserve a rich wildlife.

Keywords: conservation, diet, DNA metabarcoding, reforestation, seed dispersal, wildlife

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Permanent Plot Network in Aragón to study natural dynamics in Mediterranean forests

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As part of its Conservation Strategy on Forest Environment, the Autonomous Community of Aragon (Spain) began in 2016 the installation of a Permanent Plot Network for monitoring forest dynamics. The plots were installed in reference forest stands with a high level of maturity with enough legal protection to ensure their longterm conservation at free evolution over time. The main objective of this facility is addressed to understand how natural disturbances affect the structure, ecological processes and biodiversity in different types of forest stand to check their resilience to ongoing climate change. The plots have been established in different types of forest both in the Mediterranean and the Alpine Biogeographical Regions. Here we present those in the Mediterranean Region composed of a total of 7 wooded locations representative of different Natural Habitat Types of Community Interest.

In each stand, two plots of 50 x 50 m were established taking the main dasometrical, structural, biological and ecological data. The location of all living and standing or fallen dead trees was established on a high precision sketch map. The presence of seedlings and saplings of different tree species was also quantified, as well as the coverage of the different shrub species. Regarding the dynamics, the objective was to study how trees die and how they are being replaced by other individuals that have been born from their seeds. The analysis of the phases of the silvogenetic cycle allow us to compare areas of forest in different states of development. We also analyze the presence of epiphytic lichens and bryophytes as bioindicators allowing us to study the microecologic conditions that occur inside the forest.

Innovative technology was also used to improve the collection of information: the use of terrestrial Lidar and drones allows us to obtain a detailed representation of the forest structure and a spatial vision of the canopy at the stand scale (gaps and distribution of dominant trees alive or dead). It will be accurately comparable with the measurements that will be taken in successive repetitions every 10 years. Finally, a dendrochronological study allows us to reconstruct the dynamics in the past, exploring into the causes of the current structure defining the history of disturbances that occurred in the stand. All together, long-term monitoring of these stands will enable to understand the changes that occur from natural dynamics, the functioning of the system and the resilience of mature forests facing the climate change.

Keywords: conservation, monitoring, dendrochronologie, innovative technologies, epiphytic lichens

Effectiveness of protected areas on Italian forest in the Mediterranean biogeographical region

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As one of the most biodiverse ecosystems on earth, forests offer vital benefits to those who live therein and nearby. Forest biodiversity is dwindling as a result of extensive human-caused forest loss and degradation. Protected areas (PAs) can be a useful tool for reversing this pattern and boosting forest resilience. Similarly, to other Mediterranean countries, PAs in Italy are frequently believed to be helpful in preserving forest biodiversity and supporting natural vegetation dynamics. However, their effectiveness in protecting vascular plants hasn't been explicitly quantified especially at the national scale. Here, we filtered the Italian forest dataset (Alessi et al. 2023) and extracted 3043 vegetation plots sampled between 1980 and 2020 in the Mediterranean region of Italy. To assess the effectiveness of PAs in conserving vascular plant diversity we compared the differences over time (20 years before and after 2000) in vascular plant alpha diversity between protected and non-protected areas using generalized linear models (GLMs). We used propensity score matching to account for confounding factors related to the non-random distribution of vegetation plots in time and space. Matching was based on covariates that are usually linked to biases in plots location and their characteristics: protection status, elevation, annual mean temperature, annual precipitation, minimum distance from roads, population density and size of the plots. GLMs were designed to quantify the interaction between time and protection status, while accounting for all the variables included in the propensity score matching as additional covariates. Our results show that, on average, PAs contained more plant diversity than non-PAs, both before and after 2000. Nevertheless, alpha diversity remained constant over time in PAs, but decreased outside PAs after 2000, suggesting PAs were effective at conserving vascular plant diversity in deciduous forests. These results suggest Italian PAs are well designed for supporting forest biodiversity over time to preserve the natural heritage that maintains the intimate relationship between ecosystems and human wellbeing, especially in a climate change scenario.

Keywords: vegetation, deciduous forests, conservation, propensity score matching, plant biodiversity

LIFE Teixeres project summarizes 30 years of *Taxus baccata* conservation in Valencia: the importance of the seeds

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The yew, *Taxus baccata*, L., is a long living forest species with a wide distribution in Europe, north west Africa and south west Asia. In the Region of Valencia, the yew has a very scarce presence occupying mainly the north faces of high mountains and narrow cliffs. Here is where the temperate species finds its refugia from the surrounding Mediterranean conditions. Yews and its habitat are critically endangered in Valencia and other European regions. Mediterranean *Taxus baccata* forests are protected by the Habitats directive as a priority habitat.
The Generalitat Valenciana accumulates a long-time experience with the conservation of yews since the early beginnings of the habitats directive and Natura 2000 network declaration. The creation of micro-reserves was an important milestone towards the protection of this relict habitat, thanks to several LIFE projects. Then, the creation of the Forest Seed Bank of Valencia in 1994, which later evolved to the Centre for Forest Research and Experimentation (CIEF) opened the opportunity to collect and store seeds from local populations with the objective of producing plants for reintroductions. The yews and their habitat are also protected in Valencia through the Valencian Catalogue of endangered flora with the category of Monitored Species.
Seed production in small and fragmented populations is considered one of the main threats for the conservation of the species. Guaranteeing the existence of seed dispersal cores in natural spaces is, then, crucial for its survival. The CIEF leads at the moment the LIFE Teixeres project (LIFE 20NATES001128). This project includes in its conservation strategy, both, the protection of existing seed producing individuals against perturbances like forest fires or drought, through the reduction of the surrounding vegetation and the creation of new seed producing orchards close to its natural distribution area.
This second action consists in planting and cultivating under controlled conditions yew trees in spaces near to the natural populations. These plantations have two goals: on one side promoting natural dispersal by wild fauna, specially birds, and, on the other hand, having a seed source for plant production in the nursery for future conservation projects. This communication will explain how these orchards are designed in order accelerate and increase seed productivity and to guarantee the genetic singularity from each region and its diversity.

Keywords: *Taxus baccata*, Yew, Seed, Genetic diversity, Seed source, forest habitat restoration, climate change.

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Findings on Remote Sensing of Forest and Tree Health in Southeastern Europe II

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Remote sensing data sources are applied to investigate the changes in forest cover in five countries of Albania, Bosnia and Herzegovina, Croatia, Montenegro and Slovenia in Southeastern Europe. Yet, remote sensing data sources are underused to study forest health and tree health for the five countries. Preliminary findings of manual search using the PRISMA approach showed a higher number of studies applied remote sensing data sources to investigate forest cover change (92.4 percent) compared to forest health (6.7 percent) and tree health (0.8 percent) for five countries in Southeastern Europe. Croatia and Slovenia led by 68.9 percent and Albania, Bosnia and Herzegovina and Montenegro by 31.1 percent, according to Scopus and Google scholar. A new literature review is investigating remote sensing data applied for studying forest health and tree health in five Southeastern European countries and patent applications globally used for identifying forest and tree health from 01 January 1990 until 01 February 2023 by using Google patent search engine and LDAShiny open source application. LDAShiny applies Bayesian Probabilistic Model and machine learning tools. Preliminary results obtained by LDAShiny are promising, in total obtaining 80 publication records and 6365 patent application records. Respectively, there were 95% publications and 2.79% patent applications related to forest health, tree health, remote sensing and or at least one of five countries in Southeastern Europe. No patent applications were submitted by any of five countries in Southeastern Europe. Top topics of patent applications and research publications were respectively forest, image, method, data, area, monitoring, aerial, and forest, data, dengue, regional, primary, time, information, land, research with a coherence of 0.15 and 0.099 of the second best models. Forest, data/information and area/regional top topics were found in both patent applications and research publications. Data source type and measurements of forest health and tree health were not identified in either patent applications or research publications at country, regional and transregional level in Southeastern Europe. These findings may help to identify patent applications, research trends and gaps in remote sensing data applications in forest research and potentially in forest mature conservation.

Keywords: Forest health, Google patent, LDAShiny, Southeastern Europe, Text mining

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Collaborative endeavors across the Mediterranean basin to conserve ecosystems

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The International Association for Mediterranean Forests (AIFM) plays a pivotal role as a trusted mediator, fostering collaboration among stakeholders from 25 countries across the Mediterranean. Together, they strive to preserve and enhance the invaluable forests of the region. AIFM's overarching vision is to promote widespread recognition of the profound significance these forests hold, particularly for the local communities. With a steadfast commitment to sustainable practices, AIFM focuses on preserving the 75 million hectares of Mediterranean forests and other wooded lands, while developing a community of stakeholders from different sectors (public, private and scientific). Moreover, AIFM undertakes extensive efforts to raise public awareness about sustainable forest management, empowering individuals to become active stewards of these vital ecosystems.

Among AIFM's extensive array of impactful initiatives, the MEDFORVAL project assumes a pivotal role. With its primary objective of protecting, managing, and restoring ecologically precious Mediterranean forests across 13 countries, this project effectively establishes a robust network of practitioners committed to the cause. Similarly, the MEDLENTISK project facilitates the exchange of scientific knowledge and best practices related to the exploitation and utilization of the mastic tree (*Pistachia lentiscus* L.) among five Mediterranean nations. The project focuses on the production of mastic oil, an emblematic non-wood forest product to the Mediterranean region. Additionally, the RESTOR'MED FORESTS project engages local communities actively in restoration activities aimed at preserving endemic species in both Lebanon and Morocco. By establishing local nurseries to facilitate restoration work, this project not only contributes to the conservation of these forests but also serves as an essential vehicle for raising awareness about their significance. Recognizing the symbiotic relationship between forests and communities, the project also facilitates capacity development workshops, creating new job opportunities within the forest-based sector for local communities. In Morocco, the endemic Moroccan fir (*Abies marocana* Trab.) stands out alongside 35 other emblematic species. Meanwhile, in Lebanon, the majestic Mont Tabor oak (*Quercus ithaburensis* Decne.) graces the landscape, with several rare floral species endemic to the Menjez site. This site, along with Bentaël Nature Reserve, recognized as an Important Bird Area and a declared biodiversity hotspot, stands as a testament to Lebanon's commitment to conserving its natural heritage.

Through its multifaceted endeavors, AIFM epitomizes the power of collaboration and shared stewardship, empowering communities and fostering sustainable development across the Mediterranean basin.

Keywords: International Networks, Restoration, Conservation, Local Community, Sustainable Management.

Changes in the flora and vegetation of the protected area “La Murta y la Casella” over a period of 72 years

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During the last decades, the vegetation of the Mediterranean forests has been transformed due to the abandonment of traditional agro-silvo-pastoral systems, climate change and globalization. The analysis of changes in vegetation patterns over time has been increasingly used to predict the effects of these phenomena. One of the most significant protected areas of the Valencian Community (Spain) is the Municipal Natural Park (PNM) “La Murta y la Casella” because it holds relict forests with ash trees and other deciduous species located very close to the sea. Jose Borja performed in 1950 a study of the flora and vegetation of this PNM that is of great value because of its antiquity and level of detail. The main objective of the present study is to compare the lists of flora and phytosociological relévés performed in 1950 with those performed nowadays, 72 years later. A total of 37 relévés were carried out reproducing as much as possible the methodology and location of Borja. Seven communities were sampled: the mature forest of *Quercus rotundifolia* (*Quercion ilicis*), the postclimax forest (postclimax *Quercion ilicis*), the relict forest of *Fraxinus ornus*, three communities of serial shrublands at high and low altitudes on limestone soils, and the plant community growing on decarbonized soils with lower pH values.

A total of 110 different taxa included in 45 families were recorded within the relévés. In all the communities, very rare and rare species in the Valencian Community could not be found, which corresponded mostly with endemics and temperate species (e.g., *Fritillaria hispanica*, *Jasione montana*). Despite this common trait, various patterns of change along time were observed depending on the community. The more mature communities corresponding to the forests of *Fraxinus ornus* and postclimax *Quercion ilicis* have incorporated Mediterranean species and lost temperate species, probably because of climate change (e.g., *Verbascum chaixii*, *Rosa agrestis*). Despite these losses, many of the most representative elements of the relict local flora still exist, such as ash, gall oak and maple, which reinforces the role of microclimatic refugia in the Mediterranean. On the other hand, the serial communities have progressed towards climax following a secondary progressive succession, probably due to the abandonment of traditional activities, especially wood and firewood extraction and reduction of grazing pressure. As a consequence, a homogenization of the landscape was observed, which was characterized in 1950 by a mosaic structure where each spot displayed different species. Finally, endemic species of Ibero-Levantine origin (e.g., *Helianthemum croceum*) have been lost in the shrublands developing on limestone soils, whereas the number of Mediterranean species of wider distribution has increased. The floristic composition of the reduced and inaccessible community of siliceous soil is the only one that has not suffered notable changes over time, and still holds species of great ecological value in the coastal areas of the Valencian Community, such as *Pteridium aquilinum*.

Keywords: Climate change, Land use, Relict forest, Shrubland, Vegetation shift.

Conservation of forest resources: Clonal propagation and cryopreservation of cork oaks tolerant to *Phytophtora cinnamomi*

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The progressive decay of the *Quercus* (*Q. ilex* and *Q. suber*) species, mainly due to the so-called oak decline syndrome of the "seca", together with the lack of regeneration of the trees have prompted the Spanish Government (MITECO), with support from the European Union, the creation of a program for the improvement and conservation of the genetic resources of both species [1].

The objective of our work is to generate, by somatic embryogenesis (SE), cork oak progenies from mother trees tolerant to *Phytoptora cinnamomi* that have also shown some adaptation to drought (www.resseca, TRAGSA, Spain). Also, by cryopreserving the embryogenic lines we aim to create a germplasm bank that can be used as MFR (Forest Reproductive Material). Ninety genotypes that are progenies of 5 *Quercus suber* mother trees have been used. SE in cork oak was obtained by culturing expanding leaves that, once sterilized, were successively transferred to establishment, induction, and manifestation media [2]. Well-formed embryos were stored at 4 °C for 1-2 months before proceeding to germination and subsequent acclimatization to greenhouse conditions. This protocol allowed to capture 82 % of the tested genotypes. Between 20 and 70 % of the somatic embryos germinated depending on the embryogenic line. Until now, plants with vigorous growth have been obtained in the 60 % of the genotypes.

In order to establish a cryobank, embryogenic lines were cryopreserved by the vitrification-based procedure, where somatic embryos in globular-torpedo state are precultured for 3 days in high sucrose concentrations and subsequently treated with PVS2 vitrifying solution for 60 min at 0 °C before immersion in liquid nitrogen (LN). From each line, 8-9 vials were stored with 12-15 somatic embryos/vial. After 1 month in NL, 3 vials/line were removed from the tank to determine survival and capacity for embryogenic recovery. To date, a total of 68 embryogenic lines (genotypes) have been successfully stored, with recovery rates after rewarming of 37-100 %.

Keywords: in vitro conservation, disease-tolerant trees, *Quercus*, somatic embryogenesis, cryopreservation

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Field conservation of traditional Valencian horticultural varieties

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In 2016, the Valencian government initiated a plan for the recovery, use and in situ conservation of traditional horticultural varieties of agricultural interest, called “The Valencian Agrarian Diversity Plan”. This initiative was born from the need to preserve the Valencian agricultural diversity in the cultivated fields and to disseminate its knowledge among farmers and consumers. The most important tool of this plan was the creation of a seed transfer service based on a catalogue, The Valencian Catalogue of Traditional Varieties, available not only for the professional agricultural sector but also for horticulture enthusiasts in general, whether in home gardens, social gardens, educational centres, associations, etc.

To make possible the conservation of the varieties and the supply of seeds, two collections of seeds were created, an active one, kept at 4ºC and used to make the transfers, and a base collection, kept at -18ºC to ensure long-term conservation. The Catalogue was presented in 2018 with the description of 45 traditional cultivars belonging to 21 different vegetable species. From that moment, the seed transfer service was put into operation and in its more than 4 years of operation, more than 9,500 batches of seeds have been served to a total of 971 “guardians” in the field, of which 68 are professional farmers who also have contributed to the dissemination of the characteristics of these varieties to consumers.

The seeds transferred to the users are produced in accordance with organic production standards in the cultivation fields of the Agricultural Experimental Stations and of the CIEF and are characterized and analysed following international protocols (ISTA standards), as well as subjected to controls and treatments to prevent the presence of pests.

When receiving the seeds, the receptor must sign a transfer agreement, committing himself to collaborate in the conservation of the requested varieties and not to carry out lucrative activities with the transferred seeds. These transfers of seeds are made free of charge, at the official agricultural experimentation centres of Carcaixent, Vila-Real and Elche and at the CIEF. The Catalogue is available on the website of the Department of Agriculture [1] and it aspires to be participatory, dynamic and with projection to the future. In fact, in 2023 the inclusion of 7 additional varieties is planned and the inclusion of other varieties in the future is continually being considered.

Keywords: agrarian diversity, local cultivars, seeds, in situ, ex situ

[1] https://agroambient.gva.es/es/web/cief/cataleg-valencia-de-varietats-tradicionals

Innovative practices to improve the adaptive capacity of *Pinus pinaster* reforestations

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Pinus pinaster Aiton forests in inland Valencian Community (Spain) are represented through remainders of native forests and reforestations, often made on the same sites where ancient big forests have disappeared. However, these forests, both pure and mixed -often with other *Pinus* spp.- show serious regeneration problems, caused by the high recurrence and intensity of wildfires, together with the succession of very dry years -lack of enough rainfall and excessive summer heat-. This species used to be more exigent in soil moisture than other local native pines, so their forests have experienced a strong decline during the last decades.

An improvement opportunity for *Pinus pinaster* is to act on the reforestations -often characterized by their dense repopulations, resulting from the lack of silviculture treatments after plantations-, aiming to restore their natural characteristics, and to advance towards mature stands. The LIFE project, RedBosques_Clima, coordinated by Fundación González Bernáldez and executed in the Valencian area by Generalitat Valenciana and Vaersa, develops actions to improve the adaptation capacity of selected sites holding reforested areas dominated by the maritime pine. The same LIFE project also develops actions on other kind of forests in several parts of Eastern and Central Spain (see https://redbosquesclima.eu/en/home/)

The purpose of these actions in the Valencian Community is to promote the adaptive capacity and resilience of the Northern Mediterranean maritime pine (*Pinus pinaster* subsp. escarena) forests, whose characteristics -structure, composition, ecological relationships- made them highly vulnerable to the effects of climate or global changes. These actions consist of applying the so-called “silviculture of natural processes”, as an expression of the adaptive silviculture, aiming to reach attributes of forest maturity, by modifying the reforestation structure to promote natural regeneration, increase species diversity and reduce competition. The pilot plots have been located though the three Valencian provinces (Castellon, Valencia and Alicante) in order to promote their replicability. To start these experiences, initial activities have been taken on several plots in the municipality of Barracas (inland Castellon).

To modify the structure, cuts by groves have been made, in addition to diversification of species and in diameter classes. The groves have been based on the dominant height, and clearcuts were opened using two different sizes that, in addition to breaking the linearity of the streets, improve the landscape and favor natural regeneration. The usual treatments bring sunlight to the entire tree mass. This treatment through copses and clearcuts also maintains shaded areas that are not treated and that help to maintain the diversity of species, particularly for nemoral ones. The reduction in tree density will reduce competition for resources, creating a more balanced and stable forest mass that reduces its dependence on water. In addition, complementary practices to increase the amount of deadwood are made, facilitating an improvement on fauna diversity, and plantation of selected local species can be applied if needed.

Keywords: Adaptative silviculture, *Pinus pinaster*, Mature forests, Silviculture of natural processes

Protection and conservation of monumental and singular trees of the Valencian Community (SPAIN)

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The Valencian Law 4/2006 on Monumental Tree Heritage is Spain's most advanced regulation for protecting old, veteran, monumental, and singular trees. It is the unique one considering generically protected -without needing of a specific declaration- those trees surpassing some dimensions or ages: 30 m in height, 25 m in tree crown diameter, 600 cm in trunk perimeter or 350 years old. Special dimensions are set for palm trees. Additionally, regional and local authorities (city councils), can expressly protect trees of lower dimensions or ages with exceptional cultural, scientific, or historical value. Such trees are combined with the generically protected trees to form the Valencian Catalogue of Monumental and Singular Trees.

The Valencian Catalogue, established in 2012 and renewed in 2012, 2013, 2016 and 2023, currently contains 2,439 trees. It holds Spain's most important list of individually protected trees. The most represented species are *Olea europaea* (600 trees), *Phoenix dactylifera* (254 trees) and *Ceratonia siliqua* (246 trees). The region's tallest recorded tree is a *Populus nigra* at 44.7 m, while the largest crown diameter (40.5 m) and trunk perimeter (1469 cm) belong to *Ficus macrophylla* trees.

Around 270 catalogued trees are situated in public forests under the care of the regional government (Generalitat Valenciana), mostly comprising native species like *Pinus* spp., *Quercus* spp., and *Populus* spp. To ensure their conservation, in addition to a team of officers, a conservation brigade performs up to 40-50 interventions per year. Regular inspection of catalogue specimens is essential to monitor their health and changes in key parameters. With the increasing number of protected trees, it is recommended to strengthen human teams and budget allocation for these tasks.

The remaining protected trees are primarily located on private and municipal properties, in both agricultural and urban areas. For the first case, Castellon province boasts a rich heritage of monumental olive trees (*Olea europea*), while in Valencia province, notable big carob trees (*Ceratonia siliqua*) can be found. In urban areas, significant cases include palms (*Phoenix* spp., *Washingtonia* spp.) and trees from various exotic genera like *Eucalyptus*, *Araucaria*, and *Platanus*.

Keywords: Natural heritage; old, veteran, monumental or singular trees; Valencian Catalogue of Monumental and Singular Trees.

Reforestation monitoring in Palo Laziale Forest: functional assessment of three Mediterranean tree species in field and drought conditions

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Mediterranean forests face the challenge of frequent and intense drought episodes that can hinder the successful establishment and long-term survival of tree species used in reforestation efforts in degraded areas. Seedlings in their early years of development are particularly vulnerable to high mortality rates due to their shallow root systems and limited carbon storage. Although only a few seedlings survive to adulthood and are often considered to play a minor role in forest dynamics, community turnover, and ecosystem restoration towards a resilient structure occur through the establishment of new trees. It is therefore crucial to study the regeneration niche of seedlings and predict their potential survival in Mediterranean areas.

This study focuses on the case study of Palo Laziale Forest, a Natura 2000 protected habitat, and aims to (i) assess the physiological performance, functional adjustments, and water status of different tree species (*Q. cerris*, *Q. pubescens*, and *F. ornus*) under water scarcity compared to optimal growth conditions; (ii) quantify the growth and physiological performance of the same species in the field and evaluate whether seedlings' leaf gas exchanges reflect those under drought conditions.

To achieve these objectives, key functional traits related to growth (plant height, number, and size of leaves), resource assimilation (specific leaf area, net photosynthesis, shoot-to-root ratio), and water status and regulation (relative water content, stomatal conductance, transpiration) were measured in seedlings, both in the field and in the botanical garden of Sapienza University under controlled and waterlimited conditions. During the experiment, the seedlings' capacity to recover after rehydration was also monitored. This research will help to assess the current state, understand the process, and accurately predict the success of seedling establishment under current and two future IPCC climate scenarios.

Keywords: Restoration, Moisture deficit, Mediterranean seedlings performance, leaf gas exchanges, climate change

Sporadic tree species as a key element for the restoration of Mediterranean forests

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The importance of sporadic tree species for biodiversity conservation in woodlands is since long time recognized. Conversely, centuries of human exploitation of Mediterranean forests have not only deeply simplified their structural complexity but also significantly altered their species composition. The most common consequence has been the strong reduction in the abundance and cover of the woody species considered unprofitable from an economic point of view and the concomitant increase of some target tree species (e.g., holm oak for charcoal production). Although the recent guidelines of sustainable forest management emphasize the importance of fostering rare woody species, sufficient time has not elapsed for significant results to be observed yet. In our research, we assessed the abundance and cover of sporadic tree species, including *Prunus mahaleb, Malus sylvestris* and *Sorbus torminalis*, in different Sicilian woods (southern Italy) occurring under different bioclimatic and management conditions. We carried out field surveys and used data from the phytosociological surveys performed on the island. We found that most of the studied woods hosted a few (or even none) sporadic tree species, while a higher presence was detected in woods withdrawn from management for decades and approaching old-growth conditions. Such evidence would suggest that the rarity of these species, which is partly related to peculiar ecological requirements, has been also strongly affected by past management and selective cutting. Therefore, when dealing with the restoration of Mediterranean forests, the reintroduction of these valuable tree taxa should be carefully considered. However, this need is seriously constrained by seedling availability in the forest nurseries, where they are generally lacking. Hence, to restart the propagation of these species, seed collected from the nearest woods should be used, thus ensuring the conservation of germplasm adapted to local conditions and increasing plant establishment success.

Keywords: biodiversity-informed forest management, nursery, plant propagation, woody species

6th Thematic Session

Experiences of Cryptogram conservation in the Mediterranean

Bryophyta *Cratoneurion* (Alpuente, Spain). Author: Emilio Laguna.

Chair

Sara Magrini

Sara Magrini is a researcher at the Tuscia University, Department of Ecological and Biological Sciences Viterbo (Italy). Currently, she is the president of RIBES, the Italian network of seed banks, and a member of the Steering Committee of GENMEDA, the Network of Mediterranean Plant Conservation Centres. Since 2006, she has been working at the Tuscia Germplasm Bank.

She is a plant ecologist working in Mediterranean plant conservation and an expert on in vitro reproduction, mainly focusing on terrestrial orchids and ferns. Research interests span the field of plant conservation (seed-banking, reintroductions, red listing), population ecology (fitness, demography, dynamics), seed/spore ecology (longevity, drought resistance, thermal preferences/thresholds for germination, orchid asymbiotic germination, evaluation of seed quality, storage behaviour, in vitro propagation), and best practices in translocations of threatened plants, with a focus on Italian terrestrial orchids and ferns. Main activities in these core areas include investigations on the germination ability, the definition of new specific methods for histochemical seed viability testing, research on long-term seed storage behaviour and seed ageing, and the assessment of the effect of climate changes on the fitness analysing plant/fruit/seed functional traits in native populations. She has been currently researching the storage behaviour of terrestrial orchid seeds through thermal analysis with differential scanning calorimetry, in collaboration with the Millennium Seed Bank (Royal Botanic Gardens, Kew), within the project "Comparative analysis of terrestrial orchid seeds to inform ex-situ conservation in Europe" funded by the American Orchid Society, and the allelopathic properties of Carpobrotus species in coastal areas, within the project RIVALSA funded by Regione Lazio.

She is a member of the IUCN/SSC Seed Conservation Specialist Group, the Orchid Specialist Group, and the Freshwater Plant Specialist Group. She is co-editor of "Mediterranean Plant germination reports", an annual column published in the international journal Flora Mediterranea.

She is the deputy coordinator of the LIFE 20/NAT project SEEDFORCE "Using SEED banks to restore and reinFORCE the endangered native plants of Italy" aimed at the conservation of 29 Habitats Directive species.

Ex situ conservation of pteridophytes and bryophytes through spores

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Bryophytes (mosses, liverworts and hornworts) and Pteridophytes (lycophytes and ferns) are dispersed by spores. These spores are in most cases tolerant to desiccation < 50% relative humidity (RH) and, when dry, they tend to tolerate exposure to and storage at sub-zero temperatures [1, 2]. Due to these characteristics, spores of bryophytes and pteridophytes can potentially be stored for the long-term in *ex situ* collections (i.e., germplasm banks) using the conventional storage conditions defined for orthodox seeds (e.g., desiccation at 15-25% RH, storage at -20°C). However, some spores present short longevity at such conditions which challenges their long-term conservation.

For example, many chlorophyllous fern spores age relatively fast when compared to non-chlorophyllous fern spores. In this sense, longevity (measured as time to reduce 50% of initial viability or p50) at conventional seed storage conditions has often been measured <2.5 years, as in *Equisetum hyemale* and *Osmunda regalis* spores. For comparison, longevity of most non-chlorophyllous fern spores at the same storage conditions have been predicted over 5.5 years, with longevity being generally estimated around 16 years or over [1]. But, overall, these longevities are quite poor if compared to orthodox seeds for which longevity is generally measured or predicted >20 years. The causes for this short longevity in fern spores at conventional seed storage conditions have been mainly related to two issues: (1) an exacerbated oxidative stress due to the misfunctioning of the photosynthetic machinery in the absence of free water (in chlorophyllous spores), or (2) physical damage induced by the crystallization and melting dynamics of the storage lipids within the dry cytoplasm of the cell (in non-chlorophyllous spores) [2]. Nevertheless, cryogenic storage appears as a potential solution for the long-term storage of dry fern spores. The low temperatures provided by -80°C freezers or liquid nitrogen (<150°C) increase significantly fern spore longevity, at least doubling or triplicating the longevity estimated for samples stored at about -20°C [1].

Bryophytes tend to have chlorophyllous spores, often with relatively high amounts of storage lipids that crystallize around -20°C. In addition, comparative longevity studies performed by our group indicate that bryophyte spores have longevity comparable to chlorophyllous fern spores. These characteristics suggest that their longevity at the storage temperatures of conventional seed banks could also be relatively poor. Since bryophyte spores tolerate exposure to liquid nitrogen temperatures, cryogenic storage has been suggested for their long-term ex situ conservation [2].

In addition to other *in situ* and *ex situ* conservation measures, we encourage spore banking as a relatively easy and low-tech solution for the long-term storage of the rich and endangered pteridophytic and bryophytic diversity. Diverse protocols and manuals have been published over the last years to facilitate and stimulate the creation of fern spore banks [3]. However, just a few fern spore banks exist globally. Some are historical (created in the 1990s) and some of new creation (2020-2023), but most are currently active collecting and storing fern spores from diverse plant hotspots in the world (e.g., Hawaii, southeast Asia, the Mediterranean basin, Australia). On the other hand, and despite their potential, we are not aware of any bryophyte spore bank in the world. The increase of research, training and awareness may improve the current situation.

Keywords: dry storage, longevity, oxidative stress, lipid crystallization, cryopreservation

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Ancient, endangered, overlooked, and uncharismatic: Risk assessment and conservation strategy for two Levantine quillworts

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Quillworts are “un-charismatic” lycophytes that date back to the Jurassic period. They belong to the genus *Isoetes* (Isoetaceae: Lycophyta), which currently includes more than 200 described species and hybrids. In Lebanon and Syria, it is represented by three (possibly four) amphibious species, two of which, *I. libanotica* and *I. olympica*, are regional endemics. Geographically, *Isoetes libanotica* is restricted to a small area in Akkar governorate, north Lebanon, and Homs governorate, western Syria. *Isoetes olympica* on the other hand, occurs in Turkey, Syria, and Lebanon. Due to their amphibious nature, both species are threatened by habitat alteration, particularly land drainage for agriculture. Furthermore, their range in Lebanon is being partly reforested or developed, which may be negatively impacting their habitat. While *I. libanotica* remains unassessed, a global assessment of *I. olympica*, undertaken more than ten years ago, found it to be critically endangered (CR) according to IUCN Red List criteria. In this study, we assess *I. libanotica* for the first time since its description in 2011. We also reassess *I. olympica*, considering populations of this species located since its earlier assessment in 2009 (published in 2010), thus increasing its extent of occurrence and area of occupancy. We also develop conservation strategies for the two species in Lebanon and Syria, taking into account the fact that the two species are, to this day, not present in any protected areas in both countries, and therefore remain unprotected *in situ*. We also revise the boundaries of two Key Biodiversity Areas (KBAs) for plants, KBA 06: Menjez in Lebanon and KBA 11: Al-Kabir Al-Jonubi in Syria, both delineated based on the presence of these endemic quillworts among other endangered endemic species, including *Vicia kalakhensis* and *V. hayaeniscyamus*. This study will guide the *in situ* protection of two endangered non-charismatic plant species, through their global Red List assessment, and ultimately their conservation in collaboration with local stakeholders.

Keywords: *Isoetes*, lycophytes, *in situ* conservation, Red List assessment, Key Biodiversity Areas

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Comparative longevity of bryophyte spores: influence of storage conditions, spore maturity stage, and plant ecology

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Bryophyte spore longevity influeces long-distance disperal and ex situ conservation options, but it is not well known. The main objective of the present study was to compare bryophyte spore longevity in relation to the spores and seeds of other land plants, such as pteridophytes and spermatophytes. Spores of four moss species (*Funaria hygrometrica*, *Lewinskya acuminata*, *L. iberica* and *Ulota crispula*) were subjected to accelerated ageing (AA) at 45°C and 60% relative humidity (RH) and periodically sampled for germination [1]. Additionally, spores of *F. hygrometrica* were also stored dry at 15% RH and 20°C. For comparative purposes, spores of *F. hygrometrica* were stored at different degrees of maturity as per the colour of their capsules (green, yellow, and brown). Spore survival curves were constructed based on germination percentages. The time taken for germination to fall to 50% (P_{50}) was determined using probit analysis [1].

Overall results showed short spore longevity for all species tested, regardless of storage conditions. P_{50s} calculated for the four species under AA conditions ranged from 0.4 to 5.7 days, suggesting a rapid viability loss of spores when compared to data available for seeds at the same storage conditions [1]. P_{50} values for *F. hygrometrica* stored under dry conditions were higher, ranging from 58 to 150 days, but still considered short-lived when compared to fern spores and seeds aged at comparable conditions [2]. In the case of F*. hygrometrica*, spores collected at peak maturity (brown) were found to have the longest longevity under both dry and AA conditions.

The data of this study suggest that bryophyte spores are relatively short-lived. This could be related to the chlorophyllous nature of the spores tested. The presence of plastids with chlorophyll in other dry systems (seeds and fern spores) have been related to an acceleration of the loss of viability due to exacerbated oxidative stress
[2].

We do not know what relationship there may be between spore longevity and longdistance dispersal ability of many bryophytes, as is the case of *U. crispula* and *L. acuminata* [3]. Also, due to the epiphytic nature of some of the species tested, it could be reasoned that they lack an efficient dormancy mechanism as an evolutionary trade-off to maximise the strategy of safe emplacement rather than longterm survival of the spores in the substrate. In terms of ex situ conservation, data suggest the need of fast processing steps before storage [2].

Keywords: accelerated ageing, dry storage, spore germination, P_{50}, survival curves

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Conservation insights from the endangered Mediterranean lichen *Seirophora villosa* (Ach.) Frödén

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Seirophora villosa is strictly associated with coastal juniper habitats and could be used as an indicator of their status of conservation. This study aimed to evaluate how light regime and water availability affect individual specimens of *S. villosa*, by studying the relationship between photosynthetic activity and water content in thallus areas of different thalli sizes. Furthermore, we investigated the role of the thin tomentum on the thallus surface characterizing *S. villosa* to withstand the effects of seawater by continuous exposure to marine aerosols. Our results showed that the size of the thalli influences the water retention capacity of *S. villosa* species, and consequently influences responses to strong exposure to light. *Seirophora villosa* thalli are susceptible to sudden increases in light exposure, especially in the case of small specimens, which after photoinhibition exhibited a reduced ability to recover. Our work evidenced the relevance of hairs as a strategic morphological trait. Hairs could offer a passive, but selective, water control. Hairs could repel the salt dissolved in water, by activating a passive resistance mechanism, which by not allowing salt to enter, allows the thallus to tolerate the presence of salt. In brief, considering that light regime, water availability, and high salt concentrations are generally the main ecological factors modified by habitat fragmentation, incorrect management of dune systems could be detrimental to the survival and establishment of this species, triggering a decline in populations. Based on the results obtained, we developed a conservation strategy for *S. villosa* in situ at the Duna Feniglia Nature Reserve in Tuscany, the major Italian hotspot for this species. The project plans to strengthen populations threatened by habitat loss and fragmentation, increasing the dispersal capacity and survival of dispersed propagules by means of shading networks. The results obtained in this study will help to define a conservation plan that can also be implemented in other realities of the Italian territory.

Keywords: ecophysiological aspects, *Juniperus* shrublands, lichen conservation, Mediterranean area, salt stress

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Desiccation tolerance, longevity and storage at sub-zero temperatures of uni- and multicellular spores of the moss family Orthotrichaceae (Bryophyta)

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Bryophyte spores are known for their long-distance dispersal and tolerance to the stresses imposed by adverse conditions, such as desiccation and sub-zero temperatures. These tolerances over the long-term are also key to facilitate their *ex situ* conservation [1].

Multicellular spores in bryophytes are originated from a process of endosporic germination. It has been suggested that they could be sensitive to desiccation [2]. However, their desiccation tolerance (DT) has not been characterised empirically and an alternative hypothesis indicates that they were developed as an adaptation to dry periods [3]. If these spores are DT, we should expect longer longevity than unicellular spores due to their greater energy reserves.

The aim of this study is to characterize how uni- and multicellular spores of the moss family Orthotrichaceae tolerate the stresses of drying and freezing and how they shape their viability over time. Furthermore, we aim to study if fundamental differences between uni- and multicellular spores can affect their storage and *ex situ* conservation.

To accomplish these aims, firstly, we measured spore tolerance to drying to relative humidity (RH) between 11-75%. Secondly, we performed a comparative study of uni- and multicellular spore longevity at different RH. Then, spore viability was measured in several specimens of *Ulota* spp. preserved in herbarium conditions (ca. 50%RH and 20°C) for 4-7 years. Finally, we studied the effect of -20 and -80°C storage of uni- and multicellular spores after their desiccation at different RH.

Results indicate that both uni- and multicellular spores are DT and show lower loss of viability when stored at low than at high RH. We also found that spores from herbarium sheets of *Ulota* spp. were not viable after dry storage for over 4 years. Finally, we determined that both spore types tolerate sub-zero storage after desiccation at RH ranging between 30 and 90%. However, multicellular spores were found to be much more sensitive to sub-zero temperatures over time.

These results confirm the possibility of dry and cold storage of uni- and multicellular spores from Orthotrichaceae. However, more work is still needed to understand the optimal conditions for the preservation of multicellular spores in germplasm banks. Our work also indicates that the endosporic germination of bryophyte spores does not mark the loss of DT in this plant group, unlike spore or seed germination in other groups of embryophytes.

Keywords: dry storage, relative humidity, sub-zero temperatures, viability, spore germination.
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Forest management and conservation of the threatened lichen Lobaria pulmonaria in Mediterranean forests

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Intensive forest management may threaten forest lichens, causing habitat fragmentation, degradation and loss. After logging, lichens are exposed to a sudden microclimatic variation, consisting of an increase in solar radiation, temperature, wind and a reduction of humidity. Drier conditions may negatively affect photosynthetic activity, and hence the overall vitality of sensitive species, such as the forest lichen *Lobaria pulmonaria*, a species widely used as a model organism for population ecology and conservation biology. Although red-listed and legally protected in several European countries, this species has been declining during last decades due to air pollution and habitat fragmentation. The background for this research was offered in 2016 by a logging for timber production which depleted a large population of *L. pulmonaria*, including hundreds of fertile thalli in Central Italy. Afterwards, *L. pulmonaria* from that area has been used as a model to investigate the stress induced by logging and to enhance better conservation practices, by means of a series of experiments carried out in Mediterranean mixed forests. We tested the impact of forest management on threatened lichens in Mediterranean oak forests; the effectiveness of forestry retention coupled with microclimatic conditions; the alterations in vitality and growth due to logging; the influence of local microclimate modifications introduced after logging using in situ and ex situ transplanted thalli/fragments, as well as the efficacy of translocation for conservation purposes. In addition, the response of sensitive lichens to habitat changes introduced by invasive alien species, such as black locust (*Robinia pseudoacacia*), has been investigated in chestnut woods (one of the main habitats for *L. pulmonaria* populations).

Keywords: biodiversity, cryptogams, forest logging, indicator species, translocation

Rare or common? Developing protection schemes for bisexual-parthenogenetic species

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Parthenogenetically reproducing species, which lack at least some of the genetic recombination mechanisms, are more vulnerable to loss of genetic diversity compared to sexually reproducing species. Investigating the role of sexual ancestor populations in maintaining genetic diversity and, consequently, the acclimation potential of parthenogenetic populations will provide the basis for developing effective conservation measures. *Chara canescens* has been chosen as the model organism to investigate this because of the relevance of this organism group. Charophytes play an important role as habitat engineers in mesotrophic to eutrophic water bodies by providing shelter for zooplankton and juvenile fish, allowing for efficient top-down control of phytoplankton and consequently stabilizing clear-water conditions, which enhances the ecosystem service provision. For coastal water lagoons, *Chara canescens,* as the only true brackish water species of charophytes, is the key element for stabilizing clear-water status. Until now, only parthenogenetic populations are known for coastal lagoons world-wide; sexual reproducing populations are restricted to Mediterranean and Pannonian inland brackish water sites, whereas the distribution maximum clearly is in the Baltic Sea region, requiring long-distance vectorial transport. Protecting the coastal stands only will not be effective, because their fitness depends to a high degree from connectivity with inland brackish water sites. Those inland sites are, if at all, protected for other reasons, mainly bird protection, which can result in conflicts of interests and even harm the charophyte stands. In order to develop effective transnational conservation strategies, it is necessary to provide the site managing authorities with the knowledge about niche structure to allow multi-target management of the sites bearing the extremely rare bisexual populations. Unravelling recent as well as past gene flow via stepping-stone habitats will allow for estimation of the effects of lost inland brackish water sites and identifying potential gaps which need to be restored. For this, niche structure differences between parthenogens and bisexuals as well as the restoration suitability of lost habitats needs to be assessed. The presentation (showing data from a Biodiversa+ project) will give an overview about the current state of knowledge, highlighting the role of diaspore banks as “hidden biodiversity elements”. These diaspore reservoirs are not only ensuring mid-term resilience of temporary or/and degraded habitats but could be also potentially useful for restoration initiatives.

Keywords: Charophytes, *Chara canescens*, inland brackish water, wetlands, integrated protection

Lichen conservation in the Plant Microreserve Network of the Valencian Community (E of Spain)

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The Plant Micro-Reserves (PMR) of the Valencian Community have become the world's largest network of small-protected areas, primarily focused on the conservation of vascular plant and their habitats. This pioneer project for in situ plant conservation was developed in the early 90's and the first PMRs were declared in 1998. Over time, this network has grown to include 312 sites, covering 24.68 km^2, which represent approximately 0.1% of the regional surface. Despite the small surface of the network, Valencian PMRs include 69.8% of total native flora (up to subspecies level) and a high percentage of Spanish endemic plants (80.7%).

Although PMRs were originally designed with vascular plant conservation in mind, they also shelter a significant diversity of rare or threatened cryptogams. The proposal to create micro-reserves for cryptogamic flora confirmed the interest of this figure as a tool for conservation of fungi, lichens and bryophytes.

The preliminary catalogue of lichen-forming and lichenicolous fungi in the Valencian PMR network has been compiled from the data stored at the Biodiversity Data Bank of the Valencian Community (https://bdb.gva.es/). This repository of regional biodiversity information holds in excess of 54,500 records of 921 lichenized (832 taxa) and lichenicolous fungi (89 taxa) in what can be considered the regional checklist. Included in the PMR network are 387 taxa, of which 384 lichen-forming fungi and 4 lichenicolous fungi. This means that 42% of the lichenized fungal species at regional level have at least one population within the network. Moreover, 11 species occur exclusively within PMRs, and 17 species (8 Endangered, 5 Vulnerable, and 4 Least Concern) are included in the Red List of lichens of the Valencian Community.

The afore mentioned figures become even more remarkable when the small size of the PMR network is considered. Additionally, it should be borne in mind that only 50% of PMRs have had their lichen flora studied to some degree and that some species proposed for inclusion in the Spanish Red List for lichens are also found within the network. All these results highlight the role of the PMR network as an effective conservation tool for lichens, particularly for rare or threatened species.

Keywords: Lichen biota, Endangered species, site protection, Red List.

Conservation Program for threatened ferns of caves of the Valencian Community

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For more than two decades, the El Palmar Aquaculture Centre (CAEP) that belongs to the Wildlife & Natura 2000 Network service of the Valencian Regional Government (GVA), has been carrying out conservation actions on threatened Pteridophytes of the Valencian Comunity (Eastern Spain).
In the Valencian Community there is a large number of underground cavities, caves and chasms which, thanks to their environmental characteristics, mainly light and humidity, are home to different species of ferns adapted to this type of ecosystem. The Catalog of Caves of the Valencian Community (Decree 65/2006) includes 134 cavities, among which are some with the presence of ferns, both in the mouth and inside. As a result of their rarity and limited distribution, some are threatened. This is the case of *Asplenium marinum*, *Phyllitis sagittata* and *Phyllitis scolopendrium*, included in the Valencian catalog according to Order 2/2022, of February 16, of the Ministry of Agriculture, Rural Development, Climate Emergency and Ecological Transition, by which they are updated the Valencian lists of protected species of flora and fauna, the first two being classified as Endangered Species (EP) and the third as a Non-Cataloged Protected Species (PNC).
The main objective is to improve the conservation status of threatened cave pteridophytes through the replication of new populations and the reintroduction of specimens in population reinforcements.
This paper describes the conservation actions for these taxa, both *ex situ*, carrying out germplasm conservation or the development of propagation and cultivation protocols, as well as *in situ* actions, for instance, the census, tracking, monitoring of the population dynamics and mapping of the populations of the Valencian Community.

Keywords: fern conservation, Natura 2000 network, endangered species, Pteridophytes, restore populations.

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7th Thematic Session

International networks for the conservation of Mediterranean flora and habitats

Genmedoc field excursion 2004 (Medenine, Tunisia). Author: Gianluigi Bacchetta.

Chair

Mauro Fois

Mauro Fois is a postdoctoral researcher at the Department of Life and Environmental Sciences, University of Cagliari. He holds a master's degree and a PhD from the same University, although he spent part of his academic training in Ireland and Spain. His early research focused on mapping habitats and plant species, then developed studies on species distribution patterns, ecological characterisation and threats. His research now focuses on monitoring and species distribution and interaction, with particular emphasis on alien, endemic and endangered flora.

Main studies are localised in Sardinia, but also collaborated with other researchers from Egypt, Croatia, France, Tunisia, among others. He is coordinator for Sardinia of MedIsWet, a Mediterranean project on the inventory and monitoring of island wetlands, and referent for other regional and international projects on plant monitoring and conservation. He is a member of the editorial board of Ecological Processes, Frontiers in Ecology and Evolution and Global Journal of Environmental Science and Management.

Integrating data repositories with multi-disciplinary analyses to address practical conservation questions using updated science: examples from Macaronesia and the Mediterranean

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Diverse genetic and biogeographic investigations on Canary Island plant endemics are revealing complex diversification contexts. The emerging framework entails very rapid diversification (often following multiple colonization events), frequent within- and between-island migration and gene flow, a great influence of the dynamic geological ontogenies of the islands in recurrent cycles of genetic reconnection-isolation among population subsets, and a substantial role of purely stochastic processes in the origins, distribution and makeup of the endemic flora. DNA Barcoding analyses have often revealed overlooked species erroneously regarded as conspecific populations of pre-existing taxa, or discovered new endemics earlier considered as widespread Mediterranean taxa. The presentation will pick out diverse examples of plant diversification that illustrate the close relationship between Macaronesia and the Mediterranean, some of which conflict with the mainstream hypotheses on the evolution of oceanic floras.

Beyond setting important challenges for conservation, the complexity and speed of the heterogeneous variables that come into play emphasize the need of casting a stronger focus on the preservation of the biological processes that foster evolutionary change. The recent and intense threats posed by anthropic action in the Mediterranean hotspot add up a factor of urgency in most conservation endeavours; they also confront conservation science with the challenge of fast integrating different sources of scientific knowledge to implement sustainable conservation strategies.

The development of proper information repositories with built-in analytical capabilities seems crucial to store relevant information to obtain a fast diagnosis of the current conservation status of species and propose informed conservation actions. Our group is working in the supercomputing-based information system NEXTGENDEM (MAC2/4.6d/236, https://www.nextgendem.eu/) to create the needed framework to enable the fast analysis of multiple biotic and abiotic data layers associated with the Macaronesian and Mediterranean biodiversity, including genomic data. The system is conceived to enhance understanding of a wide array of crucial evolutionary questions relevant for conservation, e.g. When did the current species originate and how are they related?, Which biotic and abiotic factors represent most relevant threats for a given species/lineage? Are species adapted to the ecological conditions of the areas where they are living? Which territories contain the highest concentration of genetic, taxonomic and ecological diversity? How do we select the sources of genetic variation for reinforcement or restoration projects? Or, Which areas are the most suitable to carry out population translocations?

The analytical pipelines implemented so far in NEXTGENDEM allow us to carry out single- or multivariable analyses with curated collections of geographic, territorial, ecological, climatic, reproductive, genetic, morphological and other relevant data. Our overarching objective is to organise and further develop the information contents of biological collections and databanks on Macaronesian floras, and provide a framework for their integrative analysis to facilitate science-based biodiversity conservation. In future projects we will foreseeably establish connections with the Biodiversity Data Bank of the Canary Islands Government (*BIOTA*, https://www.biodiversidadcanarias.es/biota/), with the *Demiurge* information system for genetic diversity data (http://www.demiurge-project.org/), and with Mediterranean institutions and data portals that manage or generate complementary knowledge and are keen to collaborate.

Keywords: phylogeography, plant diversification, oceanic islands, conservation, DNA barcoding, bioinformatics.

GENMEDA network: results and future challenges for the conservation of the Mediterranean flora

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GENMEDA, Network of Mediterranean Plant Conservation Centres, is a community of seed banks and conservation centres of genetic resources, including local/regional authorities and national bodies.

Established in 2010, after two EU projects funded through the INTERREG Programme (GENMEDOC and SEMCLIMED) with the participation of its 13 founding members, GENMEDA is nowadays made up of 25 members and 2 associate members contributing to the conservation of the Mediterranean flora genetic resources. The work within the network is organised in 4 working groups: communication, database, orchids and microbiota, and seed force international.

The GENMEDA mission is to contribute to the conservation of Mediterranean flora genetic resources through the following objectives: enhancing human capital, equipment and methodologies in order to boost flora conservation applied knowledge; harvesting of most threatened species genetic materials and creating living plant collections; creation of a virtual common collection of vegetal genetic and reproduction materials; planning joint initiatives concerning flora conservation and/or management; supporting decision-making processes of flora conservation public policies; supporting environmental education and public awareness of biodiversity conservation.

Its cross-border nature from the southern, eastern and northern shores of the Mediterranean is one of GENMEDA's most important aspects, with members from Morocco, Algeria, Tunisia, Egypt and Lebanon in the south and east shores, and members from Spain, France, Italy, Malta, Croatia, Greece and Cyprus in the northern shore.

Partners share a common floristic region, a geographical area with a similar landscape and a common set of problems concerning natural environment disruptions. For this reason, they make a large contribution to conservation by running both *ex situ* and *in situ* joint and coordinated actions. Furthermore, cooperation leads to the development of common methodologies, applied technical and scientific know-how and information-sharing.

In the last year, the dissemination of central issues for the network has acquired a greater space thanks to the renewal of the website (www.genmeda.net), the opening of social accounts and the re-issue of the Odissea Seminum newsletter.

The results obtained in more than 20 years and the future challenges for the conservation of the Mediterranean flora are presented.

Keywords: Botanical gardens, genetic resources, *in situ* and *ex situ* plant conservation, Mediterranean flora, seed banks

Establishment of the Database on conservation actions on threatened plant species and institutions dealing with plant conservation in Europe: challenges and opportunities

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In the scope of the COST Action CA18201 ConservePlants, an initiative was launched for the establishment of the Database on Conservation actions on threatened plant species and institutions dealing with plant conservation. A database where plant conservationists could get information on practical conservation actions and their scientific foundation would be important and helpful to advance and coordinate conservation interventions on the European level.

Thus, the main goal of this initiative is to gather data on past (from 2000 onward) and ongoing conservation actions including various information about plant species included in it, habitat types, threats, existing management and conservation plans and specific activities undertaken, as well as the data about institutions dealing with different threatened species in European countries. The database will be freely available online and hopefully updated regularly with new conservation actions in the future. In this way, the exchange of knowledge and experience about plant conservation between scientists and other interested parties will be facilitated.

Up to date, despite different obstacles, we managed to gather information from 34 European countries. This enables us to reveal current geographical distributions of these actions; differences in organization, financial structures, success; type of the involved institutions; characteristics of species covered by these actions and their habitats; type of actions performed, etc. Finally, on the basis of all these analyses it will be possible to review some positive and negative aspects of finished conservation actions, identify knowledge gaps in plant conservation and provide guidelines for future use.

Keywords: *In situ*, *ex situ*, introduction, reintroduction, translocation, reinforcement

Acknowledgements: The research was supported by COST Action CA18201 “ConservePlants – An integrated approach to conservation of threatened plants for the 21st Century”.

Towards a Mediterranean Wetland Plant Red List Index – Call for collaboration by Mediterranean botanists

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Mediterranean wetlands face multiple pressures such as changes in land-use and over-exploitation of natural resources, that have led to significant degradation of wetlands in the region. More than half of the wetland area in the region in 1900 disappeared during the 20th century, and due to global warming, pressures on wetlands are likely to increase in coming decades. The unfavourable conservation status of many wetland-related species has been confirmed through assessments carried out for the IUCN Red List. However, our current knowledge of the conservation status of wetland species is still fragmented, while assessment of demographic trends is only possible for certain species, including very few plants. The Red List Index (RLI), an indicator based on changes in Red List category over time, appears to represent a promising solution to the lack of abundance data. We propose the establishment of an RLI for the Mediterranean region targeting wetland-dependent plant species. We present here a description of our approach to selection of species for inclusion and the results of the assessments used to establish a baseline for the RLI.

A list of 500 plant species was established, based on their distribution and habitat preferences, including 203 taxa endemic to the Mediterranean region. Among the 500 species assessed, 10% were assessed as Data Deficient, 66% Least Concern, 5% Near-Threatened, 7% Vulnerable, 8% Endangered, 5% Critically Endangered (thus 20% of the species assessed were assigned to threatened classes), while 1 species is Regionally Extinct but persists outside the Mediterranean Basin. More Mediterranean endemic species were classed as threatened than non-endemics. We propose the use of this RLI in conjunction with the Living Planet Index by the Mediterranean Wetlands Observatory and its partners, to document biodiversity trends and measure progress in wetland biodiversity loss in Mediterranean countries. To do this, we propose to mobilise a team of botanists from throughout the region to repeat Red List assessment of the target list of species at ten-year intervals.

Keywords: IUCN Red List Index, Wetland plants, Mediterranean flora, Conservation, Mediterranean Wetlands Observatory

The Mediterranean Alliance for Wetlands: the voice of wetlands in the Mediterranean

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Formally established in 2017, The Mediterranean Alliance for Wetlands (MAW) is a network of civil society and research organisations across 15 countries working together to increase the capacity of the Mediterranean communities to ensure the protection, restoration and sustainable use of wetlands and rivers. MAW vision is to ensure healthy Mediterranean wetlands supporting thriving communities and abundant nature and its mission to increase the capacity of Mediterranean societies to ensure the protection, restoration and sustainable use of wetlands and rivers.

As the most productive ecosystems in the world, wetlands and rivers provide a remarkable array of resources and services, including food and clean water, and also support biodiversity and people. Wetlands are one of our most vital strengths to tackle climate change.

Yet, wetlands and rivers are one of the most endangered ecosystems in the world. In the Mediterranean region alone, wetlands have halved between 1970 and 2013, with 36% of species threatened with extinction. Despite the action of several organisations individually preserving, promoting and restoring wetlands and rivers, these ecosystems are highly threatened by factors such as human action and climate change. In light of this, a strong and cohesive movement, such as the Mediterranean Alliance for Wetlands, which integrates a network of several organisations, is essential to upscale interventions and achieve the needed impact.

It is now more crucial than ever to build and collect knowledge around these ecosystems, to raise public and decision-makers' awareness on the value of wetlands and to facilitate exchanges between main actors. The Alliance can then leverage wetlands and rivers to enable greater commitment and have better informed policy and business decisions that prioritise suitable on-ground environmental action.

The members of the Alliance represent a wide array of experts working on wetlands-related topics at different geographical levels, and advocating for the promotion of sustainable uses, based on innovation and evidence-based best practices. Their niches and competencies range from scientific research and communication, capacity-building, and advocacy, to on-the-ground conservation and restoration. The Mediterranean Alliance for Wetlands crosses borders to bring together organizations who share a common goal: to increase the capacity of Mediterranean societies to ensure the protection, restoration and sustainable use of wetlands and rivers. It works together with key networks in the Mediterranean, particularly with MedWet, who is a permanent observer, and with IUCN Centre for Mediterranean Cooperation (advisory role) to develop successful advocacy, capacity building and communication actions.

The Mediterranean Alliance for Wetlands is an informal mechanism, without legal existence, meant to be as light, flexible and inclusive as possible. It is meant to be adaptive and responsive to serve the mission and the functions of the Alliance and seize opportunities. The priority of this mechanism is to create and maintain a good flow of communication, to build trust among members and to deliver key messages in a concerted way. The Members' Assembly guides the Alliance's strategy and action plan and is represented by a Steering Committee of members. The Secretariat is the supportive body that facilitates the operationalization of the action plan following the MAWs governance, currently is co-led by Tour du Valat and Wetlands International Europe. https://www.medallianceforwetlands.org/

Keywords: Restoration, sustainable use, Red alert, communication, capacity-building

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Driving forward the Mediterranean network on the interpretation, conservation and management of temporary ponds (habitat 3170)

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Transitional small wetlands are among the most degraded and threatened ecosystems in the European Union. According to the Habitats Directive, this has resulted in many standing freshwater habitats having 'unfavourable', 'vulnerable' or 'near threatened' conservation status. Transnational commitments are particularly needed to identify and overcome barriers hindering habitats' conservation status improvements. Temporally or seasonally inundated ponds are the most representative small transitional wetlands in the Mediterranean, although similar environments of great interest can be found in other bioclimates, such as tropical ones, or overlooked in the Mediterranean itself.

In March 2022, a platform of Natura 2000 practitioners, researchers and policy-makers from the Mediterranean area was established to brainstorm interpretation, restoration and valorisation approaches to harmonise identification schemes and enable long-term habitat conservation 3170. This platform of experts met for the first time in Rome at the Natura 2000 Networking Event "Disentangling the complexity and variability of Mediterranean temporary ponds (habitat 3170)", and on various other occasions, including at the European Vegetation Survey in Rome in the spring of 2023, the Symposium for European Freshwater Sciences in Newcastle in June of the same year. Many platform representatives cooperated in the appraisal of a project proposal for the Biodiversa+ BiodivMon Call for Research Proposals on "Improved transnational monitoring of biodiversity and ecosystem change for science and society" that was submitted on April 2023.

The 4th Mediterranean Plant Conservation Week will be an excellent opportunity to put forward the network and to exchange views and methodological advancements on the interpretation, conservation and management of temporary ponds in the Mediterranean and to exchange opportunities, experiences and knowledge worldwide.

Keywords: habitat misinterpretation, Natura 2000 Biogeographical Process, Habitats Directive, EU harmonisation process, data standardisation

An international network for the protection of sexual and parthenogenetic populations of streptophytic green macroalgae (*Chara canescens*)

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The loss of genetic diversity is considered a key element in entering the extinction vortex. This is especially true for asexually reproducing species, where recombination of traits is limited to the genetic variability of a single parent. The conservation of genetic diversity is thus a central element of conservation concepts. This presentation focuses on a project (Biodiversa+ 2021-2022) studying the stonewort *Chara canescens*, a species consisting of a few sexually reproducing populations and widespread asexual ones. The asexual populations are mainly found in Europe, with a few outposts recorded from North America, Australia and Central Asia. Sexual populations are very rare, only five sites are currently known worldwide, four in the Mediterranean and one in the Pannonian Basin. Previous studies have shown that the *Chara canescens* asexual populations have a higher genetic diversity than assumed. These results have led to the establishment of this hypothesis: “Species consisting of linked sexual and asexual populations can overcome the risk of loss of genetic diversity as long as efficient transfer of genotypes between populations is ensured”. So far, little is known about the connections between sexual and asexual lineages of a species. We will gather the knowledge necessary for the development of transnational conservation strategies. Based on this, we will establish a network for the sustainable conservation of C. canescens, as said, composed of extremely rare bisexual and common parthenogenetic populations. For this, field work at recent sites as well as analysis of herbarium material will be carried out to unravel recent and past gene flow within and between populations. The key activities will be: (1) to identify former and recent inland brackish water sites suitable for sexually and parthenogenetically reproducing populations, (2) to gain knowledge on recent and past genetic diversity of the target species, (3) to evaluate the potential of a few sexual populations in sustaining the genetic diversity of the widespread parthenogenetic populations. These data will provide a sound scientific basis for the ultimate goal: to develop management plans for inland brackish water sites that meet the requirements of C. canescens embedded in a transnational network of conservation sites with sexually mature populations, and focus on maintaining effective gene flow. In this presentation, the strategies to develop this plan, consisting of recommendations for site management and information exchange among network partners will be put forward.

Keywords: aquatic flora, charophytes, conservation strategies, genetic diversity, inland brackish water

Conservation strategy for flora in the French Mediterranean region

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The floristic heritage of the Mediterranean biodiversity hotspot is endangered by current socio-economic mutations and global change. In the French part of the Mediterranean region, a network called "RESEDA-Flore" (Network of Actors for the Conservation of Mediterranean Flora) was created in 2018. It brings together 22 members of scientific, governmental and non-governmental organizations, in order to improve cooperation for a better conservation and management of species and ecosystems.

This network needs to implement a conservation strategy to better allocate resources towards species and natural habitats. For the conservation of vascular flora, a strategy in four steps was developed, based on (1) the hierarchization of taxa; (2) the typification of conservation actions; (3) the prioritization of projects and (4) their implementation.

The first step enabled to hierarchize 5,252 taxa according to three criteria: biogeographical rarity, local rarity and threats. The taxa were sorted according to four different conservation concerns: very high (323 taxa), high (867 taxa), moderate (3,070 taxa) and low (283 taxa).

The second step enabled to define different conservation actions: knowledge improvement, knowledge review, site inventory, monitoring, surveillance and action plan. Each high or very high conservation concern taxon was linked to one conservation action. Knowledge improvement was suggested for 7% of taxa, knowledge review for 6%, site inventory for 20%, monitoring for 10%, surveillance for 18%, action plan for 2% and implementation of action plan for 4% of taxa. No action has been suggested for the remaining 33%.

The third step enabled to prioritize those conservation projects according to their benefit, feasibility and direct threats.

Concerning the fourth step, the RESEDA-Flore network is currently choosing conservation projects for species, and the members will implement them in their territory, sharing the same methods. The actions already implemented by the networks members are available online in a shared map database (http://www.reseda-flore.eu/src/actions/carto.php?idma=41), and the new ones will be added gradually.

Keywords: strategy, prioritization, vascular flora, network, conservation actions

Green Light: A system to promote wetland restoration activities in the Mediterranean

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The Mediterranean Alliance for Wetlands is a coalition of 30 civil society organisations and research organisations with the aim of increasing the capacity of Mediterranean civil society to ensure the protection, restoration and sustainable use of wetlands. Together, we are supporting the nature restoration movement with the Green Light protocol.

The Green Light is a protocol from the Alliance to support civil society organisations to conceptualise, advocate, communicate and finance a new restoration initiative.

The protocol fosters dialogue between stakeholders, scientists and landscape architects to build together the first vision and conceptualization of a restoration project. As an Alliance, we mobilise our members to provide the best professional expertise to local organisations to create strategies and plans, visualizations and communication materials. We believe that initiating and communicating the restoration opportunity as an international network of experts can make it easier to convince decision-makers to get involved in the process and help the stakeholders to find the right donors to invest. In this way, the protocol facilitates access to private and public funds for restoration.

Mediterranean wetlands are particularly vulnerable to climate change. Capacity building accelerates the implementation of wetland restoration as a nature-based solution to climate change. Empowering civil society by providing technical and financial support in the Mediterranean area is crucial to ensure ecological restoration and strengthen the resilience of nature to climate change.

The first pilot site for the Green Light is Akyaka in Turkey. Over the next two years, four sites will have the opportunity to take part in the Green Light protocol.

Keywords: restoration, partnership, visuals, international cooperation, communication

Acknowledgements: All partners from the Mediterranean Alliance from Wetlands and from the Mediterranean Wetlands Observatory

Strengths, limitations and opportunities of iNaturalist in plant research

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iNaturalist (https://www.inaturalist.org/) defines itself as an 'online social network of people sharing biodiversity information to help each other learn about nature', and it is likely the largest citizen science web portal of the world as it includes over 154 million observations (of them nearly 63 million plants) produced by a community of more than 2 million users.

The strengths and potentialities that explain the success of the platform are reviewed and include, among others, its easiness of use and low technical requirements (just a camera and internet connection are needed), immediacy (the observations can be published instantly, linking the images taken with the GPS coordinates), open-access (released under a Creative Commons license by default), the possibility of interacting with other users (which allows, among other things, to be helped and to aid identification--crowdsourced species identification), artificial intelligence-aided identification, versatility ('projects' can be created for certain species or regions or a certain time scale, which makes it a very useful tool for educational or Bioblitz-type projects), and the automatic incorporation of the 'validated' records (labeled as research grade) to GBIF, the main platform for biodiversity data on a planetary scale.

However, there are certain aspects that must be taken into account if you want to obtain quality results from data coming from iNaturalist. Among these aspects we highlight the identification errors, the lack of geographic precision or the inclusion of data on cultivated plants. Without forgetting that the platform continues to be a valuable tool for collecting biodiversity data and for involving the community in citizen science, we propose a series of improvement options that strengthen its potential within biodiversity research and conservation.

Keywords: citizen science, distribution maps, mobile app, occurrences, photography

The Conservation of Mediterranean flora in times of global changes. Twin missions of the National Mediterranean Botanical Conservatory of Porquerolles (France) and the Hamma Botanical Garden of Algiers (Algeria). An ongoing cooperation project

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A wide range of habitats or microhabitats characterizes the Mediterranean ecosystems. They are important not only for their biodiversity but also for their crucial role in coastal protection. The retreat of the coastline largely caused by massive removal of sediments and the destruction of coastal dune ridges resulting from continuous beach and backshore development, constitute a real threat to coastal habitats. The destruction of coastal habitats is further worsened by overcrowding places and leads to the loss of vegetation, often with high heritage value that it is urgent to preserve.

The ongoing project aims to strengthen capacities by providing training to garden staff and students completing their master's degree, with the objective of enhancing knowledge about coastal flora and *ex situ*/*in situ* conservation techniques. The project involves the constitution of a seed bank and a reference herbarium of taxa encountered along the sandy coastlines on both shores of the Mediterranean. The preservation of plant species with heritage value, through the creation of seed banks from either side of the Mediterranean, supported by capacity building in the field of conservation and restoration, are key factors in ensuring the protection and sustainable management of these vulnerable coastal ecosystems.

Preliminary studies prior to the restoration of coastal plant species are being conducted. A regional action plan to safeguard the coastal plant *Stachys maritima* Gouan, which is extremely rare and significantly declining in France, while its status in Algeria has not yet been evaluated. Stationary assessments are being carried out in Algeria for *Pancratium maritimum*, *Achillea maritima*, *Echinophora spinosa* and *Ammophila arenaria*. The scarcity of the latter species on the Algiers coast calls for urgent restoration efforts given its crucial ecological role in the fixation of dunes. On the French coast, *Cyperus capitatus*, *Erodium laciniatum* and *Maresia nana* are targeted.

This cooperation between the two shores of the Mediterranean would benefit from being renewed for targeted restoration actions and for continued capacity building.

Keywords: coastal dunes, Mediterranean, cooperation, training, conservation.

Theoretical and practical problems in defining habitat, ecosystem and related terms: the case of temporary saltmarshes

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The application in Europe of the "Habitats" Directive (HD) has accustomed us to consider the term "habitat" in a sense that is not the correct or the originary one. Although usually referred to as 'habitats' or 'habitat types', the ones listed in Annex I of the Directive are more correctly biotopes or biotope complexes [1], or ecosystems [2]. According to IUCN, ecosystem types are complexes of organisms and their associated physical environment within a specified area.

During field investigations in the Trapani province (Western Sicily), we had the opportunity to observe that, in the same area, an aquatic seasonal coenosis (characterized by species such as *Ruppia maritima*, *Althenia* sp., *Lamprothamnium papulosum*) occurring during the winter season is replaced by another terrestrial seasonal coenosis, characterized by glassworts *Salicornia* sp. pl. and showing its peak in summer.

The vegetation dominated by glassworts is usually referred to the "Habitat" 3110 ("*Salicornia* and other annuals colonizing mud and sand"), while the vegetation dominated by *Ruppia*, *Lamprothamnium* and *Althenia* is usually referred to the "Habitat" 1150 ("Coastal lagoons"). The problem is that in this way, according to the HD, the same area is occupied in different seasons by two different habitats.
We think it is more correct to consider the two "habitats" as part of the same ecosystem. This is discussed according to theoretical and pragmatic aspects related to ecological successions, European legislation, and efficient conservation.

Temporary saltmarshes have been recently the subject of a paper by Latron et al. [3] where the authors propose to separate the temporary "lagoons" from the permanent ones. We agree on the separation, and we understand the pragmatic choice to keep the temporary "lagoons" within the habitat 1150, but for the same reason we think they should be kept separated, and that the name "lagoon" cannot be used for a temporary basin.
Contacts between international governmental entities, research networks and international NGOs working in ecosystem/habitat conservation are needed, in order to clarify and improve the meaning of "habitats" in the European legislation.

Keywords: succession, phenology, conservation

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Valencian Plant Micro-reserves network, a valuable tool for the conservation of Valencian flora

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The Valencian Community is considered an outstanding hotspot of plant diversity of Western Europe, with 70 species and subspecies exclusive to this territory and 93 sharing small parts of their distribution area with neighbouring territories. According to the Order 2/2022 for the protection of Valencian endangered species, 50 species are listed as *In Danger of Extinction* and 44 as *Vulnerable*. Since 1994, the regional government has co-financed with different European funds several protection measures for these species, and promoted a network of statutory protected areas (namely 'Plant Micro-reserves', PMR). The Valencian Community has been a global pioneer in the formulation and creation of PMR, a legal figure that formally began with Decree 218/1994. The first PMR was declared in 1998 and, currently, the Valencian network has 312 PMR that occupy an area of 2,468 ha, distributed across 149 municipalities.

PMR are small land plots (up to 20 ha) of maximum value in terms of plant species richness, endemism or rarity, designed for long term monitoring and conservation of plant species and habitats. According to data available in 2023, the network includes 54% of the Valencian plant richness, with more than 28,500 populations of 1,882 different native species, in only 1% of the total regional area. Furthermore, 96% of the strictly endemic species and 91% of the species shared with neighbouring territories, 66% of *In Danger of Extinction* species and 48% of *Vulnerable Species* are included in the network. The network also protects 18 priority habitats (*sensu* EU "Habitats" Directive), covering the 69% of all type of habitats present in the Valencian Community.

The legal frame provides strong legal protection for plants and substrates in PMR, while allowing for traditional activities compatible with plant conservation, such as hunting, sustainable grazing or educational activities. PMR are mainly located in public land, although they can also be established on private grounds by means of contracts with landowners, either physical or legal persons, and this increases society's commitment to plant conservation.

The Wildlife and Natura 2000 Service of the Valencian Government legally carries out the PMR network management by employing one technician in each of the three provinces and several brigades distributed across the Valencian Community. Each technician coordinates all the management and conservation actions, such as censuses of protected species, seed collection and storage in seed banks, population reinforcements and translocations, herbivore exclusion, environmental restoration, control of alien invasive species, educational activities, etc.

PMR become a valuable tool for effective protection of plant diversity. This model of conservation of small-scale plant richness places has been adopted by other Spanish regions and other European Union countries, such as Greece, Cyprus, Bulgaria, Latvia or Slovenia.

Keywords: Plant conservation network, Endangered species, Endemic species, Valencian Community.

Wide-ranged, highly disjunct, locally rare and severely endangered: the challenging risk assessment and the global conservation strategy of *Erica sicula* Guss. *sensu lato* (Ericaceae)

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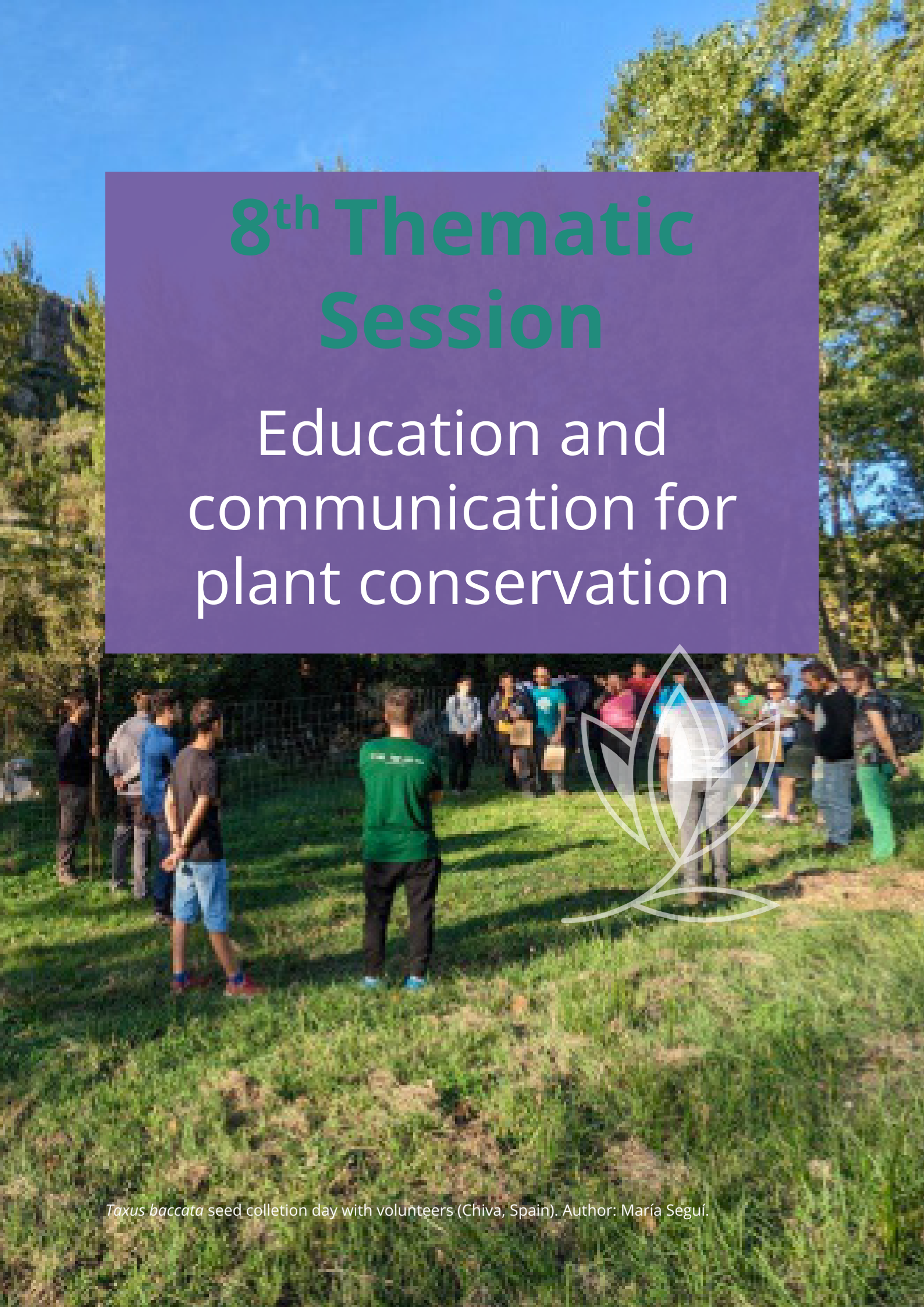
A global update on the knowledge related to the distribution and ecology of Erica sicula is provided. Despite its broad overall range area, this species, which probably represents one of the most ancestral members of the genus Erica, shows a strongly disjunct and fragmented distribution pattern and is subject to continuous regression at the local scale. Data obtained from literature and herbarium specimens, in fact, testify that two of the three historic populations of subsp. sicula have disappeared from north-western Sicily. Equally alarming is the situation of subsp. libanotica, increasingly affected by goat overgrazing and wildfires in Cyprus and counting one single population in Lebanon, located in a valley which is severely threatened by the growing impact of quarrying, urbanisation, road and dam construction. Further fieldwork is needed to better assess the demographic trend and the overall conservation status of subsp. libanotica and subsp. bocquetii in southern Anatolia (Turkey) and of subsp. cyrenaica in northern Libya. Moreover, genetic analyses may clarify the systematic value of the different taxa described in the Mediterranean Basin and help targeting future projects of in-situ and ex-situ conservation on the most unique and genetically rich populations.

Keywords: conservation priorities, disjunct distribution range, international partnership, threats, woody relict species

8th Thematic Session

Education and communication for plant conservation



Taxus baccata seed colletion day with volunteers (Chiva, Spain). Author: María Seguí.

Chair

Olga Mayoral

Degree (1998) and PhD. (2011) in Biology by the University of Valencia (Spain). She is the deputy director of the Botanical Garden-University of Valencia, as well as Professor in the Department of Didactics of Experimental and Social Sciences in the Faculty of Teacher Training.

With more than 15 years of experience as university teacher, she has carried out research and teaching visits at prestigious universities such as Harvard University and Göttingen University. She is the coordinator of the Biology and Geology specialization of the Master's Degree in Secondary Education Teacher Training (UVEG) and co-chair of the RCC-Harvard University study group "Teaching and Learning Science in Outdoor Environments (TeLeSOE)". She is a member of the Research group in "Scientific Education and Science Teacher Learning" of the same Department (UVEG).

Olga has participated in numerous international conferences and published books, chapters and articles in journals indexed in the Journal Citation Reports (JCR), SCImago Journal Rank (SJR) or the Latindex Catalogue, both on botany and in didactics of science. She is involved in research projects of the Ministry of Science and Innovation, related to the inclusion of sustainability in teacher training and is the coordinator of the Young Innovators project (EIT-Climate KIC) at the University of Valencia.

Her research focuses on one side on plant and biology conservation and on the other on outdoor education, Environmental Health Education, pseudoscientific issues, science literacy and critical thinking. She also participates in the project Fostering Outreach within European Regions, Transnational Higher Education and Mobility (FORTHEM). Since 2019 she is associate editor of the journal "Didáctica de las Ciencias Experimentales y Sociales" and Guest Editor of Special Issue "Challenges and Opportunities for Sustainable Education in Teacher Training in Time of Pandemic" of the journal "Sustainability". Since 2022 she is the Director of the Chair in Scientific Culture for Climate Emergency (CCC Chair), devoted to promoting the development of citizenship competences in relation to the current climate crisis in the context of the 2030 Agenda.

Plant conservation: Who cares?

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There are some ideas that it's easy to be agree with it. We are in these congress because plant conservation is important to us. Furthermore, our planet is living a complicated environmental moment with a significant loss of biodiversity, this situation gives added importance to conservation. Finally, different countries in the last few years have been working for the conservation of its diverse flora with lists, research projects, protocols, etc. However, there's always a loose tread in this garment: the communications of the importance of conservation and the education in these sense.

We know that the general concept it's understood. Who would want to see a shattered forest or a grass field? Unless you are an evil character of a cartoon (unfortunately this characters also exists in the real world). But we must ask ourselves if are we communicating the reality of conservation in a depth wat. Are we transmitting the importance of conservation? Are we teaching new generations to see conservation like a concrete concept, instead of an abstract concept?

We must take into account different things. In one side, the public is a very broad concept. It's important to know who we're addressing and why. The substance of the discourse will be the same, but not the form or the channels. In addition, we have that plants are in fashion, maybe only on an artistic or esthetical level, I call it "influencers plants". We could see that fact as a handicap or superficial, or make the most of it. This global world with all the people connected, the access to a technological tools unthinkable before ant to an informative universe, could be even our ally also.

The plants, their conservation, the importance of this action, a powerful idea that are we strongly convinced for. But here we are only a several hundreds of people, is not enough. The communication and the education of such conservation, well designed, can allow us to grow up these numbers exponentially.

Keywords: science dissemination, environmental education, social media, awareness, new channels

A network of volunteers and observers for LIFE medCLIFFS: an efficient tool for the detection of invasive plants in the Costa Brava

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Citizen science is currently a great source of biodiversity data that allows monitoring species at multiple temporal and geographic scales. The project LIFE medCLIFFS [1] leverages citizen science to improve the management of invasive plant species in the Costa Brava (NE Spain) with a double objective: (1) to early detect invasive plants and (2) to raise citizen awareness of the problems they cause. For this purpose, two participatory networks have been developed through the iNaturalist application. The observers' network of LIFE medCLIFFS [2] allows the public to collect data on 180 alien species. Anyone can upload data to the project and more than 3,500 observations made by nearly 400 observers have already been collected in just one year. The volunteers' network of LIFE medCLIFFS [3] needs a higher degree of commitment from the participants, since they must conduct the follow-up (once a year) of their assigned transects (usually only one, of approximately one km long) in the Costa Brava, to detect and monitor the populations of 33 selected invasive or potentially invasive plant species that have been previously selected. Using the same app, they record data such as the reproductive status of the observed individuals, the area they occupy and the number of individuals observed. Since April 2022, 81 volunteers have been recruited to monitor 78 transects, although the enrollment of volunteers is still ongoing. Volunteers are specifically trained for species recognition and data collection by specific courses, supporting materials such as dichotomous keys, complete descriptive cards of the 33 species and a protocol for monitoring, as well as planned one-day trips to teach how to monitor in situ.

The final objective of the data collection (by both observers and volunteers) is the elaboration of invasion risk maps, which will be further used by land managers to prevent the establishment or advance of the most dangerous invasive species. To recruit volunteers and encourage citizens to become observers, different activities have been promoted; these include, among others, Bioblitz type activities, to show the rich biodiversity of these cliffs and to raise awareness of the problem of invasive plants, field workshops on how to use the iNaturalist application, and seminars to the general public about the project and the targeted invasive species. We expect that these activities, all together, will raise awareness of the problem of invasive plants and their management among the general public.

Keywords: citizen science, conservation, iNaturalist, alien plants, citizen awareness

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A new look at the book “The secret life of plants” (C. Bird & P. Tompkins)

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The secret life of plants compiles a series of experiments and findings related to plants carried out by various researchers, exposing the relationships that exist between plants and Man. Through its pages we discover, among other things, that plants are effective ecological sentinels and that they can cure certain diseases.” (cf. Spanish edition, 2016).

The studies on the communication of plants described reach the conclusion, by an unsuspected path, that all living beings are related to each other and to their environment.

With our contribution, the 50th anniversary of the publication of the first edition of the book *The secret life of plants* is celebrated.

An unprecedented first-hand look is presented through Christopher Bird’s daughter, Doina Bird, as co-author and presenter of this communication. It relates how and why the genesis of the book took place, the working methods for bibliographic research and the experiments carried out, in situ, by the contemporary researchers of the cited authors. Part of the biographies of the authors who influenced the idea of writing the book are reviewed and some of the criticisms received are commented on, at a literary and scientific level.

And the book that followed *The secret life of plants*, *The Secrets of the Soil*, by both Bird and Tompkins, which was never translated into Spanish, is presented. Published in 1989, and following the pioneering line, through multidisciplinary research, ancestral and biodynamic global practices of improving the soil are described, avoiding the use of chemicals in insecticides and fertilizers that continue to destroy the field and offer solutions and hope to problems ignored during the industrial boom.

Keywords: Christopher Bird´s daughter, 50th anniversary, research, book anecdotes, book contribution.

Batloun Native Botanical Garden – Chouf, Lebanon

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Tariq El Nahl (Way of the Bees) Collective was established as a response to the Beirut explosion in August, 2020. The mission of the collective is to create avenues in educating local communities about the native plant diversity surrounding them and the land-based culture derived from it. Ultimately, this knowledge will contribute to enhance the protection of our local ecosystems. Levantine ecosystems as a whole are poorly studied. The knowledge about the uses of local plants in alimentation, medicine and landscaping is slowly going extinct. Our approach is the curation of regional native botanical gardens in target regions across Lebanon, hosted by local actors, that serve as local hubs for both the gathering and dissemination of knowledge around local biodiversity. Our aim is for each garden showcase wild plant diversity specific to the region, with a focus on typical plant species of the Mediterranean region, on representative examples of the fragile and unique flora of Mount Lebanon and the Levant, and species that are under-represented in protected areas. Our first regional native botanical garden, Beit Sarmada Botanical Garden, situated in the village of Batloun in the Chouf district, was established in March 2021. It includes exclusively selected plant species that naturally occur in the adjacent valley of the Barouk River, just below the village of Batloun. Visitors to the garden can encounter any of these plant species during a walk in the valley afterwards. A particular attention was given to rare species and to species endemic to Mount Lebanon, such as *Centaurea mouterdei* Wagenitz, which is endangered at the global level. Currently, the garden currently exhibits 150 plant species. We recreated their natural habitats in the garden, namely rocky slopes, cliffs, wooded areas and humid areas. Alongside the garden, we also have a seed library containing all cultivated species, a native nursery for propagating target species, an open-sourced online database listing the plant species present in the garden. In collaboration of three traditional artists – a sculptor, a ceramist, a bushcraft expert, installations were included to serve as a guide for visitors, highlighting target species and cultural stories, and offering a visually and experientially beautiful experience. The ultimate goal is for these gardens to gather locals and visitors in building awareness, and together making a case for the greater conservation of our unprotected regions.

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https://www.youtube.com/@tariqelnahl2396

Keywords: ethnobotany, botanical garden, Levant, education, awareness

Can citizen science help plant conservation? Strategies and tips from LIFE 4 Pollinators and Conserve Plants projects

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We cannot halt biodiversity loss, restore degraded ecosystems and guarantee food security, without safeguarding wild pollinators and pollination, the "service/benefit" that they supply to agricultural and natural environments. Indeed, a great majority of flowering plants relies on insect pollination for sexual reproduction; by transferring pollen between flowers and among individuals, flower visitors maintain genetic diversity within and among wild plant populations. However, information on plant–pollinator interactions is only partly available to the scientific community, with a big knowledge gap characterizing the Mediterranean region. Indeed, in southern EU countries people's level of awareness is generally very low and attempts to address specific policies are just starting. The project LIFE4Pollinators (www.life4pollinators.eu, LIFE18/GIE/IT/000755) aims to encourage a change of behaviour in key stakeholders and civil society and improve the application of pollinator-friendly practices across the Mediterranean region. Beyond the general public, specific target audiences are students, educators, farmers, urban gardeners and urban green managers, conservationists, park managers, policy makers, and competent authorities.

Different tools are used to increase awareness and knowledge: animation videos, digital and printable illustrated field-guides to pollinator, and plant diversity, specific handbooks and pollinator-friendly codes of conduct. A general citizen science approach is adopted and specifically developed regarding a spectrum of diverse actions to be implemented. Citizen science activities involve people not only as recipients, but also as active contributors to the collection of scientific data, fostering public knowledge, awareness and engagement. An online web platform to collect data from pictures sent by users has been developed: to date (June 2023) almost 2000 photos have been uploaded from 6 countries, some of them depicting species of conservation concern. Such specific information represents a tiny contribution to the implementation of the first "List of pollinators of EU threatened plants", deliverable of Conserve Plants COST Action (CA18201, www.conserveplants.eu). This information, as well as that gathered through the web-platform thanks to citizens and volunteers, can become easily available to natural parks managers and practitioners, all constituting a major potential of the citizen science tool. Herewith, we present materials and tools of the two projects, focusing on the web-platform dataset from a conservation perspective.

Keywords: plant-pollinator interactions, biodiversity conservation, participatory science, repository platform, public awareness

Contribution of Mediterranean Ecosystem Conservation Center education activities on Mediterranean Flora Conservation in Portugal

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Nature Conservation has an undeniable role in order to repair human impacts on ecosystems, but at the same time pressures on natural ecosystems have been continually increasing. On the Mediterranean region, and particularly in Portugal, land use changes, intensive agriculture, climate change impacts have been producing negative effects on local Mediterranean Flora. Environmental education can play a major role in preventing new negative impacts on the Mediterranean ecosystems and Flora, and at the same time reduce the impact of current pressures; by making possible to re-establish the connection between people and nature and at the same time by promoting pro-environmental behaviours, attitudes and values.

In this paper we will review the contributions of Mediterranean Ecosystem Conservation Centre, managed by Marca-ADL education activities on Portuguese Mediterranean Flora conservation. MECC develops its activity from a Plant Nursery, which started to be implemented in 2015. Education activities are implemented using the principles of transdisciplinary, inclusion of different types of communities, through partnerships and networks, in articulation with different territories, enabling a local, regional, national and international intervention.

Such activities include: environmental education; environmental volunteering, nature and creative tourism and a free of charge support service to the plant nursery clients, interested in acquiring plants and associated services (e.g. plantation services).

As a result of these education activities the target audiences contribute directly to more than 100 species of the Portuguese Mediterranean Flora conservation by assisting: seed collection, propagation in the plant nursery, habitat restoration particularly in urban and peri urban areas, eradication of invasive species and awareness raising. At the same time the target audiences also increase their knowledge around Mediterranean Flora and ecosystems conservation and around the value of biodiversity, build a connection with nature and change their perceptions, attitudes and behaviours towards the environment.

Keywords: behaviours, volunteering, plant nursery, communities, transdisciplinarity, education

How can Mediterranean plants help understanding Climate Change? A teaching proposal for the Botanical Garden of the University of Valencia

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The role of botanical gardens in facilitating scientific literacy becomes exceptionally relevant in the context of the current scenario of Climate Change and biodiversity loss. There are basic concepts about Climate Change that find in botanical gardens an ally to facilitate their understanding throughout outdoor education. Taking advantage of the outstanding plant diversity, the importance of biodiversity for the maintenance of human life can be addressed in an attractive way. We present an itinerary in the Botanical Garden of the University of Valencia with this aim.

- Stop 1. *Quercus ilex*. The role of photosynthetic organisms, both terrestrial and marine, is irreplaceable in climate regulation. Plants, tropospheric carbon sinks, play a fundamental role in the maintenance of environmental living conditions, which is currently being compromised due to habitat loss and degradation.

- Stop 2. Greenhouses. The greenhouse effect, natural and essential for life on Earth, inspires the use of a similar mechanism to modify the environmental temperature and thus reproduce habitats and climatic conditions different from the natural ones. A visit to the greenhouses of a botanical garden helps to understand this process, as well as the need to restore the atmospheric balance on which it depends.

- Stop 3. Mediterranean rockery. The adaptations of plants to environmental conditions are a good way for understanding the Mediterranean climate. It is also possible to discuss the differences with previous climate changes, natural and prolonged in time, and the current abrupt, accelerated, and anthropogenic. *Taxus baccata* and *Fraxinus ornus* are good examples of trees from periods of time in which we had colder or subtropical climate.

- Stop 4. Threatened plants. Ecosystem services, the multitude of benefits that nature unintentionally offers us and that make human life possible, are being altered because of the increase in environmental degradation due to anthropic causes. Botanical gardens allow the study of habitats, not just isolated species, and help to understand that human health is directly dependent on the state of the natural systems that support it. The itinerary focuses also on this relationship designated by the World Health Organisation as “One Health”.

Keywords: photosynthetic organism, climate crisis, education, green spaces, carbon sinks

ICT and elderly in the TURNTABLE project: educational and recreational activities of social agriculture and gardening for plant conservation

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Turntable is an ICT platform that promotes healthy and active aging among the elderly, motivating them to adopt healthy lifestyles and involving them in recreational farming activities and social gardens. It has been hypothesized that as people age, they tend to be less active and more sedentary leading to a variety of problems such as muscle wasting and a decrease in physical power and strength. The elderly therefore become more fragile and subject to constant health problems. To fight this phenomenon and invest more in the elderly population, it was decided to create the TURNTABLE platform, which integrates various unified ICT tools into a single intuitive, personalized and adaptable solution. The TURNTABLE project was tested in Italy, Belgium and Portugal, involving about 200 people over 60.

The experimentation in Italy was organized by the University of Cagliari. The community gardening experience took place at Hortus Botanicus Karalitanus (HBK) of the University of Cagliari between 2021 and 2022 using a special area dedicated to agrobiodiversity.

Participants were involved in the planting, cultivation, irrigation, soil care, and harvesting of vegetables for a period of six months in which they learned how to use mobile applications and sensors developed specifically for the project to manage and optimize common agricultural practices. Participants were asked to complete a series of questionnaires both before and after the agriculture activities to gather baseline information and evaluate the impact of the social experiment.

Results shown that participants not only acquired knowledge about preserving plant agrodiversity, but also embraced the value of sociability engaging in outdoor recreational activities and breaking down the isolation many elderly people suffer from.
Furthermore, at the end of the experimentation, participants were able to share their experience with the community by discussing and providing suggestions on how to take care of plants and preserve biodiversity.

The important results obtained provide the basis for extending the experimentation to other countries not currently involved in the project to sensitize the population to preserve the biodiversity of local territories.

Keywords: agrobiodiversity, elderly, healthy lifestyles, ICT, social gardening

Masters of survival: Why are climate relict plants so important?

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The Mediterranean Basin hosts several plant species that are defined as climate relicts. Most of them have a very narrow distribution range, and their survival is very often related to particularly favourable (micro)climatic conditions (e.g., no or slight seasonal water stress, no frost damage). Many of these relict plants represent the last remnants of ecosystems once widespread across the entire Palearctic; they gradually disappeared during the Pleistocene, mostly due to repeated glacial events.
Understanding the strategies adopted by climate relicts to face global changes is of paramount interest and may help us to bear light on ongoing climate change. In fact, to survive in the long-term, such plant species underwent important niche shifts, which in turn often required deep changes in their physiological, anatomical, and reproductive traits. Moreover, most climate relicts live “out of context”, behaving like “special guests” that bear many traits that are uncommon in the plant communities where they currently grow. In fact, they often represent the only survivors of the extinct ecosystems they used to live in, and past global changes may have affected not only the assemblage of co-occurring vascular plants, but also other key components such as pollinators, seed dispersers, predators, symbiotic soil organisms or pathogenic fungi.
The study of the distribution pattern of relict plants looks very promising and of paramount concern when combined with the study of other biogeographically peculiar taxa. For instance, it cannot be a coincidence if large ferns of paleotropical origin, narrow-ranged and evolutionary isolated plants, species belonging to monotypic and/or endemic genera or subgenera, and plants with highly fragmented distribution ranges grow in the same region. Instead, the co-occurrence of such plants may provide valuable pieces of knowledge to the understanding of specific mechanisms and processes allowing their persistence until present time and may represent a useful, complementary clue for identifying important and still neglected refugial areas.

Keywords: adaptation, ecosystem functioning, evolution, historical biogeography, species assemblages

On Farm Plants Genetic Conservation and Sustainable Pastoralism In Georgia

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The Association for Farmer's Rights Defense, AFRD is a non-profit organization dedicated to improving livelihoods, advocating for local Farmers, conserving Agrobiodiversity and ecosystems, sustainably producing food and organization of Farmer's Markets, and restoration of degraded land and rural landscapes. For 20 years, our cutting-edge work has harnessed the power of integrated on-farm Plants Genetic Resources Conservation and pasture management to achieve interlinked goals of food security, human well-being, climate action, ecosystem regeneration, and biodiversity and habitat conservation in the Alpine zones of Georgia.

Climate Change consequences are increasingly technically feasible, but remain highly controversial due to their transboundary nature, their risks of unintended harmful impacts, and the presence of fundamental ethical concerns on Pastoralism. Advancing an understanding of the potential efficacy, cascading environmental and social impacts, and societal acceptability of climate intervention requires broad public engagement and ongoing collaboration across a diverse spectrum of expertise for sustainable pastoralism as a multidimensional area for various disciplines.

Keywords: Agroecology, Pastoralism, Climate Change, Gene Banking, Habitats

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‘Projecte Posidònia’ a scientific, educational and social approach to the preservation of Posidonia oceanica meadows in Marina Alta region (Alicante, Spain)

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During the academic year 2023-2024, ‘Fundación Oceanogràfic’ with ‘Ciudad de las Artes y las Ciencias’ developed a project towards the protection and study of *Posidonia oceanica* in the region of Marina Alta (Alicante, Spain). The project was funded by Banca March through their Mediterranean Fund. *P. oceanica*, or Neptune’s grass, is a marine plant endemic to the Mediterranean that generates extensive and productive meadows with multiple ecological benefits. The region of study stands out for holding one fourth of all *P. oceanica* meadows in Spain. On the basis of the transformative power of education, we present a project that puts *P. oceanica* in the center of discussions on sustainability issues and coastal biodiversity in general. Ocean literacy is generally a forgotten area of knowledge in formal education, creating an opportunity to create alternatives to traditional approaches that the teachers and the general public can find enriching, increasing knowledge and awareness in an attractive way. The project divided the work in two dimensions: 1) a technical, intended to update the knowledge of the area covered with P. *oceanica* with the use of a side-scan sonar technology, mapping the seafloor between the municipalities of Dénia and Calp (isobaths between -0.5 and 35 m depth approximately). 2) and one of educational interpretation-awareness, whose ultimate goals were to promote correct decision-making in matters of environmental conservation and to generate attitudes that contribute to sustainable behaviors on the part of citizens and all interest groups. This included three types of activities: a) the development of a free access application in which to integrate the resulting seafloor map, allowing the users to avoid anchoring in *P. oceanica*, and where information-awareness articles about the coastal environment are provided, targeting nautical users in an area of high impact of this recreational sector; b) an awareness campaign on the school community that proposed the development of projects that exercise the scientific method, critical thinking and the generation of scientific vocations; c) a tourist-aimed awareness campaign, focusing on coastal ecosystems as natural heritage. The positive outcomes of the project show how a diverse approach considering many stakeholders can benefit educational and awareness purposes when working with environmental issues.

Keywords: *Posidonia oceanica*, Ocean literacy, Marine Botany, Marine Phanerogams, Didactic Proposal

Acknowledgements: Banca March for the funding of this project through their Mediterranean Fund.

The relevance of citizen participation in decision-making processes related to environmental preservation

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LIFE Teixeres (LIFE20 NAT/ES/001128 LIFE TEIXERES) is a nature conservation project funded by the European Union's LIFE Programme and carried out in the Valencian Community. Under the title Conservation and restoration of relict forests of *Taxus baccata*, the main objective of the project is to improve the conservation status and resilience of Mediterranean yew (*Taxus baccata*) forests in Valencia. Its coordinating beneficiary is the Generalitat Valenciana, the technical coordination relies on the Centre for Forestry Research and Experimentation, and its associated beneficiary is the company VAERSA. It has a budget of 2.406,410€, 75% of which comes from European funds. It is the most important intervention carried out so far in the improvement of the yew habitat in Valencia.

The LIFE Teixeres project is carrying out a participatory process in the areas of action with the aim of gathering the opinions, concerns and proposals related to the project, as well as the environmental preservation and management of the biodiversity of organised citizens.

Specifically, seven workshops will be held from June to September 2023 in the locations close to the project: 1. Tinença and els Ports, 2. Alt Maestrat and Alcalatén, 3. Alt Palància and Alt Millars, 4. Puebla de San Miguel, 5. Chera and Sot de Chera, 6. L'Alcoià and el Comtat, 7. La Marina Alta and Marina Baixa.

Organised representatives of civil society such as local development agents, environmental associations, neighbourhood associations, agricultural/livestock cooperatives, rural tourism organisations, hunters' associations, environmental educators and owners of plots of land in the project, as well as representatives of the general public and councillors and environmental technicians from local councils have been invited to participate.

The participatory process is using a methodology of social mapping or collective mapping, in which workshops, discussion tables and/or surveys have been used as tools to collect qualitative and quantitative information from the participants.
The communication will present the results of this participatory process that seeks to foster local community participation. The results will reveal the level of commitment and awareness on the part of organised citizens regarding the importance of preserving the natural environment and biodiversity of the areas included in the LIFE Teixeres project. Challenges and opportunities will be identified, as well as innovative ideas for the implementation of the project, ranging from yew conservation to environmental education and the promotion of sustainable tourism.

This communication aims to highlight the relevance of public participation in the project.

Keywords: participation, life programme, Taxus baccata, relict forests conservation

Towards a new participative approach to the conservation of Mediterranean Wild Edible Plants

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Wild Edible Plants (WEPs) are vital components of traditional Mediterranean food systems, yet knowledge gaps persist in understanding their taxonomic diversity, biogeographic distribution, and nutritional value. Societal changes have accelerated the decline of WEP consumption and eroded traditional ecological knowledge (TEK) related to their gathering and preparation. These factors pose threats to the Mediterranean diet's long-term integrity and hinder effective conservation and valorisation strategies for native non-crop resources. Our study aims to address these challenges by retrieving, maximizing, and consolidating accessible knowledge on WEPs to enhance nature's contribution to people's lives in the Mediterranean Basin.

We present the first comprehensive checklist of WEPs of the Mediterranean region, including all countries bordering the Mediterranean basin, as well as those included in the broader Mediterranean cultural region (i.e., Jordan, Portugal). By integrating information from international datasets and extensive literature reviews, this checklist includes supraspecific taxa, accepted species names, authors, species origin, geographic information, conservation status, and detailed ethnobotanical insights into their phytoalimurgic use across Mediterranean countries. Additionally, we will develop an open-source online database, serving as a valuable resource for researchers, policymakers, and practitioners, facilitating a participative approach to WEPs conservation.

By fostering accessibility and engaging various stakeholders, we empower communities to actively participate in the preservation of WEPs, ensuring the long-term sustainability of these valuable resources. Through these efforts, we can fully unleash the untapped potential of these extraordinary resources, contributing to a thriving Mediterranean biota and sustainable food systems.

Keywords: Wild Edible Plants (WEPs); Mediterranean vascular flora; Conservation; Traditional Ecological Knowledge (TEK); Online database

A botanical garden and a wide variety of audiences, a commitment to the public and the promotion of scientific vocations. The case of school audiences

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Marimurtra is a Botanical Garden placed in an exceptional location, with a very favourable climate at the emblematic cliffs of the Costa Brava. It has a peculiar origin since its creation was the dream of one person, Carl Faust, a German businessman with a great sensitivity for nature and science, who surrounded himself with great botanists (such as Pius Font i Quer and Sventenius) to create a garden where scientists could study plants from all over the world.

The Marimurtra Botanical Garden has historical, cultural and natural characteristics that make it receive, every year, a large number of visitors from different origins and with different interests. This fact allows us to work to spread the importance of the plant world, as stipulated by Carl Faust at the time of the foundation of the organization which today (71 years after his death and 99 years after opening its doors) continues to ensure the conservation of this small gem of biodiversity, 4 hectares in size and with 4000 cataloged plant species from 5 continents.

Thus, as a Botanical Garden, living museum and science center, its basic function is to protect and promote the study of Mediterranean biology, especially botany, and with this aim, to conserve and improve Marimurtra, for the benefit of scientific research and dissemination.

At present, different dissemination activities are carried out for different audiences (schools, universities, vocational training, environmental technicians, families, etc.) through different formats (guided tours, technical, manipulative activities, itineraries and routes, etc.) with the aim of contributing to the dissemination of plant knowledge. Over the last few years, Marimurtra has been working to make its educational activities, especially those aimed at younger audiences (school stage), more experimental and manipulative as shown in this poster. In short, seeking to generate more experiential experiences that really encourage interest in botany and curiosity about the environment. All of this, facilitating the acquisition of knowledge and adapting the content to each educational stage.

These activities are being very well received and in the near future the Fundació Privada Carl Faust intends to extend this *modus operandi* to other activities, not only those focused on the younger public,

Keywords: education, experience, science, botany, school, manipulative activity, garden.

About the flora and conservation interest of Les Moles (Paterna, Valencia, Spain)

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The natural site of Les Moles, in the municipality of Paterna (Valencia) is located in the metropolitan area of the city of Valencia. Incorporated since 2021 to the Turia Natural Park as an Agricultural-Forest Mosaic Area, according to the PORN approved by the Valencian Autonomous Government, it occupies an area of 471 hectares of forest and agricultural land. Rainfed crops with carob and olive trees coexist with pine forests of *Pinus halepensis* Miller and dry scrub in limestone and semi-arid soils rich in endemic Ibero-Levantine species.

The flora of Les Moles amounts to 323 taxa of which 18 are of Ibero-Levantine endemism, in addition to others considered rare taxa by the Biodiversity Data Bank of the Valencian Community (BDDB). The presence of *Teucrium edetanum* Crespo, Mateo & Navarro stands out, Valencian endemism included in the Valencian Catalogue of threatened flora species, annex III, VIGILATED category.

The climatic conditions of the area, close to the semi-arid bioclimate, give extra value to its plant communities, with three habitats of priority Community interest (Habitats Directive 92/43/EEC).

A part of the site has already undergone irreversible changes in the landscape, flora and fauna. The latest attempt at urbanization that threatens the conservation of these natural values is the construction project of a Macro Shopping Center, which began in 2012 to requalify 200 hectares as developable land. Finally, in 2021, thanks to the natural values listed and the citizen pressure represented by social groups, the Valencian Government incorporated the place of les Moles in the scope of the Turia Natural Park.
Currently the aforementioned protection of the site has been appealed before the courts by the construction company of the macro-shopping center and the City Council of Paterna, to whom the resolutory sentence issued by the Superior Court of Justice of the Valencian Community recently has given the reason, sentence appealed, in turn, by the aforementioned Coordinadora.

Keywords: protection, endemism, biodiversity, Coordinadora, Paterna.

Ancient roses in the province of Albacete (Spain): A biocultural heritage to be gathered through citizen science

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In many localities of the province of Albacete (Spain) we can still find people who develop a way of life that has made them bearers of valuable information about the traditional uses of natural resources. Their way of life is a guarantee of sustainability and the Traditional Knowledge they have acquired about the natural environment is an important part of our Natural and Cultural Heritage. An important aspect of this way of life are the vegetal elements with an ornamental function and, especially the so called “old roses”; very aromatic roses that, in good part, arrived to the Iberian Peninsula in past times. Today, this roses are located in small towns and villages and, especially in country houses like *cortijos* or *quinterías*. Among the objectives of this work are: to elaborate an inventory of the species and varieties of “old roses” cultivated in the province of Albacete, to document the traditional management model of the cultivated rose species, to register the different populations of cultivated rose species as well as to collect scions in order to reproduce it. The work methodology is based on: field work with prospecting of abandoned gardens and country houses. Review of bibliographic and oral sources from published works on ethnography or ethnobiology and interviews. Results: More than 40 populations have already been registered and its living material has been collected and donated to the Botanic Garden from Castilla-La Mancha and other stakeholders. Finally, we intend to publish a monograph for publication and dissemination.

The predominance of old species of exclusively spring flowering and well-defined colors is noteworthy, predominating among the yellow ones: *Rosa foetida* Herrm. and R. *foetida* f. *persiana* (Lem.) Rehder and the multi-petalled *R. hemisphaerica* var. *plena* Rehder. Among the red ones, *R. bicolo*r Jacq. stands out, which sometimes presents chimeras with branches that revert to their yellow ancestor (*R. foetida*). The non-remontant white roses belong to the complex *R.* x *alba* L. Finally, there are frequent perfumed roses of more or less intense pink color with varying levels of polypetalia of the complex *R. gallica* L, *R.* x *damascene* Herrm. and *R.* x *centifolia* L.

The whole denotes an ancient character prior to the appearance of the remounting hybrids, the “Bourbon” roses and the hybrid tea roses.

Keywords: Cultural Biodiversity, Citizen Science, Ethnobiology, Ancient Roses, Albacete

Acknowledgements: Rest of the members from the Amigos del Jardín Botánico de Castilla-La Mancha Albacete’s Association (more than one hundred partner-volunteers)

Biodiversity 2030-2050: An art project to empower society in plant conservation

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During the 4th Mediterranean Plant Conservation Week, it will be possible to visit the Biodiversity 2030-2050 project at the Botanical Garden of the University of Valencia (JBVal). The same 12 photographs were presented at the XI Congress of the Spanish Society for Plant Conservation Biology (SEBiCoP) in Las Palmas de Gran Canaria. This project proposes, from the "Visual Ecocriticism" perspective and considering the "plant blindness" phenomenon, a "happening" action consisting of voting with ballots by visitors, who would select two images of species that should be protected. A template accompanies each image with some botanical information. Visitors who wish to participate in the vote will answer anonymously a series of simple items related to their person. The aim is to detect possible trends to understand patterns of behaviour about the protection and conservation of plants, as well as to establish possible links between the selection made by the public and the information and contrasted data provided for each photography to help their knowledge and argue their status. The comparative data of the first surveys collected in the JBVal with the surveys obtained at the SEBiCoP congress are presented. The results indicate a selection of photographic images utterly different between both population samples ($\chi2 = 167.82$, $p<0.0001$, d.f.=11). Differences that are detected in the rest of the characteristics of both samples, such as gender ($\chi2 = 24.386$, $p<0.0001$, d.f.=2), level of studies ($\chi2 = 137.36$, $p<0.0001$, d.f.=8), type of studies ($\chi2 = 287.39.36$, $p<0.0001$, d.f.=12), employment ($\chi2 = 79.175$, $p<0.0001$, d.f.=4), and marital status ($\chi2 = 45.743$, $p<0.0001$, d.f.=7). The two species to be conserved have also been different: in the JBVal sample, *Gazania* sp. and *Kleinia grantii*, were the most voted (42 and 40 votes), while in SEBiCoP, were *Cistus creticus* and *Onopordum nervosum* (42 and 40 votes). In both samples, there is a coincidence in the low assessment of *Nothoscordum gracile*. The Mantel test for the similarity matrices between images selected in the surveys based on the Jaccard index for both samples gives a cophenetic correlation of -0.15264 ($t=-1.1329$; $p = 0.1286$; 999 permutations), and for the similarity matrices between the images but based on the number of times they were selected, gives a cophenetic correlation of 0.1217 ($t = 0.7301$; $p = 0.7674$; 999 permutations), which demonstrates the lack of resemblance between these two samples.

Keywords: Visual ecocriticism, Plant blindness, Biodiversity, Conservation, Happening, Fine art photography.

Acknowledgements: The authors thank the staff of the Botanical Garden of the University of Valencia and the organizing staff of the XI SEBiCoP congress for their interest in the Biodiversity 2023-2050 project.

Ecological restoration in Eastern Spain: A baseline on the needs of knowledge for future and current practitioners

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Although ecological restoration (ER) is a key need for sustainability and environmental policy in the Mediterranean area, its knowledge transfer has proved to be a main barrier to advance towards its spreading as a regular practice. Apparently, the inter-relation between the main actors for ecological restoration -scientists, managers, policy-makers- strongly fails, due, amongst other factors, to the scarce transfer of knowledge, both thinking of the formation of new practitioners, and of the daily work of the ER community. Are there knowledge gaps on ecosystem restoration in the learning curricula at different levels -at least for medium and higher education-, as well as in the facilitation of knowledge advances to professionals working in this topic?

To solve these problems, a baseline information is needed, and main practitioners and entities involved in restoration planning and practice should be consulted. The Erasmus+ project TRAIN#ER (Training and Ecological Restoration, March 2022-February 2023), has been devoted to search for this knowledge needs and gaps across Europe, joining partners from Germany, Czech Republic, Norway, and Spain. For the last case, the unique Mediterranean representative, the project has been mainly developed in the Valencian Community (Eastern Spain). The TRAIN#ER schema involved 5 steps: 1) a survey to capture training needs in ER; 2) establishment of focus group, to discuss and propose recommendations in ER training; 3) setting up of a community of practice, sharing and interacting with the ER community; 4) bringing outputs such as summaries, reports and papers including the results and recommendations; and 5) the communication of the progress and outcomes to the whole ER community. For the referred case of the Valencian Community, an online survey to specialists from 4 groups of practitioners -science and education, government, enterprises, and third sector and NGOs- was performed, sending an accurate questionnaire up to 208 people, and receiving positive feedback from 132. The needs were assessed for two main lines: vocational and education training (VET), and continuous education. In addition, a focus group formed by selected people -12 persons- chosen amongst those answering the survey was joined, to exchange opinions and ideas. Although most results are still under analysis, some specific patterns are being detected. For both lines, needing on training in basic ecology, and knowledge on restoration methods are relevant issues for the Spanish practitioners. As a main recommendation coming from the focus group discussions and the results of the survey, there is a clear need to qualify secondary school and VET teachers in ER, as well as to establish networks of demonstration sites of ER practices and results.

Keywords: Knowledge, Vocational training, Ecological Restoration, Continuous Education, Erasmus+

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Environmental education for the conservation of Valencian flora and ecosystems at CEACV

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The Environmental Education Center of the Regional Government of Valencian Community (CEACV. Centre d'Educació Ambiental de la Comunitat Valenciana) is the public centre of reference in this field in the Valencian Community. The aim of the CEACV is to promote the eco-social transition through environmental awareness and education. The CEACV's educational project is organised into different programmes with the aim of informing, raising awareness, motivating, training and empowering citizens and society as a whole to understand, understand, get involved and participate in individual and collective actions to solve environmental problems. One of the topics addressed in the CEACV's educational project is biodiversity. Through different actions, we work to raise awareness of the flora, vegetation and their habitats, their values and the ecosystemic services they provide, in order to promote their protection and active conservation. Preferably we work on Valencian autochthonous flora, but we also deal with agricultural and ornamental flora. These are the objectives pursued with the educational actions on biodiversity: to provide information and knowledge to trainers and environmental educators in this field; to provide the Centre itself, as well as other entities (educational centres, town councils, etc.) with didactic materials. These materials are prepared for different audiences and educational levels; to motivate people and generate empathy towards the plant world in general and towards Valencian biodiversity; and to develop actions for the conservation and improvement of plant biodiversity in situ through environmental volunteering. Based on scientific knowledge, these objectives are pursued through training activities, awarenessraising and participation activities, preparation of teaching materials, exhibitions, participation in campaigns, etc.). The CEACV has a wide variety of facilities and spaces in which plant elements (wild, agricultural and gardening) play a fundamental role in showing biodiversity and, at the same time, function as educational and didactic resources that are used in many of the activities that are carried out on-site at the Centre's headquarters.

Keywords: Environmental education, biodiversity education, didactics

Importance of primary education and environmental awareness-raising for plant conservation in the Valencian Community (Spain)

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The aim of this work is to show some didactic and informative proposals to work with nature in an experiential way and to value the importance of the knowledge and conservation of the plant kingdom in the Valencian territory (Spain). In the same way, the aim is to achieve the appropriate development of our pupils, both intellectually and physically, in contact with nature.
There are numerous authors who, more and more, emphasise the importance of carrying out a teaching-learning process based on manipulation, experimentation, movement, close development, the need for nature, freedom and contact with the environment, respect for creativity, green pedagogy and naturalist intelligence. On the other hand, schools are understood as miniature societies, where the bases are built on the lives of the pupils. In the legislative framework, Organic Law 3/2020, of 29 December, protects the care and respect for the environment and proposes that schools should promote the development of teaching activities in open spaces and natural environments.
In this work, 5 educational projects are proposed for learning about and raising awareness of the plant kingdom, such as: “investigating colour”, “investigating shape”, “investigating texture”, “investigating smell” and “creations, serializations and plant compositions”. On the other hand, 10 manipulative and experimental activities are shown: “Why do leaves change colour”, “conditioning factors”, “germination”, “conducting vessels”, “colouring and absorption”, “photosynthesis”, “plant reproduction”, “the herbarium”, “study of plant cells and tissues” and “handling dichotomous keys”. In addition, some educational projects related to conservation and good environmental practices are presented: “we learn outside”, “we know our natural parks”, “the school garden”, “Medicos-mundi”, “Projecte guarda-bosc”, “Detectius dels arbres”, “Basuraleza”, “Trobades d’Escoles Valencianes amb el lema Recuperem el verd” and “Bosquet Carme Miquel”. In the same way, the competition for educational centers has been held: “El treball col·lectiu per a recuperar el verd” (Collective work to recover the green). Similarly, mention should be made of the creation of the “Plataforma Territori Viu” for conservation in the Central Valencian Regions. Finally, the C.V. Victoria Laporta Carbonell Foundation has designed an ethno-botanical itinerary and workshops and field activities for the study and dissemination of Valencian flora.

Keywords: Primary school, popular science, plant knowledge, Mediterranean environments, school projects

Making cities of the future more sustainable through the awareness of policy-makers and citizens about the importance of the use of native flora in the urban environment

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Importance of urban forestry was born in Europe and North America, during the 19th century, with the unplanned urbanization caused by industrialization. The deterioration of hygienic-sanitary conditions caused by overcrowded cities has led to rethinking cities in a modern key with large parks and tree-lined avenues and a lower density of buildings.

United Nations demographic projections predict that in 2050, two-thirds of the human population will live in cities. This process brings challenges on the environmental and social sustainability of cities. Ecosystem services generated by urban forests are the solution for the mitigation of the main problems associated with urban environments such as the microclimate regulation, flood regulation, maintenance of genetic and biological diversity, habitat provisioning etc. In particular, the composition of urban flora plays a key role because is often affected by the choice of a few species and often a few cultivars - which leads to genetic poverty - making green areas not very resilient and exposed to rapid decline caused by pathogens and/or environmental changes. The conscious choice of a floristic composition dominated by native species is precisely what can ensure the greatest biodiversity and the greatest resilience over time, permanently guaranteeing ecosystem services.

The technical-scientific collaboration with many municipal administrations of Sardinia, aimed at developing projects on various aspects of environmental management, has allowed the transfer of knowledge and the awareness of policy makers on the importance of conservation of spontaneous flora in urban and peri-urban areas and how this is fundamental for the sustainable development of urban areas.

The aware knowledge of citizens and administrators about ecosystem services is a fundamental part of making the cities of the future sustainable. In particular, the transfer of correct practices from the research world to policymakers has proved to be the correct way to achieve the objectives of conservation of native flora and greater biodiversity in the urban environment.

Keywords: Biodiversity, ecosystem services, resilience, sustainability, urban forestry

Medicinal plants to treat sleep disorders in Valencian Community

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Medicinal plants have been used for thousands of years for the treatment and prevention of numerous diseases. In this paper we will focus on sleep disorders and anxiety. There are many medicinal plants to treat these kinds of disorders such as valerian, passionflower, goldshower, lavender, ashwagandha or hops. However, not all people use and know about plants.

The research aimed to determine which medicinal plants people use for these disorders, as well as whether they use them alone or in combination. Furthermore, how they have come to know them and the way of administration.

A semi-structured face-to-face survey was conducted in Valencian Community between July 2020 and November 2021. It was calculated the Use Value to analyze the local relative importance of medicinal plants mentioned.

The main medicinal plants used to treat sleep disorders are valerian, linden, chamomile, lemon balm and passionflower. A high number of associations were found between them and with other medicinal plants. Participants responded that medicinal plants are often consumed in herbal teas, but also in tablets. Most of the population answered that they had learned about medicinal plants through family habit, advice from an acquaintance and advice from a pharmacist.

In conclusion, the predominant medicinal plants used to treat sleep disorders and anxiety in Valencian Community are valerian, followed by linden and chamomile (alone or in combination). People usually take them in herbal teas and know them from family habit.

Keywords: medicinal plants, sleep disorders, anxiety, Valencian Community

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Plant germplasm banks as teaching resources to address plant-blindness of secondary school students

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In the current context of planetary emergency, it is essential to search for solutions to mitigate the different socio-environmental crises we are facing, such as climate change, biodiversity loss and ecosystem degradation. Part of these solutions may be provided by plants and their role as carbon sinks, which is why it is necessary to increase efforts to preserve their biodiversity. However, due to the phenomenon of plant blindness, their importance often goes unnoticed, so there is a clear need to provide tools related to environmental education that incorporate knowledge and increase interest in plants in the educational system. In this sense, a didactic proposal has been developed, with different teaching methodologies, which uses plant germplasm banks as the main didactic resource, including not only seeds but also spores so that the approach also includes ferns. Pteridophytes have proven to be excellent organisms for understanding aspects related to the time scale, as they take us back to periods such as the Carboniferous, when they were much more abundant. Their current ecological role and their privileged position as climate indicators complement the leading role they played in periods that were essential for the gradual accumulation of a large part of fossil fuels. The construction of an attractive story through the world of pteridophytes allows us to address issues related to current climate change and other sustainability issues. In addition, the proposal addresses how the seeds of many plants have developed reproductive strategies aimed at the survival of their seedlings in extreme environments or with limiting periods, such as the Mediterranean climate. In this sense, certain seeds, dependent on pre-germination treatments, are a valuable didactic resource to address some interesting evolutionary strategies that allow addressing issues such as Nature Based Solutions.

Keywords: *Ex situ* conservation, Teaching sequence, Climate change, Seeds, Ferns.

Pollinator-friendly students, schools and gardens: a new hope for urban pollinators

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The overall aim of the project LIFE4Pollinators (LIFE18 GIE/IT/000755 - life4pollinators.eu), in line with the EU Pollinators initiative, is to improve pollinator conservation by creating a virtuous circle leading to a progressive change in practices across the Mediterranean region. Although conservation measures are necessary, efforts cannot be made unless people are properly informed, aware and educated. For this purpose, the school project "Students4Pollinators" has been implemented. In Bologna (Italy) this activity involved more than 800 pupils from several secondary schools. Virtuous schools were awarded with the "Pollinator-friendly" certificate, while activity's success is being evaluated and proven by questionnaires.

To guarantee the continuation of Students4Pollinators and provide the necessary tools to repeat it independently, training courses dedicated to external teachers and to the educators of the University Museum Network (SMA) took place in 2023.

The Pollinator Garden realized in the Botanic Garden of Bologna University is housing around 100 different species of entomophilous plants and offers the possibility of implementing various education pathways, thanks to several supporting tools such as eight ceramic flower models and two bee hotels made by students of the art high school "F. Arcangeli". A "List of (some) entomophilous plants" has been published to help the choice of plants for private and public urban gardens. In addition, to help recognize wild bees of the Botanic garden of Bologna, a digital guide with more than 500 photos of plant-bees interactions is on-line.

The Pollinator Garden is representing the hub for most education, communication, and dissemination actions of LIFE4Pollinators project in Bologna. Here we describe the school project activity, its results and the experiences arising from the Pollinator Garden.

Keywords: citizen science, pollinator conservation, public awareness, education, pollinator garden

Posidonia oceanica as a teaching resource to raise awareness among students of two different educational levels

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For decades, both the scientific community and a number of organizations, institutions and citizens in general have been warning of the serious situation caused by human activity, for which immediate action is required to tackle a global socio-environmental emergency characterized by multiple problems that are intimately interconnected. One such problem affects the seas and oceans, which are suffering unprecedented environmental problems. These vast bodies of water, which cover more than 70% of our planet's surface, are affected by a series of challenges that threaten their health and the marine life they harbor. These problems are closely interconnected with others that the world is facing at large such as climate change, food security, economic and employment issues, as well as biodiversity conservation. Specifically in the Mediterranean Sea, marine phanerogams constitute one of the richest and most important coastal habitats and play an essential role as carbon sinks, primary producers and as ecosystems that harbor rich biodiversity. One of the endemic and emblematic marine phanerogams of the Mediterranean Sea is the species *Posidonia oceanica*. Based on the transformative power of education, in this communication we present a teaching proposal focused on *P. oceanica* in which the plant itself becomes the didactic resource to work both on marine botany and on sustainability issues. Marine botany is generally a neglected area of knowledge in formal education, so the proposal aims to offer teachers an attractive alternative to traditional textbook- and classroom-based learning. Students from two different educational levels (primary and secondary school) carried out a learning sequence using different active methodologies, including service-learning and project-based learning, to address the Sustainable Development Goals (SDGs), reduce 'plant blindness', increase environmental awareness and promote good conservation and sustainability practices, showing that *P. oceanica* is an effective teaching resource for the training of students and teachers, increasing knowledge and awareness in a stimulating and attractive way. The proposal was part of *Projectes Natura*, an innovation project from the University of Valencia aimed at creating inter-stage teams with teachers and students of secondary and high school and was awarded first prize in the 2023-2024 edition. The didactic sequence consisted of various sessions that included the training of secondary school students, the organization of a fair by them to transmit their learning to primary school students and a visit to the Oceanogràfic of Valencia, including a laboratory practice. The proposal was also presented at *Expociencia*, the University of Valencia´s science festival.

Keywords: marine phanerogams, environmental problems, climate change, didactic proposal, *Posidonia oceanica*

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The commitment of the Italian Alpine Club for the protection of the native flora: the example of the handbook n. 33 “Endemic flora of the italian mountains”, a national summary

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Mountainous areas of the planet, much like islands in the oceans, represent an extraordinary laboratory for understanding the evolutionary processes of life forms on Earth. Mountain flora is characterized by a high percentage of endemics, plants whose distribution is exclusive to a very restricted area, the result of evolutionary processes triggered by reproductive isolation of small populations.

Italy boasts a heritage of 8,249 taxa of native vascular plants [1]. It has the richest flora in Europe and ranks second in the Mediterranean basin, following Turkey. Italian endemics (1,739) account for 21.08% of the flora.

This volume, coordinated by Fabio Conti, Fabrizio Bartolucci, Aurelio Manzi, and Luciano Di Martino, is the result of careful and in-depth work by numerous Italian botanists. It represents an important outcome of collaboration within the botanical community, especially among local experts who engage at the national and international levels on systematic, taxonomic, nomenclatural, and conservation knowledge related to endemic species.

Following extensive work on Italy’s endemic species, the collaboration of the same botanical experts, resulted in this volume, which, thanks to the Italian Alpine Club, provides distribution data, information on biological characteristics, ecology, reference habitats, and conservation threats of endemic species in mountainous regions to a broader audience.

Many species in our mountains have been at risk of extinction or remain heavily threatened. Most of these plants are associated with specific environments, especially peat bogs and other wet ecosystems.

Floristic discoveries continue to increase exponentially: for instance, Pignatti [2] recorded 5,600 species, including non-native plants, while Conti et al. [3] reported 6,852 native taxa. We are likely still far from having complete catalogs of our flora, but the components of floristic richness and endemism mostly coincide with our mountains.
Italian plant species are protected under international conventions and European directives adopted by Italy. However, there is still no national framework law for the protection of flora, and this matter is effectively delegated to individual regions and autonomous provinces.

The mountain endemic plant species presented in this volume are among the most localized and threatened, often discovered only recently and thus frequently overlooked by protective legislation.

Keywords: Hotspot, Biodiversity, Conservation, Endemics, Vascular flora

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