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Next Challenges in Vegetation Science: Facing the Anthropocene
Siena, 13-14 July 2023

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1st session: Progresses in vegetation science

Chair: Maria Laura Carranza

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THE RISE OF TECNHOECOLOGY: THE SWARM THEORY

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In the last decades, ecology has witnessed and has been an actor in several technological revolutions. The global challenges (e.g., climate change and biodiversity loss) together with the complex research questions are increasingly driving rapid development, refinement, and use of technology in ecology. This trend is paving the way for a new sub-discipline (i.e., "technoecology"). Here, I will list some of the past and present technologies used for investigating species and ecosystems and I will highlight some of the recent ground-breaking and transformative technical revolutions. Among these: bio-batteries, telemetry, the Internet of things, 3D painting, low-power computers, and finally the swarm theory. In essence, swarm theory refers to individuals self-organizing to work collectively to accomplish goals. Swarm theory is directly applicable to the collection of remotely-sensed data by multiple unmanned vehicles (UAV), whether aerial, water surface, or underwater. By employing swarm theory, data collection and transfer could be faster, while also eliminating safety issues. Although several technical aspects need to be solved before the application of swarms of unmanned vehicles within ecological research, the idea of such swarms is not far-fetched.

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SYNERGIES BETWEEN BOTANY AND ROBOTICS FOR VEGETATION MONITORING

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The Natura 2000 network, established by the European Council Directive 92/43/EEC, is a network of protected areas to be monitored in order to ensure biodiversity conservation in Europe. Monitoring the health status of the network's habitats is the responsibility of each EU member state. Such monitoring activities mainly involve the assessment of the habitat vegetation. Specifically, highly skilled human operators periodically assess the structural and functional parameters such as the presence and the coverage of typical (and/or early warning) species for each habitat. The H2020 EU Project "Natural Intelligence for Robotic Monitoring of Habitats - NI" aims to employ robots to assist in data gathering and parameters interpretation. These are typically time-consuming tasks that can be executed effectively, efficiently, and reliably by robots. This abstract presents the potential benefits of using this technology, specifically focusing on a quadruped robot developed for the purpose. Legged robots were chosen over flying robots because of their superior energy autonomy, ability to withstand adverse weather conditions, and capability to navigate within forests. The chosen quadruped robot, ANYmal C, is equipped with proprioceptive and exteroceptive sensors (LiDAR, full-HD RGB-D cameras, encoders, torque sensors) to collect environmental data useful for the evaluation of habitat parameters such as: tree diameter, vegetation coverage, species presence, number of individuals. This approach has been already successfully tested on four different macro-habitat types: grasslands, dunes, screes, and forests. The data that the robot has so far collected is already available for everyone to see and use on the Zenodo platform. The project's expertise will be used to update the national standards for habitat monitoring and incorporate these new tools, providing an example of innovation in habitat monitoring for the international scientific and institutional communities.

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BELOWGROUND PLANT LIFE: FEASIBILITY STUDY ON THE USE OF ROOT TRAITS TO EXPLAIN TIME CHANGES IN VEGETATION AT THE VELINO-DUCHESSA LTER SITE

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Changes in vegetation have been recorded over the last 30 years in the high-mountain plant communities of the Monte di Sevice research station, belonging to the "Appennino Centrale: Velino-Duchessa" LTER site (https://deims.org/12c79ecb-7890-4b75-9655-0883dacd8a29). Systematic sampling was carried out in two high-mountain plant communities, alpine tundra *(Saxifrago speciosae-Silenetum ceniasiae)* and snow-bed grassland *(Trifolio thalii-Festucetum microphyllae)*, ranging from 2100-2200 m a.s.l.. Preliminary results on the recorded time changes were published in 2005 [1] and 2021 [2], based on species occurrence and their relative coverage, life forms and strategies. While aboveground strategies have been sufficiently investigated, the belowground ones have remained almost completely unexplored. On the basis of 30 years of ecological research (phytosociological relevés systemically collected in 18 years, from 1993 to 2022, and microclimate measurements recorded in the same site over 10 years, starting in 2014), a feasibility study has been carried out to interpret time changes through the root traits of the most sensitive and locally invasive species. The hypothesis is that the belowground component of the biocenosis is affected by the increased frequency and duration of frost periods, connected to the increased discontinuity of snow coverage in winter.

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IT-V NET: THE ITALIAN INTRASPECIFIC TRAIT VARIABILITY NETWORK

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Plants, as sessile organisms, are exposed to mutating environmental conditions across scales which result in a variety of phenotypes between and within populations. Exposing multiple phenotypes to the environment might help plants to buffer the effects of environmental changes, and eventually adapt to novel ecological conditions. In other words, functional trait variability within species, or Intraspecific Trait Variability (ITV), represents the raw material for natural selection. At the global scale, up to 31% of the total plant trait variability within communities is due to ITV (depending on the trait x habitat combination). Despite its relevance, which likely becomes greater at finer spatial scales, we still lack a detailed understanding of the extent of ITV within and across many ecosystems at the local and regional scale, an inherent limitation of any global study. In this sense, we still lack a standardized estimation of the relevance of ITV using a common, reproducible statistical framework. Thus, we envisioned a national collaboration to bring together data and expertise in Italy to: i) map the relative contribution of ITV compared to between-species trait variability (BTV) across major Italian habitat; ii) investigate the relative contribution of ITV *vs.* BTV across different spatial scales (i.e., plot, habitat, region). We focused on two leaf traits, namely leaf area and specific leaf area, since these are widely measured traits mirroring key and independent aspects of leaf form and function mainly associated with species allometric properties and resource allocation. So far, we have attracted 56 researchers from 21 institutions, and collated a dataset spanning more than 1,000 plots, 700 plant species and 10,000 measurements of leaf traits across Italian habitats along the whole peninsula (i.e., coastal dunes, Mediterranean macchia, sub-Mediterranean and temperate deciduous forests, temperate shrublands, primary and secondary mountain grasslands of the Alps and the Apennines, inland surface waters, helophyte beds, and arable lands). To broaden the scope of our initiative, we will describe the main ideas, approaches and preliminary results from this collaboration, hoping to attract more contributors working with functional traits. This endeavor has the potential to deliver a significant contribution to one of the currently hottest topics in plant ecology, especially in light of the accelerated global changes that are challenging the acclimation limits of plants' form and function globally.

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VEGITALY VEGETATION DATABASE: A VALUABLE SOURCE FOR ITALIAN VEGETATION SCIENTISTS

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In 2010, the national vegetation database *VegItaly*, a collaborative project developed by a large group of scientists and supported by the Italian scientific community, was presented at the 46th Conference of the Italian Society for Vegetation Science (SISV) held in Pavia (Italy) [1,2]. Soon the database has been acknowledged in Europe and become a founding partner of the rising European Vegetation Archive (EVA) [3], the first Italian member of the Global Index of Vegetation-Plot Database (www.givd.info/ID/EU-IT-001) and one of the main Southern European reference points for the creation of the European taxonomic standard list for vegetation studies named EuroSL [4]. The number of vegetation plots stored in this repository increased exponentially in the first years. After 2 years, the database already amassed 31,100 vegetation plots [5,6]. The large majority of these plots derived from published sources, representing at the time the largest Italian vegetation database. *VegItaly* was the first Italian database proposed as a standard to collect and manage vegetation data at the national scale. It currently hosts 37,452 vegetation plots but is not any more the largest Italian vegetation database, outnumbered by the "Vegetation Plot Database - Sapienza University of Rome" and followed by the more recent "AMS-VegBank - Alma Mater Studiorum - University of Bologna". However, *VegItaly* is still standing as the only vegetation data repository in Italy held and managed by a scientific society. More than 10 years later, the Italian Society for Vegetation Science (SISV) along with the recently-nominated Steering Committee wants to relaunch its use by means of some technical novelties that have been introduced in the meantime. In this contribute, we provide an overview of the current material archived in the database, some basic statistics, data distribution in space and time, and representation of vegetation types.

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FUN-VIOLA DATABASE: FUNCTIONAL TRAITS OF VEGETATION OF CENTRAL APENNINES

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During the last decades, the interest on plant functional ecology have raised and new research exploring the response of vegetation to actual environmental conditions and to different scenarios of global change have been carried out [1, 2]. Plant functional traits are measurable morpho-functional characteristics that reflect the eco-evolutionary responses of species to the environment. The measurement of plant traits offers essential information to improve the understanding of community assembly rules and ecosystems functioning [3]. Several international databases have been created in order to provide sound information on different biomes and vegetation types [4]. Despite the great number of plant traits measured worldwide and in Europe, there is still a large gap of knowledge about field-measured functional traits of plant species growing on the alpine and subalpine belt in Mediterranean mountains [5]. In order to contribute to bridging this gap, we have created the Database FUN-VIOLA (FUNctional traits of VegetatIOn of centraL Apennines). FUN-VIOLA is the first database of field measured plant functional traits depicting high mountain vegetation on Central Italy (Gran Sasso, Maiella, Mainarde, Matese, Velino summits). We collected for 80 plant species and subspecies (29 of which endemics), distributed in 25 taxonomic families, more of 500 records of 9 plant traits on the alpine and sub-alpine grasslands of Central Apennines. The species were selected because the most abundant ones (summing up 80% of total vegetation cover) on a sample of 140 relevés stored on the vegetation database VIOLA (high mountain VegetatIOn of centraL Apennines) (http://www.givd.info/ID/EU-IT-019) [6, 7], which are representative of 5 EUNIS (European Nature Information System) habitat types: Apennine stripped grasslands (code E4.436), Central and southern Apennine dry grasslands (code E1.54), Oro-Apennine closed grasslands (code E4.38), Temperate-montane calcareous and ultra-basic screes (code H2.4) and Windy edge swards (code E4.42). The taxonomic attribution and nomenclatural updates of vascular plant taxa follow Bartolucci et al. [8]. In particular we measured for each species 6 vegetative traits: Leaf Area (LA, mm^2), Specific Leaf Area (SLA, mm^2/mg), Leaf Dry Matter Content (LDMC, mg/g), Plant Height Vegetative (PHV, cm), Plant Height Generative (PHG, cm), Leaf Thickness (LT, g/mm^2); and 3 reproductive traits: Seed Mass (SM, g), Seed Length (SL, mm) and Seed Width (SW, mm), following the standardized protocol of Pérez-Harguindeguy et al. [9]. During field campaigns carried out on summer of the years 2017, 2020 and 2021 we measured: a) the vegetative traits (plant height, PHV, PHG), b) the leaf traits (LA, SLA, LDMC on 2 healthy fully expanded leaves) for at least 10 individuals of each species selected on 5 different populations and c) the reproductive traits (SM, SL and SW) for at least 100 seeds of 20 individuals of each species selected on 5 populations. Leaf and seed measurements were carried out in the "Majella Seed Bank" lab of the Maiella National park [10]. FUN-VIOLA was built up and populated storing measured field traits mean values for each species. The stored data depicting plant functional ecology in Mediterranean limestone summits in Central Apennines contributes to improve the knowledge on the plant traits of alpine and subalpine vegetation on the Mediterranean. FUN-VIOLA should support a wide range of ecological studies on functional strategies across scales and comparing Biomes. It also may support an improved understanding about intra- and inter-specific functional diversity. FUN-VIOLA is periodically updated and can be accessed online on the version 7 of TRY Plant Traits Database (www.try-db.org/TryWeb/Home.php), or by contacting the authors.

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TOWARDS THE IDENTIFICATION OF REGIONAL 'TYPICAL' SPECIES FOR GRASSLAND HABITATS: A CASE STUDY IN UMBRIA REGION

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The phytosociological approach to the analysis and classification of plant communities is the bedrock of the identification, description, and monitoring of Annex I habitat types of the Habitats Directive (HD, 92/43/EEC). Article 17 of HD regulates the assessment of the conservation status of habitats, and the parameters to be used are defined by European Guidelines (EGs) [1, 2]. Among these, the 'structure and functions' parameter takes into account both the physiognomic component and the ecological processes necessary for the long-term maintenance of habitats, and requires the assessment of 'typical species' (TS). Although a definition of TS was not provided by HD, EGs assert that they should: i) occur with high constancy in the habitat type or at least in a major subtype or variant of it; ii) be good indicators of favourable habitat quality; iii) be sensitive to changes in the condition of the habitat ('early warning indicator species'). At the national level, the Italian manual for the monitoring of Habitat types provides lists of TS only for a few species-poor habitats, pointing out that TS of species-rich habitats must be identified at a local scale, rather than at a national or biogeographical one, in order to consider the geographical and ecological habitat variability, and based on the overall plant species composition [3, 4]. So far, the identification of TS has been mainly based on expert knowledge, and a few efforts of quantitative data analyses have been done only recently [5, 6] and concerning alpine and saline habitat types. Our case study focused on semi-natural grasslands (6210 and 6230* Annex I Habitats) occurring in the whole territory of the Umbria region (central Italy). We started by gathering relevés from published scientific literature, consulting the Italian database "VegItaly" [7], and we implemented them with a survey campaign, started in 2021, in order to cover the entire geographical and ecological variability of the target habitats at the regional scale, both inside and outside the Natura 2000 network. The resulting dataset, consisting of 715 relevés, was classified using unsupervised classification methods and investigated in order to find the ecological factors that support the differentiation of the surveyed habitat subtypes. For each cluster, we identified diagnostic (phi coefficient), constant, and dominant species. From these species pools, which already qualify for being defined as lists of TS, we started evaluating possible criteria that allow us to identify those species that fit with the stricter definition of 'typical', i.e., sensitive and good indicators of favourable habitat quality. Although knowing that a gap in the theoretical definition of TS still remains, with this work we made a first step to provide TS for particularly complex and species-rich habitat types such as the Apennine grasslands, based on qualitative and quantitative data.

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2nd session: Cross-taxon approaches for vegetation analyses and habitat monitoring

Chairs: Giovanni Bacaro and Simona Maccherini

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CROSS-TAXON APPROACHES IN BIODIVERSITY: STATE OF THE ART, PITFALLS, AND EMERGING OPPORTUNITIES

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One major goal in ecology is to identify consistent biodiversity patterns that can be used to guide conservation actions under the current accelerated global change scenario, despite the considerable uncertainties due to uneven sampling effort and inventory completeness. In the last decades, scientists tried to mitigate this issue using proxy metrics that are able to synthesize the overall diversity in a given assemblage (i.e., surrogacy hypothesis). Cross-taxon congruence is based on measuring the diversity of a taxon which is chosen as a proxy of a broader range of co-occurring taxa. When the congruence is high (i.e., there is a high degree of correlation between individual species or groups of species), it implies that a single taxon may act as a surrogate for other taxa, with relevant implications for biodiversity conservation and spatial planning, especially when resources are limited. In this talk, I will present the main assumptions underlying cross-taxon analyses, the current state of the art across different environments (e.g., urban areas, plantations, invaded vs non-invaded sites) and taxonomic groups (e.g., plants, insects, fungi) and the main pitfalls to take into account. In general, plants diversity can be considered a good proxy of the overall biodiversity in an area, but the strength and direction of this relationship can be strongly influenced by abiotic factors such as climate and habitat features, the spatial scale, and the characteristics of the data (presence-absence vs abundance data). Finally, I will provide novel perspectives on how to expand cross-taxon approaches, relying on functional and evolutionary perspectives

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MULTITAXON APPROACH IN THE MONITORING ACTION OF THE LIFE DRYLANDS PROJECT (LIFE18 NAT/IT/000803)

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The "LIFE18 NAT/IT/000803 LIFE DRYLANDS" project was proposed with the aim of conserving habitats 2330 ("Inland dunes with open *Corynephorus* and *Agrostis grasslands*"), 4030 ("European dry heaths") and 6210 ("Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)", on siliceous substrates, in 8 Natura 2000 sites in the western Po Plain. In general, the project aims at restoring the dry-acidic continental open habitats to a favourable conservation status. The practical actions to achieve such goals are: (1) structural restoration of the target habitats by: mowing and removal of herbs; cutting back of native woody species, maintaining the larger individuals, under which ecotone species can refuge; sod cutting; top soil inversion; (2) removal/reduction of invasive woody species, by: cutting down, removal of stumps, and stem injection with plant protection products; (3) improvement of the typical floristic composition, planting herbaceous species; (4) creation of new patches of the target Habitats using suitable propagation material (surface sands rich in seeds of typical species for 2330; harvested seeds for 6210; cuttings of *Calluna vulgaris* for 4030). To evaluate the effectiveness of the practical actions, a multitaxon approach was used for monitoring the project sites. The selected *taxa* included: (1) vascular plants (including vegetation structure), (2) lichens, (3) bryophytes, (4) carabid beetles, (5) butterflies. The sampling design was planned with an area-dependent number of plots per patch, resulting in 95 sampled plots within 27 patches belonging to the 3 target Habitats, divided as follows: 12 plots in 4 patches of Habitat 2330, 24 plots in 6 patches of Habitat 4030, 59 plots in 17 patches of Habitat 6210. (1) Vascular plants, (2) lichens and (3) bryophytes were sampled by means of standard vegetation relevés in each plot, just once; (4) carabid beetles were sampled by means of pitfall traps in each plot, with 3 repetitions; (5) butterflies were sampled by visual sampling in a subset of plots, with 3 repetitions. *Ad-hoc* supplementary monitoring, not planned in the project but made necessary due to local situations met in the field, concerned (6) orchids, (7) the butterfly *Zerynthia polyxena*, and (8) the damselfly *Sympecma paedisca*. The *ex-ante* monitoring took place in Spring 2020 and 2021. Overall, we recorded 273 vascular plants, 12 lichens, 14 bryophytes, 50 carabids and 42 butterflies. Assemblages of all *taxa* included generalist species, species typical of the target Habitats, and also some species typical of more closed/mature habitats (e.g. shrublands or woodlands). Invasive species were also recorded among vascular plants and bryophytes. Richness patterns varied across *taxa*, whereas the composition of the assemblages of all *taxa* always showed significant differences between the three Habitats. Results of the *ex-ante* monitoring confirm the need to restore the Habitats in the selected sites, due to the occurrence of several generalist species and of some species that indicate more mature habitats. Despite the degraded situation of some patches, results also highlight the potential of the selected sites to host the target Habitats due to the occurrence of several species typical of dry grasslands and heathlands. The *ex-post* monitoring is still in progress. The comparison among *ex-ante* and *ex-post* data will be very useful to assess the effectiveness of the practical actions.

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MONITORING THE HABITAT 3170 IN THE LAZIO NATURA 2000 NETWORK USING A MULTI-TAXON APPROACH.

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Mediterranean Temporary Ponds (MTPs), identified with 3170* code in the Habitat Directive, are characterized by community belonging to alliances *Nanocyperetalia flavescentis* Klika 1935 and *Isoëtetalia durieui* BR.-BL. 1936. A European shared framework of characteristic species and ecological descriptors is still lacking and in many Italian regions the assessment of the occupied area is still rough. We present the preliminary results of a cross-taxon monitoring program performed in Lazio Region with the purpose to fill the gap of knowledge about MTPs. As also suggested by the Italian monitoring manuals, in addition to physical-chemical parameters and vegetation analysis, in the temporary ponds belonging to habitat 3170* we are evaluating the presence of Amphibians and zoobenthos, that should find refuge in these ecosystems. In the deepest (maximum depth up to 60 cm) and biggest (at least 200 square meter) temporary ponds, species belonging to *Menthion cervinae* and *Isoëtion* characterize the vegetation, if water is oligotrophic. Otherwise, *Callitriche stagnalis* and *Ranunculus peltatus* dominate on very poor stands. *Crustaceans* (*Gammaridae* and *Lepidurus*), Amphibians (*Triturus carnifex*, *Lissotriton vulgaris*, *Rana temporaria*) and Insects larvae (*Calopterygidae*, *Lestes*, *Dytiscidae*) are present. In very shallow (maximum depth of 15 cm) and small (between one to 20 square meter) temporary ponds there is the highest plant diversity, with species belonging to *Isoëtion* and *Nanocyperion flavescenti*, and many of 3170* characteristics species, according to European and Italian manuals. However, these "very shallow" temporary ponds do not allow the presence of amphibians and are not colonized by a reach zoobenthos fauna. These results represent an important step forward in defining the distribution of habitat 3170 in the Lazio region, offering new perspective on vegetation, ecology, and fauna of the MTPs.

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CROSS-TAXON APPROACHES FOR HABITAT MONITORING: LINKING LICHEN BIODIVERSITY TO FOREST HABITATS STRUCTURE

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Monitoring lichens diversity can provide valuable insights into the forest habitats degree of conservation since lichens are important indicators of forest ecosystem health. Lichen Biodiversity Index (LBI) represents one of the commonest approaches for monitoring lichen diversity. It considers lichens species richness and their relative abundance (ANPA 2001).

To shed light on the relationship between lichen diversity and forest structure, we compared forests data structure with lichen functional biodiversity. We used canopy cover, understory vegetation, and tree species composition, among the forest habitat indicators (Angelini et al. 2016, Carli et al. 2023). Since different lichen species have different ecological requirements, the variation of these indicators can directly, or indirectly, affect lichen diversity and abundance (Potenza et al. 2022). In this context, considering differences in the LBI in relation to structural and ecological aspects of different forest ecosystems, we explored a cross-taxon approach for the assessment of the conservation status of forest ecosystems. Since the LBI monitoring network is homogenously distributed on the Italian peninsula, we suggest using its monitoring sites in order to add the collection functional and structural data for assessing forest habitat types conservation status, forest management practices impacts, and ensure the long-term health and sustainability of forests.

Acknowledgements: This work was supported by the ARPA Basilicata [Agreement between ARPA Basilicata and ISPRA on Ecosystems Monitoring by innovative indicators development (30/11/2021)]

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DOES INVASIVE PLANT SPECIES INFLUENCE THE FUNGAL COMMUNITY?

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Robinia pseudoacacia (black locust) is a forest tree species introduced to Europe from North America in the early 17th century. It is a fast-growing, nitrogen-fixing species, very important to the local economy. Anyway, due to its high growth rate it tends to form pure populations, causing a strong reduction in plant and animal biodiversity, as has been widely reported in different studies focusing on the environmental impact of this invasive species. Since fungi are often neglected organisms and a crucial part of biodiversity, we aim to investigate whether mycological diversity has been affected by the invasion of *R. pseudoacacia* in native Italian forests, placed on Monte Amiata (Tuscany, Italy). In this area, there have always been chestnut groves and coppices cultivated for chestnut harvest or to obtain timber. In recent decades there has been a progressive increase in black locust forests, which are increasingly replacing the native forests. The surveys started in September 2022 selecting 16 plots equally distributed under chestnut and black locust. A vegetation survey was carried out in each plot and will be repeated in July 2023. In parallel, a monthly mycocoenological sampling was carried out from September to November followed by the identification at the species level and will continue next autumn. Subsequently, a qualitative and quantitative description of the fungal community in both vegetational aspects was made. As a preliminary result, a difference between chestnut groves and black locust formation for both plant and fungal species was evident. Under the native groves there was a greater floristic and fungal diversity than under the invasive alien formation. Furthermore, the fungal species sampled under chestnut were both mycorrhizal and saprotrophic in equal ratio, while under black locust mycorrhizal were almost absent.

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ABIOTIC AND BIOTIC FACTORS AS EXPLAINING DRIVERS OF CROSS-TAXON CONGRUENCE

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Diversity patterns can exhibit congruence among different taxonomic groups. This congruence enables the identification of surrogate indicators that can represent unobserved taxa or broader diversity patterns. The congruence in species richness or composition can arise from shared responses of taxonomic groups to environmental conditions, shared historical biogeography, or biotic interactions due to the influence of one taxon on the diversity of another taxon. The effectiveness of using biodiversity surrogates relies on understanding the underlying mechanisms that drive the strength of these relationships among taxonomic groups. In this study, we investigated congruence patterns in community composition among taxa occupying different trophic levels, taking into account abiotic and biotic factors. Based on a survey in a Mediterranean area located in Sardinia (Italy), we collected data of vascular plants and six groups of ground-dwelling arthropods (pseudoscorpions, spiders, darkling beetles, rove beetles, ground beetles, and ants) in 150 plots and pitfall traps along 30 transects. Abundance data were aggregated to transect level and used to (i) evaluate the cross-taxon relationships using Mantel tests, and (ii) examine if these relationships were influenced by abiotic drivers through partial Mantel tests, considering climate, spatial-topography features and the fragmentation degree (i.e., disturbance at landscape scale). Additionally, we conducted variation partitioning analyses to determine the contributions of abiotic and biotic drivers in explaining these relationships. Our findings revealed a consistent cross-taxon congruence pattern across most group pairs, with pseudoscorpions, spiders, ground beetles, and vascular plants showing the highest number of significant correlations with other taxa. Environmental drivers were identified as drivers of cross-taxon congruence, shaping composition patterns. Spatial-topographic factors underpinned inter-taxon congruence only across darkling beetles and ants, which reacted to this set of variables, showing a common response. On the contrary, the decrease in mean temperature and the increase in precipitation appeared to shape the community composition of pseudoscorpions and spiders without determining their reciprocal concordance and their relationships with other taxa. Similarly, the variation of spatial-topography, climate and landscape variables did not drive the congruence of ground beetles and vascular plants with the other groups, which remained associated even when environmental parameters were removed. In our study, the presence of significant relationships among taxa even after accounting for environmental conditions suggested that different biotic interactions contribute to explaining cross-taxon congruence in community composition. Biotic factors contributed to cross-taxon congruence among vascular plants and arthropod predators (such as pseudoscorpions, spiders, and ground beetles), as well as among taxa at higher trophic levels. Notably, strictly predatory taxa, known as biological control agents, emerged as the best predictors of plant community composition, even when the influence of abiotic drivers was removed. Close relationships and congruent composition patterns were observed between spiders/ants and spiders/ground beetles, independent of environmental parameters. These inter-taxa relationships may be driven by complex biotic interactions, encompassing both trophic and non-trophic interactions, as well as direct and indirect interactions. Bottom-up and top-down forces, along with consumptive and non-consumptive interactions, can influence the community composition of taxa, driving the observed relationships. Future studies should further investigate the role of these forces and interactions in determining cross-taxon congruence. Taking a multi-trophic perspective in cross-taxon studies holds promise for identifying biodiversity surrogates and their practical application in conservation planning.

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3rd session: Vegetation in cultural landscapes

Chair: Michela Marignani

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THE ROLE OF VEGETATION SCIENCE IN THE CONSERVATION OF CULTURAL LANDSCAPES

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Cultural landscapes are defined as the results of the combined action of nature and humans on the territory. Millennia of human presence on most of the Earth resulted in the current existence of many different cultural landscapes, shaped by different civilizations across time. Vegetation plays a key role in shaping landscapes and in their development. This is especially the case of cultural landscapes, where plant communities are deeply influenced by the management of men. Socio-economic changes directly and indirectly affect cultural landscapes due to shifts in such management strategies. This implies that cultural landscapes, as all landscapes in general, are highly dynamic and constantly changing, to the extent that they might disappear after the cessation of human activities or radical shifts of them. In this talk, I will discuss the role of vegetation science in the study of cultural landscapes, with special reference to their management and conservation.

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MEDITERRANEAN TEMPORARY PONDS FACING LAND ABANDONMENT AND CLIMATE CHANGES IN SARDINIAN CULTURAL LANDSCAPES

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Mediterranean Temporary Ponds (MTPs) are small and shallow freshwater bodies fed almost exclusively by rain and then characterized by alternating phases of flooding and drying up. These harsh conditions have selected a unique and highly specialized flora and fauna exclusive to this habitat, including many rare species of conservation concern.
The diffusion of the toponym ‘‘Paulis’’, used in the Sardinian language to name MTPs, suggests a high number of sites hosting them and a strong perception of their presence by local people in the past. Their presence is often connected with silvopastoral landscapes characterized by wooded grassland with *Quercus suber*. Over the years ponds and entire pond landscapes disappeared due to local and global factors, such as land abandonment and climate changes. Traditional land use is a critical factor for MTP conservation. As widely documented, grazing animals, controlling the colonization of shrubs and opportunistic species from the surrounding areas, have maintained these habitats over the centuries. Climate changes, resulting in modification of the seasonal and annual temperatures and precipitation patterns and amounts, could hurt MTPs, driving hydrological processes that control their ecology. In the long term, their modification compromises the persistence of plants, even if they show specific strategies which make them capable of tolerating different flooding conditions and can survive dry periods thanks to seed bank accumulating in the sediments.
In this study, we evaluate the responses of vascular plants of MTPs to different hydrological regimes to identify those most sensitive to their variations. We performed field surveys and indoor experiments. In the field, we analyzed the distribution of plant species along the three concentric belts typical of MTPs (central belt, intermediate belt and outer belt). In indoor experiments, we evaluated the effects of different hydrological regimes on the life cycle, using soil core collection from three MTPs. Our results highlighted a clear pattern within the ponds related to the hydroperiod length. Some key species, such as *Isoetes histrix*, *Laurentia gasparrini*, *Exaculum pusillum* and *Cicendia filiformi*s revealed a clear distribution pattern along the three belts. On the other side, the indoor experiments showed that species, such as *Crassula vailantii*, can adapt the length of their life to the different hydrological conditions while others, such as *Helosciadium crassipes*, *Middendorfia borysthenica*, *Ranunculus ophioglossifolius* fail to close the cycle with seed production if conditions are not favourable. Based on the results obtained, it will be possible to identify the species most sensitive to climate change to target the conservation efforts effectively.

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INFLUENCE OF ENVIRONMENTAL FACTORS AND FOREST STRUCTURE ON *PINUS NIGRA* OLD-ESTABLISHED PLANTATIONS DIVERSITY

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Pine forests of the Mediterranean Basin comprise 25% of forested areas. They represent culturally and ecologically important landscapes. Their current distribution results from the interplay of environmental factors, historical processes, and human activities. Historically, pine forests have been largely planted across Mediterranean Basin, typically in areas to restore alleged degraded habitats, to ensure soil stability, and to promote local economy. Subsequently, socio-economic changes in the twentieth century led to the cessation of traditional land use, including silvicultural practices for plantation purposes. These planted forest stands, named "old-established" plantations, represent viable ecosystems to study the long-term ecological status after their planting. We investigated the effect of environmental conditions and forest structure on the understory of *Pinus nigra* old-established plantations across the Trentino region (northeastern Italy). We aimed to determine the effect of environmental factors (elevation, aspect, and slope) and forest structure (tree height, basal area, canopy closure, and stand density) on (i) taxonomic metrics such as species richness and Simpson diversity, and (ii) on functional metrics such as community-weighted mean for life forms. We stratified for elevation and aspect, and we randomly selected a total of 60 *P. nigra* stands. For each plot, we collected species cover, environmental and structural parameters. We estimated the effect of environmental and structural parameters on taxonomic metrics and community weighted mean of life forms by linear models. We found environmental conditions affect more than structural parameters both taxonomic and functional metrics of understory. Specifically, species richness and species diversity changed unimodally with elevation being lower at both extremes of elevation gradient in accordance with the stress gradient hypothesis. Moreover, species richness increased with slope, probably as an effect of lower competition with tree species. Concerning life forms, geophytes increased under more moist condition, i.e., closed canopy and on north-facing slopes, while chamaephytes increased under more open canopy cover and at higher elevation. Our work improves the understanding of the ecological characteristics of the understory of *P. nigra* old-established plantations. After decades since the planting, they can be considered rather heterogeneous systems in which the understory mainly responds to abiotic constraints rather than structural ones.

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A RESAMPLING APPROACH FOR THE FLORISTIC CHARACTERIZATION OF ABANDONED FIELDS IN PIANOSA ISLAND (TUSCAN ARCHIPELAGO, ITALY)

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The Island of Pianosa, part of the Tuscan Archipelago National Park, hosted intense human activity in the form of an agricultural penal colony until the end of the 1990s. After that time, agricultural actions ceased, and the abandonment of the land process began. The abandonment of agro-sylva pastoral practices is a process that has strong influences on vegetation dynamics. Studies of secondary succession in *old fields* are numerous but, for the Mediterranean basin area, have not yet allowed general conclusions to be drawn and effective models to be proposed. The ongoing colonisation of Mediterranean scrub species on the abandoned land on the island of Pianosa is visible, and its study can provide pivotal information for the conservation of Tuscan Archipelago habitats.

The vegetation characterising the *old fields* of Pianosa was described by Foggi et al. (2008), who individuated annual and perennial grasslands of the classes *Stipo capensis-Trachynietea distachyae, Stellarietea mediae,* and *Artemisietea vulgaris.* The same authors had already identified significant encroachment of the grasslands by typical shrub species of the Mediterranean maquis. However, since the aforementioned work and due to the strong vegetation dynamism taking place in these areas, the succession has continued, and, therefore, the vegetation has been interested in important changes in plant species composition. We, therefore, considered it necessary to survey and monitor the island's vegetation again to identify further changes.

We surveyed the herbaceous vegetation of *old fields* through quasi-permanent squared plots (2 m x 2 m) in two areas of the island and compared it with the old relevés surveyed by Foggi et al. (2008) in the same patches. The result was a vegetational and floristic characterization of the abandoned areas, detecting a change in composition and confirming the ongoing process of encroachment and describing slight variations in vegetation types depending on the past land uses (e.g., pastures, cultivated fields). Moreover, we recorded changes in the abundance of typical species of habitat Natura2000 coded as 6220 “Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*”, highlighting the need for intervention measures for the conservation of this semi-natural habitat.

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VEGETATION ASSESSMENT AND MAPPING OF PASARGADAE WHS (IRAN) AS A TOOL FOR ENHANCING ITS NATURALISTIC VALUE AND FOR THE SITE MANAGEMENT IN THE SCENARIO OF CLIMATIC CHANGES

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Flora and vegetation growing in archaeological areas are often analysed to assess the risk of their negative interactions with monuments [1,2]. However, vegetation can also have an essential role in conserving biodiversity and for positive microclimatic actions, which reduce the overheating of materials in sunny seasons. Furthermore, the knowledge of wild vegetation can be of great utility to understand the bioindication values of environmental and edaphic factors, which can highly vary during history. Ongoing global climate change may be a major contributor to the modifications that may occur to vegetation: then, these changes can be analysed to measure the intensity of the impact. Such impact is particularly relevant in dry areas, where climatic changes due to direct or indirect anthropogenic actions occurred, such as in the WHS of Pasargadae (Iran), where the Persian garden originated. Historically there was a significant water availability, but the site became arid over time, and this phenomenon highly increased in recent times. Due to its location in the border zone of the Zagros mountains and the Irano-Turanian region, the area is a rich ecotone from a biodiversity point of view, and it shows a high naturalistic interest, due to the floristic richness and high rate of endemisms [3]. Thirty-three vegetation surveys were carried out on different vegetation types in the area, considering homogeneous habitats. The ecological traits of the species were also analysed to study their bioindication values, using statistical tools of cluster analysis and ordination methods. A geomorphologic analysis and a vegetation mapping were also carried out using different aerial photos elaborated through QGIS software. Thanks to the meteorological station set up in the last decade, a bio-climatic analysis was carried out for the years 2006-2021. Data on human intervention in the surrounding area (installations, dams, etc.) were also considered. The results showed that several vegetation types are settled in the area, as the result of an ecological gradient driven by environmental and edaphic factors and anthropogenic stress. Some species have been found to have a key-ecological value, due to their role in the landscape, and for their value as bioindicators. Among them, we underline *Stipa barbata* Desf., which dominated in natural semi-rupestrian habitats; *Bellevalia saviczii* Woronow, which also frequently occurs in clayey soils; *Glycyrrhiza glabra* L., which is linked to silty-sandy alluvial deposits; and *Hordeum murinum* L., which mainly occurs in trampled areas. We also found interesting remnants of vegetation with a dominance of *Alhagi maurorum* Medik, that is very resistant to extreme conditions and is a bioindicator species of such conditions in the past. The high plant diversity still present and the mapping of the most relevant communities should be considered when planning management activities for archaeological sites. Bioclimatic data and the ecological values of the occurring vegetation types indicate the increasing xeric condition of the site, which needs to be better protected for his relevant historical and naturalistic value.

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FIRST RESULTS OF A VEGETATION SURVEY ON THE FUCECCHIO MARSH, AN AREA SHOWING A DEEPLY TRANSFORMED PLANT LANDSCAPE COMPARED TO THE PAST

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Extending in central Tuscany between the provinces of Florence and Pistoia and covering about 2,000 hectares, the "Padule di Fucecchio" area is one of the largest inland marshes in Italy. It is one of the wetlands of international importance listed in the Ramsar Convention and encompasses several protected natural areas, either of European or local interest, due to their naturalistic richness and hydrogeological and landscape peculiarities. The studies on its flora, even if rather dated, are numerous and several specimens are deposited in the Tuscan herbariums [1; 2]. Moreover, more recent floristic reports are contained in Wikiplantbase#Toscana. On the contrary, studies on plant communities of Fucecchio Marsh are surprisingly very scarce and out of date. In the last two years, we carried out a vegetation survey concerning aquatic and marshy vegetation; using the phytosociological approach, we collected more than 140 relevés in the area. As it could be predicted, the preliminary data analysis showed that, with respect to past vegetational and floristic data, a large part of the aquatic and marsh plants of relevant conservation value have disappeared or have greatly reduced their diffusion, in favour of alien species, which have also become an important or predominant component in plant communities. Hydrophytic coenoses are rather scarce and distributed in very peculiar habitats such as the small puddles along the paths of the nearby forests or in the few ponds and streams with less turbid or polluted water. Only communities with *Callitriche sp. pl., Persicaria amphibia, Myriophyllum spicatum* and *Ranunculus trichophyllus* have been detected. On the contrary, helophitic communities are more abundant and distributed along the entire study area, in particular *Phragmitetum australis* and other coenoses such as *Schoenoplectetum lacustris*, *Caricetum ripariae* or *Phalaridetum arundinaceae*. In addition, communities dominated by different species of the genus *Bolboschoenus* have been detected and are being defined through comparison with updated data from taxonomic and vegetation points of view [3; 4]. Communities of ephemeral environments dominated by native and alien species (e.g., *Cyperus sp. pl., Amaranthus blitum, Lindernia dubia, Crypsis schoenoides*) resulted to be widely present in the study area and their syntaxonomic definition is underway.

Generally speaking, the great upheavals of the Fucecchio Marsh first began with post-war agricultural changes, and tragically intensified starting in the late 1990s, when the Louisiana crayfish (*Procambarus clarkii*) and nutria (*Myocastor coypus*) have accidentally spread to the area. From an avifaunistic point of view, the crayfish has represented a valuable resource for many marsh birds of conservation interest, but the increasingly massive presence of these invasive alien species led first to the rarefaction and then to the complete destruction of numerous aquatic and marshy plant communities, which are no longer present today (e.g., *Hydrocharis morsus-ranae* or *Nymphaea alba* or *Oenanthe acquatica* dominated communities) and, consequently, to a profound transformation of the plant landscape of Fucecchio Marsh.

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STEPS TOWARDS POPULARIZING VEGETATION SCIENCE: THE "FIELD GUIDE TO THE PLANT COMMUNITIES OF ABRUZZO LAZIO & MOLISE NATIONAL PARK"

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Nell'ambito delle iniziative per il centenario del Parco Nazionale d'Abruzzo Lazio e Molise (PNALM), è stata pubblicata una dettagliata (344 pagine) guida alle comunità vegetali dell'area protetta [1]. Gli autori, per cercare di garantire la massima accessibilità e leggibilità per il pubblico non specialistico e allo stesso tempo contenuti rigorosi e approfonditi, hanno adottato un approccio non molto frequente in Italia, richiamandosi allo stile e all'impostazione adottati nelle "field guides" alle comunità vegetali che hanno una buona tradizione nei Paesi Centro- e Nord-Europei [es. 2,3,4]

Il libro è stato articolato in una prima parte che illustra in modo concreto l'azione dei fattori che determinano l'eterogeneità del paesaggio vegetale; una seconda parte che descrive in modo sistematico le comunità vegetali del Parco; una terza parte con una selezione di escursioni lungo i gradienti che controllano l'eterogeneità della vegetazione, che consentono di incontrare le diverse fitocenosi descritte nella seconda parte.

Particolare cura è stata rivolta a far comprendere le interazioni fra tutte le componenti del paesaggio, in modo da svolgere anche un'opera "educativa" nel sensibilizzare il lettore (escursionista, turista, fotografo naturalista, ma anche guida ambientale, personale degli enti locali, ecc.) alla lettura di processi ecologici poco o per nulla noti al pubblico, anche collegati a problemi di gestione e conservazione.

Sono stati seguiti i seguenti criteri editoriali e stilistici: 1) I termini tecnici sono stati il più possibile evitati; quando necessari, sono stati spiegati nel testo (e in tal caso evidenziati in corsivo), oppure in un glossario (e in tal caso marcati da un asterisco). 2) Non è stata utilizzata la nomenclatura fitosociologica; le comunità sono suddivise su base prevalentemente fisionomica, ma di ciascuna è fornita una accurata descrizione floristica ed ambientale. 3) Per le specie arboree e arbustive sono stati utilizzati prevalentemente i nomi italiani (il nome latino è riportato solo alla prima occorrenza in ciascun capitolo). 4) Per garantire il rigore scientifico e la tracciabilità delle informazioni, sono presenti numerosissime citazioni bibliografiche, che per non appesantire il testo sono collocate in nota; le note contengono anche approfondimenti tecnici di interesse per il lettore più specializzato (es. riferimenti alla letteratura fitosociologica o cenni al dibattito scientifico).

Numerosissime fotografie di buona qualità e stampate in formato generalmente grande (metà pagina) costituiscono una parte essenziale dell'approccio adottato, con approfondite didascalie esplicative che formano una sorta di libro parallelo al testo principale.

Sono state inserite numerose schede fuori testo, per il riconoscimento dei principali alberi e arbusti ma anche di *Poaceae*, muschi e licheni (sempre facendo molta attenzione a non utilizzare un linguaggio formalizzato). Altre schede presentano, in modo accessibile a tutti, tematiche di ecologia vegetale raramente affrontate nei libri divulgativi disponibili in italiano, come ad es. i gruppi funzionali delle specie di prateria, gli effetti delle utilizzazioni selvicolturali o i peculiari processi ecologici del sottobosco di faggeta.

La fitta rete di note e rimandi bibliografici può rendere il volume utile anche al lettore specializzato, tanto più che numerose informazioni derivano da nostri studi ancora inediti o da dati per il momento pubblicati solo nelle note illustrative alla recente Carta degli Habitat del PNALM [5] (es. per quanto riguarda la vegetazione acquatica lacustre, le torbiere o le pinete autoctone della Camosciara).

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Free session

Chair: Gianmaria Bonari

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THE NATIONAL BIODIVERSITY FUTURE CENTER: A BOOST TO THE KNOWLEDGE OF ITALIAN BIODIVERSITY

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Starting from September 2022, the National Biodiversity Future Center (NBFC), a research and development program funded within Mission 4 of the Italian Recovery and Resilience Plan, was set up under the supervision of the Italian Ministry for University and Research. The Centre, whose headquarters are in Palermo and to which 26 universities, 7 public research bodies and 15 private companies participate, has two main goals: a) to understand the main factors responsible for marine, terrestrial and urban biodiversity erosion, and b) to increase the intangible and tangible value of biodiversity, making its increasingly in-depth knowledge a central element for sustainable development. As indicated in the first goal, the three priority scientific areas are marine, terrestrial and urban biodiversity, to whose study 6 spokes are dedicated. Two spokes are instead dedicated to the impact that the study of biodiversity can - and must - generate, both in terms of public engagement and societal values, and in terms of technological transfer and industrial development. NBFC coordinates the activities of over 2000 researchers, engaged on the national territory to contribute to the largest national initiative ever undertaken on the study of Italian biodiversity, in compliance with the European Strategic Plan and the UN 2030 Agenda.

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VEGETATION OF CENTRAL ARGENTINA: SO DIVERSE AS ENDANGERED

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Central Argentina boasts a variety of vegetation types, ranging from native forests, shrublands, and grasslands to halophytic vegetation and non-native woody communities. These vegetation types can be found in both lowlands and mountainous regions, showing the exceptional plant diversity of this region. The unique biodiversity of central Argentina is not only defined by its high plant species richness, but also by its complex landscape heterogeneity. To enhance our understanding of the region's vegetation, a database called ArgVeg was established in 2022, containing 1092 vegetation-plot records. This comprehensive database encompasses 1184 native and non-native vascular plant species and encompasses the various vegetation types within the Chaco, Espinal, and Pampean phytogeographic provinces.

1. **Chaco**, this region features forests and savannas as potential vegetation types. The floristic composition and physiognomy, as well as human activities, are influenced by a decreasing precipitation gradient from east to west.
2. **Espinal**, forests and savannas dominated by *Prosopis* tree species are the primary vegetation type in this region.
3. **Pampean**, originally characterized by temperate grasslands, this region is currently covered by crops, occupying 92% of the area.

The mountainous areas account for 60% of the overall plant diversity and have two distinct biogeographical histories. The lower part is connected to the Chaco region, while the upper part, which represents less than 10% of the mountains, is associated with the Andes (Sub-Andean). Both regions are characterized by a complex mosaic of vegetation types, including native forests, shrublands, grasslands, and rocky outcrops. Here is a more detailed breakdown:

- Mountain Chaco. this area is covered by forests and open forests dominated by *Lithraea molleoides* and *Schinopsis marginata*. It also features rich closed and open shrublands comprising *Vacchelia caven, Baccharis aliena,* and other woody species. Additionally, grasslands and lawns dominated by grasses from the genus *Festuca, Nassella, Paspalum, Schizachyrium,* etc. are also present.
- Sub-Andean. Dominated primarily by different types of grasslands such as *Festuca, Deyeuxia, Poa*, and lawns of *Muhlenbergia* with *Cyperaceae* and *Juncaceae* species, outcrops with grassland and outcrops with exposed rocks and lower cover. Forests and open shrublands of *Polylepis australis* are also found in this region.

This complex and diverse landscape arrangement is the result of the interplay of multiple factors over time. Temperature decrease along the elevation gradient, a phenomenon observed in many mountain ranges worldwide, is one of the most significant ones. Additionally, fire and grazing pressure play crucial roles and, combined with climate and vegetation characteristics, contribute to the maintenance of treeless patches dominated by flammable vegetation and forest patches dominated by shade-tolerant plants. Currently, urban areas, native forests, and shrublands dominate the lower part of the landscape. Above 1000 m and up to 2770 m, mountains are primarily covered by grassland at different successional stages, although there are no climatic constraints for tree establishment along the altitudinal gradient. However, the gradual colonization of over 40 woody exotic species is considered a major threat to these ecosystems, not only impacting native biodiversity but also affecting essential contributions to people, such as water, meat, tourism, and medicine.

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MOLECULAR EVIDENCE AND ENVIRONMENTAL NICHE EVOLUTION AT THE ORIGIN OF THE DISJUNCT DISTRIBUTION IN THREE MOUNTAIN ENDEMIC TEPHROSERIS (ASTERACEAE) OF THE MEDITERRANEAN BASIN

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The genus *Tephroseris* includes three taxa whose distribution is localized in three oromediterranean hotspots: *Tephroseris balbisiana* endemism of southwestern Alps, *Tephroseris elodes* for the Sierra Nevada, and *Tephroseris coincyi* for the Sierra de los Gredos. These three taxa grow exclusively in very wet and oligotrophic to mesotrophic habitats and are characterized by strong morphological homogeneity.
Multiple studies proposed several different combinations of species and subspecies, but no comprehensive studies were published so far. We compared their biology, ecology, and phylogeny using molecular phylogeny, species distribution modeling and genome sizing. Results highlighted a clear separation between the Alpine *T. balbisiana* and the two Iberian taxa. Molecular phylogeny showed two separated and well supported clades, moreover divergence time between Alpine and Iberian taxa is estimated to date before Pleistocene glaciations. This is partially confirmed by distribution models predictions for the last interglacial period and the last glacial maximum, excluding the expansion of *T. balbisiana* towards the Iberian Peninsula. Flow cytometry data revealed that genome size of the Iberian taxa is significantly larger than that of *T. balbisiana*. We collected several different clues to conclude that Iberian taxa can be regarded as two separate subspecies. Our findings shed light on a difficult complex species and open new perspectives in conservation of not only these rare species, but also the conservation of their peculiar habitats.

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DUNES UNDER ATTACK: TEMPORAL TRENDS OF ICEPLANT INVASION (*CARPOBROTUS* SP. PL., AIZOACEAE) IN DIFFERENT LANDSCAPE CONTEXTS. AN INSIGHT ON MEDITERRANEAN COASTS

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Carpobrotus acinaciformis, C. edulis (Aizoaceae) and their hybrids, native to South Africa, are considered as one of the worst Invasive Alien plants (IAPs) along the Mediterranean coastal dunes causing irreversible damage in ecosystem biodiversity and loss of ecosystem services [1]. The Convention on Biological Diversity (https://www.cbd.int/) and the Regulation (EU) no. 1143/2014 on Invasive Alien Species propose a common strategy to monitor the invasion and to contrast the negative impacts of IAPs [2]. The invasion of these two species and their hybrids with similar impacts, referred here as *Carpobrotus* spp., is a highly dynamic process shaped by the interplay of biotic factors (e.g. competition with native communities, spread by mammals or birds), abiotic ones (e.g. coastal erosion and accumulation, seashore distance) and anthropic pressure (e.g. dune trampling, land take, artificial infrastructures) [3,4]. Due to the widespread presence of *Carpobrotus* spp. on Mediterranean coasts and the huge threat it poses to biodiversity, important efforts have been devoted to mapping it [5], studying its relation with biodiversity [6] and analyzing its spatial pattern in the landscape [7]. However multi-temporal studies exploring the mutual relationship between landscape dynamics and alien species expansion or contraction are still lacking.

In this context, the present work sets out to investigate landscape pattern changes occurred in areas invaded by *Carpobrotus* spp. (i.e. composition, configuration) during the last decade (2012-2022), and to examine the relationships among such spatial pattern changes and invaded patches dynamics.

We produced fine-scale (1:2000) land-cover/vegetation maps for two time steps (years 2012 and 2022) on invaded coastal dune in central Mediterranean (Lazio region, Italy). We mapped 95 invaded sites with a round buffer of 100 m radius by visual inspection of aerial orthophotos in Google Earth at the fourth level of CORINE land cover legend. Overall landscape change was analyzed by a transition matrix and summarized them by a chord-diagram [8]. We classified the mapped areas into two categories: EXP_{CAR} gathering sites in which alien expansion occurs (e.g. increasing cover of *Carpobrotus* spp. patches in 2022) and RED_{CAR} grouping sites with a reduction of alien cover over time (e.g. decreasing cover of *Carpobrotus* spp. patches in 2022). For each area and time step, we calculated a set of non-redundant landscape metrics (LM) depicting the spatial pattern of the whole coastal mosaic (LM_{land}) and of each land cover class (LM_{class}). In particular: the percentage of the landscape covered by each class (PLAND), patch density (PD), edge density (ED), mean patch area (AREA_MN), Shannon index (SHDI) and Simpson's index (SIDI) [9] and we tested their temporal difference through non-parametric pair-wise Wilcoxon rank test. Then, we quantified changes in pattern metrics occurring in each cover category by computing ΔLM = 2022LM - 2012LM and we explored the partial dependence of the changes on *Carpobrotus* spp. spatial pattern (ΔLM_{CAR}) in the coastal dune landscape variables without multicollinearity problem and Variance Inflation Factor (VIF) lesser of three (ΔLM_{class}, ΔLM_{land}) using a Random Forest model (RF) and Partial Dependence Plot (PDP) [10]. In general, the transition matrix confirms natural dynamism of coastal dune during the last 10-years with comparable shifts towards adjacent land cover classes. Landscape analysis over time evidenced important changes on *Carpobrotus* spp. spatial pattern during the last decade (2012-2022) and such changes varied across coastal dune tracts in which invasion is expanding (EXP_{CAR}) or contracting (RED_{CAR}). In EXP_{CAR} areas a quite stable coastal context was evidenced, while in RED_{CAR} intense erosion process was detected. Focusing on *Carpobrotus* spp., in EXP_{CAR} areas, the chord diagram evidenced an increment of CAR class extension substituting HDV class, and on RED_{CAR} areas CAR class decreased and was replaced mainly by SEA and partially recovery by HDV. Consequently, the spatial pattern of *Carpobrotus* spp. patches significantly changed over time with opposite trends, all landscape metrics intensify in EXP_{CAR} areas causing increase in pressure and impacts on HDV, while in RED_{CAR} areas all landscape metrics show a contraction and simplification of invasion due to very high fragmentation caused by erosion process. Moreover, all RF models and PDP, adequately described the relation of temporal changes in *Carpobrotus* spp. composition ($\Delta PLAND_{CAR}$) and configuration (ΔPD_{CAR},

ΔED_{CAR}, $\Delta AREA\_MN_{CAR}$) with changes on the spatial pattern of the surrounding landscape (ΔLM_{class} and ΔLM_{land}) with R^2 values greater than 0.405.

The different trends of *Carpobrotus* spp. expansion or reduction denote the heterogeneous contribution of class and landscape dynamics in determining its spread. Here for the first time, we quantify the multi-temporal effects of landscape pattern and processes to shape *Carpobrotus* spp. invasion discerning different trends in increase and contraction of invasion [11]. These information concerning IAP occurrence needs to be supported by the knowledge on landscape processes to identify effective conservation and management strategies as claimed by international and regional regulations on biodiversity.

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CONSERVATION OF THE NATURA 2000 HABITATS AT CAPRAIA ISLAND (ITALY): MAPPING AND CONTROLLING INVASIVE ALIEN PLANTS

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Biological invasions represent one of the main causes of biodiversity loss on a global level, following the fragmentation and degradation of habitats. The resulting impacts are higher for island ecosystems and their peculiar habitats, more vulnerable and threatened by this process [1,2]. The EU LIFE program is one of the European tools that makes feasible the conservation of habitats and species throughout the management of biological invasions. This work is proposed as a feasibility study for a LIFE project focused on the conservation of Natura 2000 habitats in the island of Capraia (Tuscan Archipelago) throughout the eradication/management of the main invasive alien plants present on the island: *Chasmanthe floribunda, Nicotiana glauca, Opuntia ficus-indica, Opuntia stricta, Senecio angulatus* and *Zantedeschia aethiopica*. Through a series of surveys, we produced a detailed map of the current distribution of the six invasive species. The information collected allowed us to evaluate the extent of the invaded area and to identify the most impacted N2000 habitats (sensu Habitats Directive, 92/43/EEC), merging the distribution of alien species with the N2000 habitat map. Finally, we evaluated the management options for these species and calculated the removal costs of the manual eradication technique (integrated with the mechanical control with brush cutter only for *Senecio angulatus*). In the case of *Opuntia stricta*, given the large distribution of this species, we made a detailed estimation of the cost based on the density of the species, including the time to reach the areas (both evaluated in GIS environment) and the various operations necessary for removal. Alien species are most widespread in the northeastern area of the island and within the SAC, with only *Opuntia stricta* also reaching the Park area. In total, 3.6% of the island's surface (about 71 ha) is invaded by the six alien species analyzed, of which *Opuntia stricta* is by far the most widespread with over 70 ha. The habitats most affected by the invasion are 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*", all invaded mainly by *O. stricta*. The management costs of the species were estimated to approximately € 57,000 for the 4 less common species. In particular, almost € 7,000 for *Chasmanthe floribunda* and *Zantedeschia aethiopica*, € 2,000 for *Nicotiana glauca* and € 48,000 for *Senecio angulatus*. For the two *Opuntia species*, considering the not significant presence of *O. ficus-indica*, we estimated the cost in a cumulative assessment, taking in to account two possible management scenarios: the first scenario provides for the total eradication from the island with an estimated cost of about 480,000 €, while the second one considers the control of the species only in priority intervention areas (habitat within the SAC) with a cost of approximately € 285,000. The data collected in the context of this study provided essential information and represent a first cost/benefit analysis on which it was possible to base a well-detailed proposal for a LIFE project for the conservation of the habitats of the island of Capraia.

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Effectiveness of protected areas on preserving Italian broadleaf forest plant diversity

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Forests are some of the most biodiverse ecosystems and provide important services to people living in and around them. Due to widespread human-caused forest loss and degradation, forest biodiversity worldwide is declining. Protected areas (PAs) can be an important tool to reverse this trend and increase forest recovery. In Italy, PAs are often assumed as effective at conserving forest biodiversity and supporting natural vegetation dynamics. However, their effectiveness at conserving vascular plants has seldom been tested quantitatively at country level.

Here, we used a dataset of 16 259 vegetation plots sampled in Italian forests between 1930 and 2020 (Alessi et al. 2023) to assess the effectiveness of PAs in conserving vascular plant diversity. We filtered the initial dataset to only keep vegetation plots collected between 1980 and 2020 in broadleaved deciduous forests, accounting this habitat for most of the available samples (> 10000). To test whether PAs were effective at mitigating the negative effects of increasing human pressure on deciduous forest ecosystems, we compared the differences in vascular plant alpha diversity between protected and non-protected areas before and after 2000 using generalized linear models (GLMs). We accounted for confounding factors related to the non-random location of vegetation plots in the landscape and across PAs by using propensity score matching. Matching was based on covariates that are usually linked to biases in PAs location and to the plot's characteristics: protection status, altitude, 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 highlight the importance of (well-designed) protected areas for supporting forest conservation over time to preserve the natural heritage that maintains the intimate relationship between ecosystems and human wellbeing, especially in a climate change scenario.

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IMPACTS OF WOOD DISTILLATE ON SEEDLING EMERGENCE AND FIRST-STAGE DEVELOPMENT IN FIVE THREATENED ARABLE PLANTS

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In agriculture, synthetic fertilizers are increasingly being replaced by bio-based products. Among these, one of the most promising is wood distillate (WD), also known as pyroligneous acid. It is a by-product of the pyrolysis process of wood biomass which is rich in biologically active substances (sugars, polyphenols, acids, alcohols, and esters) that improve crops' fitness and yield. To the best of our knowledge there is no scientific evidence on the effects of this product on present arable plants growing among crops, including their functional traits like biomass. To test such effects, we carried out a lab experiment on artificially reconstructed arable plant communities composed of five species of conservation interest, which are specialists of winter cereal crops: *Bromus secalinus* L., *Centaurea cyanus* L., *Lathyrus aphaca* L., *Legousia speculum-veneris* (L.) Chaix, and *Scandix pecten-veneris* L. After sowing 45 pots under controlled conditions, we applied WD at three concentrations (0%, 0.2%, and 0.5%) six times over seven weeks. The number of emerged plants in each pot was counted every two weeks. Finally, we harvested all the plants and measured the fresh and dry above-ground weight of each species in each pot. The resulting data were analysed by Permutational Analysis of Variance. The application of 0.2% and 0.5% WD modified the community composition within two weeks, but the differences later disappeared. 0.2% and 0.5% WD had a positive effect on the dry weight of *S. pecten-veneris*, and a negative effect on that of *L. speculum-veneris*. Moreover, 0.2% and 0.5% WD increased seedling emergence in *L. aphaca*, and 0.5% WD increased seedling emergence in *S. pecten-veneris*. 0.2% and 0.5% WD enhanced seedling emergence in the whole community. We suggest that the use of WD at low concentrations in winter cereals may be a sustainable agricultural practice that benefits crops without harming the associated plant diversity.

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IMPLEMENTING A VEGETATION-BASED RISK INDEX TO SUPPORT MANAGEMENT ACTIONS IN MEDITERRANEAN COASTAL DUNES

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Coastal dunes are crucial ecosystems that mitigate the effects of sea processes and safeguard coastlines. However, the growing human impact on coasts, coupled with natural phenomena such as sea-level rise and erosion, necessitates the development of effective methodologies for the coastal risk assessment. These assessments offer insight into the pressures faced by coasts and their adaptive capacities. Furthermore, maps derived from risk assessments prove to be a valuable resource for managing coastal zones, especially dune systems.

This work deals with a coastal risk index grounded in geomorphological parameters (10 variables), socioeconomic activities (5 variables), cultural assets (2 variables), and ecological aspects (7 variables). The index incorporated several vegetation-related variables typically overlooked in risk assessments. The risk status of approximately 35 kilometers of sandy coastline across two protected Tuscan areas, the Migliarino-San Rossore-Massaciuccoli Regional Park and the Maremma Regional Park in Italy, was evaluated. The entire coastline was divided into 35 contiguous units, each measuring 1000 × 500 meters, with the risk index calculated for each unit using data from various databases, Google Earth, and direct field observations.

Vegetation parameters were obtained by randomly placing a transect perpendicular to the shoreline within each unit, starting from the annual vegetation of drift lines to the fixed dunes dominated by *Juniperus* sp. pl. In 2 × 2 m plots along each transect, we recorded the presence of dune habitats, identified following the EUNIS classification. The index was calculated by assigning each variable's value to a label on a five-point scale, ranging from 1 (very low risk contribution) to 5 (very high risk contribution). All the variables were amalgamated within a GIS environment into the Forcing (geomorphological parameters), Susceptibility (geomorphological and vegetational data), Hazard, and Vulnerability sub-indices (socioeconomic, cultural, and ecological contexts). The Coastal Forcing and Susceptibility indices form the basis for the Hazard index, which, when combined with Vulnerability, constitutes the coastal risk index. We then performed a non-metric multidimensional scaling (NMDS) on a 24 variables × 35 units matrix.

Results indicated that 12.5% of the Migliarino-San Rossore-Massaciuccoli Regional Park coastline and 30.8% of the Maremma Regional Park's southern coastline exhibited a high-risk index. The multivariate analysis revealed a division of cells into two main clusters: a small group with high socioeconomic vulnerability but low-risk indices, and a larger group containing natural protected and historical sites with low human activity levels but high to very high-risk indices. Despite being within protected areas, these sites displayed high risk levels due to coastal erosion processes, often a consequence of human activities elsewhere. While sea-level rise poses a threat, the rapid response to human-induced erosion effects remains the primary concern for coastal communities.

This risk assessment tool, which integrates diverse information (socioeconomic, cultural, and ecological data), provides valuable support to stakeholders for more targeted and effective management and conservation actions. By highlighting the most threatened aspects, we can direct focus towards specific management recommendations.

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NEW PHYTOSOCIOLOGICAL DATA ON THE *CARICION DAVALLIANAE* COMMUNITIES FROM THE CENTRAL APENNINES.

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The Central Apennines represent the highest sector of the whole Apennine range with numerous peaks exceeding 2400 m a.s.l., such as Gran Sasso, Majella, Sibillini, Laga and Velino-Sirente. The high altitudes and the significant influence that the glaciations had on these areas during the Quaternary allowed numerous arctic-alpine or circumboreal communities (e.g. *Armerio-Salicetum herbaceae, Leontopodio-Elynetum myosuroidis, Caricetum kitaibelianae-rupestris, Galio-Silenetum acaulis, Achilleo-Saxifragetum aizoidis*) to find refuge in the top part of these mountains [1-3]. The Laga Mountains, because of the arenaceous-pelithic substrate capable of a high hydric retention, host a high number of microthermic meso-hygrophilous environments, such as mires, peat bogs or swamps. In this research, we have identified some high-altitude hygrophilous communities characterized by the dominance of *Carex frigida* All. *C. flacca* Schreb. subsp. *flacca* and *C. davalliana* Sm.. The communities characterized by the co-dominance of *C. frigida* and *C. flacca* subsp. *flacca* are developed in wet areas located along stream banks in the subalpine belt of typically N-facing valleys. These communities exhibit high frequency and cover values for *Jacobaea alpina* (L.) Moench subsp. *samnitum (*Nyman) Peruzzi and *Juncus articulatus* L. and the occurrence of typical *Caricetalia davallianae* species such as *Blysmus compressus* (L.) Panz. ex Link, *Eleocharis quinqueflora* (Hartmann) O. Schwarz, *Equisetum variegatum* Schleich. ex F. Weber & D. Mohr, *Epilobium alsinifolium* Vill., *Eriophorum latifolium* Hoppe, *Juncus alpinoarticulatus* Chaix. *J. arcticus* Willd., *Tofieldia calyculata* (L.) Wahlenb. Particularly interesting is the constant occurrence of *Pinguicula vulgaris* L. which seems to benefit from the long snow cover until late spring and from the alternation of wet phases (flooding of streams) and partially dry phases during summer. The closest syntaxonomic references for such communities are *Junco-Caricetum frigidae* Pedrotti 1982 and *Pinguiculo-Caricetum praetutianae* Biondi et al. 1999 two associations which were already described for the Central Apennines [4-6]. On the contrary, the *Carex davalliana* communities represent a novelty in the phytosociological literature of the central Apennines as no phytosociological relevé of any plant community in which this species has ever been reported is currently known for this area. In the Laga Mountains *C. davalliana* was found in sedge rich-in-moss communities developed on permanently waterlogged soils located on flat areas and within dripping N-facing slopes. The syntaxonomic classification of both *Carex frigida* and *C. davalliana* communities in the *Caricion davallianae* alliance would lead to include them in the 92/43/EEC Habitat 7230. However, factors such as the presence of a siliceous substrate, soil acidity, and the occurrence of certain diagnostic species also warrant consideration for Habitat 7240*. Furthermore, in the present study, the composition of bryophites (a key component of peat bogs), was considered. Among the various species identified there are several rare taxa from a biogeographic point of view and new records for the Regional briophytic flora.

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VEGETATION SURVEY OF *PINUS NIGRA* NATURAL WOODS IN ABRUZZO NATIONAL PARK, AND COMPARISON WITH PINE PLANTATIONS IN THE SAME AREA

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The Abruzzo Lazio & Molise National Park hosts the only *Pinus nigra* subsp. *nigra* spontaneous woods in the central Apennines - the taxon is native also to Majella NP, where, however, it is very sparse and does not originate true forest communities. The black pine natural stands of Abruzzo NP are located on the steep dolomite outcrops of the Camosciara ridge, where the peculiar edaphic conditions prevent competition by beech. Although these woods are a well-known feature of the Park, there are no published studies about their floristic composition (except a few information in [1]) – probably because their locations are difficult to access.

The same NP hosts some more forest types dominated by *P. nigra* subsp. *nigra*: 1) the well-known pine wood surrounding Villetta Barrea, whose artificial or partially natural origin is a controversial issue [2,3]; 2) a number of plantations, sometimes obtained from autochthonous seeds, planted between 1910 and 1970; and 3) the recently observed [2], ongoing process of secondary colonization by autochtonous *P. nigra* subsp. *nigra* in old-fields at the foot of the Camosciara, probably originated by the seed-rain from the native woods on the slopes.We present here the preliminary results of a project aimed at: i) describing the floristic composition and community ecology of the native stands of the Camosciara outcrops; ii) describing the floristic composition of the Villetta Barrea wood, of the plantations and of the secondary woods; iii) comparing these four different wood types and contributing to the debate about the origin and naturalness of the Villetta Barrea wood; iv) searching for the main environmental drivers of the variations in floristic composition.

To this end, we used 65 standardized plots (of squared shape, with an area of 100m^2), placed with a stratified random sampling design (except for the autochtonous woods of the Camosciara, where the very small area of the fragments and the dangerous environment prevented from applying a randomized approach). Data were processed with NMDS and db-RDA ordination, and TWINSPAN clustering.

Results showed that: 1) The composition of the Camosciara natural woods is markedly different compared to the plantations; 2) The Villetta Barrea forest has a floristic composition intermediate between the natural woods and the plantations (as shown by NMDS ordination), but it has a higher floristic affinity with the natural woods (as shown by TWINSPAN cluster analysis); 3) The secondary (recolonization) woodlands, being located exclusively in a clayey valley-bottom, are characterized by a distinct floristic composition compared to the Camosciara stands, and share a number of species with the plantations located on clayey substrata; 4) Plantations have a very high degree of internal floristic heterogeneity, because they were planted across a range of very different habitats as for edaphic (and sometimes meso-climatic) factors.

Moreover, the closeness to urban areas, the variety of silvicultural activities and the frequent canopy openings (due to the ageing of the planted trees or to windstorms) give rise, in pine plantations, to the frequent occurrence of grassland and opportunistic species. Overall, the floristic composition of the plantations is markedly different from the native stands and is also of a very low quality, because it is mostly composed of euryecious or even ruderal species. Instead, the species with a high fidelity for the natural woods of Camosciara are mostly indicators of dolomitic substrata, or of xeric and oligotrophic habitats.

These results can be relevant for management decisions, as the plantations present a number of challenges and open questions connected, e.g., with fire prevention and landscape evolution.

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Salt-marsh vegetation of the "Palude la Vela" Regional Nature Reserve (Taranto, Apulia)

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Palude La Vela Regional Nature Reserve is a protected natural area located in the municipality of Taranto (southern Apulia). With an extension of 116 hectares, the area stretches along the shores of Taranto's "Mar Piccolo" and is included in the SCI IT9130004 "Mar Piccolo" (Margiotta et al. 2020).

Whithin the Project BEST "Addressing joint Agro- and Aqua-Biodiversity pressures Enhancing SuSTainable Rural Development", funded by the Interreg V-A Greece-Italy European Territorial Cooperation Program 2014/2020, a vegetation survey was carried out between 2021 and 2022. Vegetation data were sampled in the field according to the phytosociological approach. A total of 77 original relevés have been organized into a dataset and then subject to cluster analysis. The literature relevés from Chiesura-Lorenzoni & Lorenzoni (1977) were not included in the elaboration, due to some issues about the taxonomic identity of some species. The outcomes of the numeric analysis allowed to identify various associations, many of them floristically and physiognomically-structurally well differentiated, and referable to the classes: *Salicornietea fruticosae*, *Therosalicornietea*, *Saginetea maritimae*.

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Poster

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THE ROLE OF CITIZEN SCIENCE IN MONITORING THE ANNEX II-IV TARGET SPECIES *HIMANTOGLOSSUM ADRIATICUM* H.BAUMANN

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In order to achieve a global management technique in biodiversity conservation, there is an urgent need for constant global monitoring of plant and animal species. At this end, every source of data and knowledge acquisition is important, as well as every available monitoring method. One possible approach to enhance the acquisition of data is the employment of nowadays quickly spreading techniques such as Citizen science. The term "Citizen science" refers to a wide variety of participatory techniques involving either trained volunteers enrolled in monitoring projects, such as in the European project LIFE17 ESC/IT/00000 "ESC360" (www.life360esc.eu), or Citizens who, individually or organized into associations, willingly participate in observing wild biodiversity through sending records of occurrence of the species to institutions such as Universities, that serve as data sorters and collectors [1]. This is the case of our project undertaken for the target species *Himantoglossum adriaticum* H.Baumann in the frame of the European integrated project LIFE19 IPE/IT/000015 "LIFE IMAGINE Umbria - Integrated MAnagement and Grant Investments for the N2000 NEtwork in Umbria", Actions A11, C13 and C15 (www.lifeimagine.eu). *Himantoglossum adriaticum* is an orchid of community interest, listed in the Habitat Directive 92/43 EEC under annex II and IV, that can be easily distinguished for the flowers, equipped with a flashy, trilobate labellum, in which the central lobe is greatly elongated and wavy or spiral-shaped. In the application of Citizen science, we relied first on the unmistakability of the morphological characters of the flowers for the realization of an easily accessible flier provided with pictures of the species, including the details of the aspect of the inflorescence, the entire plant, and the flowers seen up close. In the flier, there were also the basic instructions for the monitoring activity: Citizens were supposed to send us photos of the individuals they found and the coordinates of where they came across the species, taken with their cell phones. The flier was entitled "Who saw it? Wanted *Himantoglossum adriaticum*" to make it more captivating, also relying on the odd, eye-catching aspect of the flowers of this species. The results were incredible, totally unexpected: up to 234 reports were collected, among individual citizens and orchid-enthusiast organizations, including different levels of expertise and skill, from the untrained amateur Citizen to the expert passionate orchidologist. Data from untrained providers have been validated by way of the associated images and by random verifications in the field [2]. The remarkable abundance of available data made it possible to carry out further analysis: the records were overlapped on LULC (Land Use Land Cover) layers, in particular the ESA World Cover 2021, chosen for its optimal resolution (10 meters) and the Corine Land Cover 2018, chosen instead for the numerosity of classes, which provided a good representation of the land Cover in Umbrian territory, though with a lower resolution (100 meters). The distribution data, overlapped with these layers, were displayed using the softwares for satellites data processing known as Google Earth Engine and QGIS V.3.24.0. Also, data were sorted by origin, distinguishing them into records from bibliography, citizens spontaneous observations, G.I.R.O.S. (an orchidologists and orchid-enthusiast organization) records, already stocked databases and sitography, University investigations [2]. This filtering process was important to understand better the reliability of data, the effective amount of information acquired with Citizen science, and the species preferences in terms of different environmental contexts and land uses/cover types.

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TAKE ME HOME, MOUNTAIN ROADS:

THE ECOLOGICAL PREFERENCES OF INVASIVE ALIEN PLANTS IN MAIELLA AND GRAN SASSO MOUNTAINS (ITALY)

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The ever-increasing of international trade and anthropogenic activity has led to the relocation of thousands of plant species worldwide. Many plants that are transported by anthropogenic means face difficulties in reproducing and finally establishing themselves successfully in their new location due to climatic or other environmental constraints. Mountains are generally subject to lower levels of plant invasion in comparison to lowland areas, and invasions into high elevations are rare [1]. However, the distribution and abundance of alien plant species can be strongly influenced by corridors that facilitate their dispersal. The mountain roads have been implicated as an important contributory factor in biological invasions and through them, mountain systems are becoming more susceptible to plant invasions [2]. At the same time, climate change alters the distribution of native biota [3], thereby making mountains more vulnerable to invasions.
For these reasons, in this study we analyse the distribution of invasive alien plants (IAPs) along an altitudinal road gradient in two important mountain massifs in Central Apennines: the Maiella and the Gran Sasso massifs (Italy). In addition, we aim to answer to the following question: "what ecological features of mountain plant communities make them either prone or resistant to the presence of IAPs in these mountains?"
Vegetation was sampled in Maiella and Gran Sasso massifs along roads extending from 500 m a.s.l. to 2000 m a.s.l., in 20 plots placed every 100 m of altitude, according to the MIREN sampling protocol [1]. Each plot consisted of 2 sub-plots of 50m x 2m: one located parallel to the roadside (external) and the other centered and distant from the first plot 50 m (internal). The cover of all vascular plant species was recorded. The status of alien plant species follows Galasso et al. (2018) [4].
For evaluating the ecological features of the sampled vegetation, the weighted values of Ecological Indicator Values for Europe (EIVE) [5] were assigned to each plot according to the abundance of each species. We used the presence of at least one alien species in the plots as a response variable and we explored the variables that could be linked to the presence/absence of IAPs in the community, using Random Forest classification algorithm.
A total of 673 plant species and subspecies were recorded in the massifs of Maiella and Gran Sasso, of which only 12 IAPs. In particular, *Ailanthus altissima* reached 1190 m a.s.l. and *Robinia pseudoacacia* 1144 m a.s.l. Random Forest classification algorithm showed that the presence of at least one invasive alien plant in the communities depended primarily on the location of the plot (external or internal), followed by the Temperature EIVE and secondarily by the Light EIVE. No relevant effects can be attributed to the other EIVEs, nor to differences due to massif (Maiella and Gran Sasso) or community type (forest or grassland).
The classification model found an increased probability of finding at least one IAP in the communities in external plots compared to internal plots.
In particular, considering the Temperature EIVE, it was observed that communities that are overall more thermophilic (EIV.T > 5) show a high probability of harbouring at least one IAP in both external and internal plots. Similarly, more heliophilic communities (EIV.L > 6) show an increased probability of hosting at least one IAP but only in the external plots.
Summing up, IAPs were more present in roadside plots than in inland ones, being those more affected by in motion or parked vehicles. Furthermore, IAPs mainly occur in plant communities with higher Temperature and Light EIVEs, indicating their preference for "thermophilic/heliophilic mountain" communities.
This research established a first set of permanent plots along the mountain roads of the central Apennines for monitoring IAPs spread and to develop ecological models that represent the baseline to establish strategies for keeping under control or mitigating IAPs invasion in Mediterranean mountains.

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ASSESSING KNOWLEDGE STATUS ON COASTAL DUNE HABITATS IN SARDINIA (NATURA 2000 NETWORK AND PNM)

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According to the Habitat Directive (92/43/EEC), EU countries are required to periodically assess habitat monitoring campaigns to evaluate the effectiveness of conservation status, which is crucial for the preservation of biodiversity.

In 2021 the Sardinia Region assigned a task to monitor dune habitats within the protected areas of the Natura 2000 Network System and in 256 cells as part of the National Monitoring Plan (PNM). In 23 sites of Natura 2000 Network according to the Manual for Italian habitat monitoring [1] the following habitats were monitored to assess conservation status and main threats:

Habitat dunali	Siti Natura 2000
2110 - 2250*	Stagno di Pilo e Casaraccio (SiteCode: ITB01002)
2230	Lago di Baratz- Porto Ferro (SiteCode: ITB011155)
2120 - 2250* - 2260	Is Arenas (SiteCode: ITB032228)
2120 - 2250*	Stagno di Putzu Idu (Salina Manna e Pauli Marigosa) (SiteCode:ITB030038)
2230	Stagno di Mistras di Oristano (SiteCode: ITB030034
2260	Monte Arcuentu e Rio Piscinas (SiteCode: ITB040031)
2230	Is Compinxius - Campo Dunale di Bugerru - Portixeddu (SiteCode:ITB042247)
2230 - 2240 - 2250* - 2270*	Costa di Nebida (SiteCode: ITB040029)
2240 - 2270*	Da Is Arenas a Tonnara (Marina di Gonnesa) (SiteCode:ITB042250)
2110 - 2120 - 2230	Punta S'Aliga (SiteCode: ITB040028)
2210 - 2270*	Promontorio, dune e zona umida di Porto Pino (SiteCode:ITB040025)
2110 - 2230 - 2240	Stagno di Cagliari, Saline di Macchiareddu, Laguna di Santa Gilla (SiteCode: ITB040023)
2250*	Costa di Cagliari (SiteCode: ITB040021)
2230 - 2250*	Isola dei Cavoli, Serpentara, Punta Molentis e Campulongu (SiteCode: ITB040020)
2120 - 2270*	Stagni di Colostrai e delle Saline (SiteCode: ITB040019)
2210 - 2230 - 2250*	Lido di Orrì (SiteCode: ITB022214)
2120 - 2210	Golfo di Orosei (SiteCode: ITB020014)
2120 - 2270*	Palude di Osalla (SiteCode: ITB020013)
2120 - 2210	Isole Tavolara, Molara e Molarotto (SiteCode: ITB010010)
2120	Arcipelago La Maddalena (SiteCode: ITB010008)
2210 - 2250*	Monte Russu (SiteCode: ITB010006)
2110 - 2260	Foci del Coghinas (SiteCode: ITB010004)
2230 - 2250* - 2270*	Stagno e ginepreto di Platamona (SiteCode: ITB010003)

GIS-based mapping implementation was one of the outcomes to have up-to-date and comparable outputs for being able to set up conservation measures where necessary.

According to the PNM, the first goal was to assess the presence of the habitat within the random cells previously chosen. After excluding the cells where sand dune habitats weren't present, different conservation parameters were collected and vegetation surveys were performed.

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THE PLANT COMMUNITIES OF TUSCAN RICE FIELDS

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Vascular plants colonizing rice fields are highly specialized to grow in such a peculiar habitat, which is at a crossroad between wetlands and arable land. Italy is one of the main rice producers in the World, and most of its rice production is concentrated in northern regions. A few descriptive studies are available about the plant communities colonizing rice fields in the area. On the contrary, nothing is known about such communities in central Italy (Tuscany), where rice cultivation has a long tradition as well. With this study, we provide the first knowledge about the plant communities growing in the rice fields of southern Tuscany, where we carried out 40 square vegetation plots of 4 m^2 size in early September 2021 and 2022. The surveyed plant communities were characterized by a high presence of alien species, such as *Cyperus difformis*, *Heteranthera reniformis*, and *Lindernia dubia*, and were classifiable in the class *Oryzetea sativae* Miyawaki 1960. However, based on preliminary floristic observations and on distributional data from literature, most of such alien species seemed unable to spread outside rice fields and their immediate channels, except for the invasive plant of European concern *Hydrocotyle ranunculoides*. Among native species, the most frequent were *Alisma plantago-aquatica*, *Bolboschoenus maritimus*, and *Cyperus fuscus*. An abundant presence of Characeae algae was often recorded. The channels surrounding rice fields host natural aquatic communities with *Potamogeton* spp., *Utricularia* spp., and *Najas* spp., classifiable in the class *Potamogetonetea* Klika in Klika et Novák 1941 and representing the Natura 2000 Habitat 3260 "Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation".

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How plant biodiversity affects ecosystem functioning along a sea-inland gradient

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Assessing the consequences of the ongoing global biodiversity loss requires understanding how biodiversity is related to the functioning of ecosystems, e.g. to the efficient cycling of nutrients or water regulation. Nonetheless, our current knowledge of the Biodiversity-Ecosystem Function (BEF) relationship in plant communities is mainly based on experiments that only focus on taxonomic diversity, often neglecting the functional component of diversity, and especially the belowground functional structure, which should play a key role as most of the ecosystem functions and processes occur right in the soil. Moreover, one same factor driving the decline of biodiversity, such as higher stress associated with environmental changes, may also directly influence the BEF relation. Thus, maintaining well-functioning ecosystems calls for a better understanding of how different diversity facets affect the functioning of ecosystems, depending on the local environmental conditions.

To achieve this, taking advantage of the remarkable gradient of environmental stress and disturbance, i.e. salinity, soil temperature, wind, and sand burial, characterizing Mediterranean coastal dune ecosystems, here we aim to analyze 1) the relative influence of understudied belowground functional traits compared to aboveground traits on multiple Ecosystem Functions (EFs); 2) whether EFs are promoted by high functional diversity (FD, because of the so-called "complementarity effect", i.e. species with complementary niches better exploiting available resources) or by the dominance of specific functional types (i.e. dominance effect), commonly measured as the community weighted mean (CMW) of species trait values; 3) finally, the influence of the sea-inland environmental gradient on the BEF relationship.

We collected data in 110 plots (4 m^2) of herbaceous coastal dunes distributed along a sea-inland gradient of stress in Central Italy and measured 19 ecosystem functions related to productivity, decomposition, water regulation, soil carbon stocks, nutrient cycling, and, ultimately, multi-functionality. In each plot, we also conducted a floristic survey to quantify species richness as well as functional metrics, i.e. FD and the CWM of above and belowground traits related to the slow-fast economic spectrum of plants, such as height, leaf thickness, specific leaf area, leaf dry matter content, root diameter, root tissue density, specific root length, and root dry matter content. We applied linear models to test the effect of biodiversity on the EFs, also including the interaction with sea proximity, used as a proxy of increasing environmental stress along the sea-inland gradient.

Results show that, in these environments, ecosystem functions are promoted not by FD itself but rather by species-rich communities with a specific functional structure, i.e. composed by tall species with a balance between an acquisitive functional strategy in the aboveground (e.g. high specific leaf area) and a conservative one in the belowground (e.g. high root dry matter content). However, we also found that the effect of species richness, leaf and root dry matter content on multiple ecosystem functions increased as the environmental pressures decreased along the sea-inland gradient, indicating that stress and disturbance can reduce the ability of biodiversity to buffer ecosystem functioning loss. Overall, this study underlines that maintaining well-functioning ecosystems requires the conservation of specific functional strategies in addition to high species richness and, on the other hand, emphasizes the potential impact that environmental changes can have on ecosystem functioning also indirectly.

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The rupicolous vegetation of Montecristo Island (habitat code: 8220): first data

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Montecristo island has an area of 10.4 km^2 and a mountainous morphology (maximum altitude 645 m a.s.l.). It originated from the consolidation of a shallow magmatic mass and, after the erosion of the cover, it emerges today as a mass of granite rock with soil accumulations in watersheds. Montecristo is under highly restricted protected regimes since 1971 as a Natural Reserve, and since 1979 as a Biogenetic Reserve whose supervision and management have been entrusted to the State Forestry Corps and then to the Carabinieri Biodiversity Grouping (CC Biodiversity Department of Follonica); moreover, it is part of the Tuscan Archipelago National Park. Despite protection, some alien species, both plants like *Ailanthus altissima* and animals like *Capra hircus*, have been introduced. Montecristo is the only island of the Tuscan Archipelago in which the knowledge of the vegetation was not improved in the last decades, namely since the study by Filipello & Sartori (1980), when a checklist of the Flora and a vegetation map were published using previous data. Thus, an updated version of the vegetation of the island is lacking, unlike other islands of the Tuscan archipelago, whose vegetation maps date to the last 20 years. For this reason, a detailed study of the island's current vegetation was started. This specifically focused on the rocky communities where some of the endemic species of Montecristo, such as *Saxifraga montis-christi*, *Hieracium racemosum* subsp. *amideii*, and endemisms of the Tuscan Archipelago such as *Linaria capraria*, live. The exploration started in May 2023 and it presented a great difficulty given to the geomorphology of the island and the almost total lack of paths. In this period, the three main valleys of the island were explored and 21 vegetational relevés (1mx1m) were carried out following the Braun-Blanquet method and sampling both vascular plants and bryophytes. This first investigation concerned the surface of the steepest rocky cliffs (above 300 meters of altitude) and the crevices of low-elevation rocks. All the detected phytocoenoses were assigned to the habitat named 'Siliceous rock walls with chasmophytic vegetation' (code 8220), following the Directive 92/43 EEC. We identified two distinct plant communities: (1) chasmo and chomophytic vegetation with Bryophytae colonizing north-oriented vertical rocks at higher altitudes; (2) casmophytic vegetation at lower altitudes. Due to the constant presence of *Polypodium cambricum* and *Umbilicus rupestris* and to the sporadic presence of *Linaria capraria*, the surveyed communities may be classified in the alliance *Linarion caprariae* Foggi et al. 2006, class *Asplenietea trichomanis* (Br.-Bl. in Meier & Br.-Bl. 1934) Oberd. 1977, which was described for the vegetation of Capraia and Elba islands and that replaces the alliance *Asplenio billotii-Umbilicion rupestris* de Foucault 1988 in the Tuscan Archipelago. It should be noted that, in communities located at higher altitudes, *Asplenium obovatum* subsp. *obovatum* is replaced by *Asplenium obovatum* subsp. *billotii*. The rupicolous plant communities of Montecristo appear considerably impoverished in terms of flora, following the general trends observed for all the vegetation types of the island.

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IMPACTS AND 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, contributing substantially to the widespread and accelerated decline in Earth's biodiversity and associated benefits to people. The species from the *Carpobrotus* genus are well-known invasive plants native to South Africa, whose detrimental effects on native communities are widely documented. These impacts have become particularly important on small Mediterranean islands, where they often threaten coastal habitats and endemic species. Due to these features, these species have been targeted by several projects of control (1). The project LETSGO GIGLIO "Less alien species in the Tuscan Archipelago: new actions to protect Giglio island habitats" is a Life Natura project co-funded by the European Commission (www.lifegogiglio.eu). The project sees the collaboration of the Tuscan Archipelago National Park, the Department of Biology of the University of Florence, and the Company NEMO srl, for different actions on Giglio Island (Tuscan Archipelago) towards the conservation of habitats protected under Dir. 92/43/EEC, thanks to the reduction of important threat factors, mainly represented by invasive alien species. Indeed, one of the project actions is focused on the control of *Carpobrotus* spp. invading the habitats 1240: Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp., 1430: Halo-nitrophilous scrubs (*Pegano-Salsoletea*) (note that 1430 is represented at Giglio Island by the alliance *Artemision arborescentis*) and 5320: Low formations of *Euphorbia* close to cliffs. Within this contribution, we report the first data from the monitoring of these control actions, focusing on the dynamics of vegetation recovery after the interventions.

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.

The preliminary results clearly show impacts on plant alpha diversity (intended as the species diversity within each sampled plot) in all the habitats investigated in terms of a decrease in species richness, Shannon index, and abundance. Invaded communities also showed a severe change in species composition with a strong homogenization of the floras of the three habitats. Finally, the negative effect of invasion emerged even through the analyses of beta diversity, with *Carpobrotus* spp. replacing a large set of native species (3). 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.

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CUPRESSUS FORESTS (*ACERO-CUPRESSION*; HABITAT CODE 9290): A NEW EU HABITAT IN ITALY?

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In the European Union, the habitat type 9290 "*Cupressus* forests (*Acero-Cupression*)" is reported in more than 20 Natura 2000 sites of Greece and Cyprus. Scientific literature on the habitat 9290 is quite limited and the knowledge on its distribution needs more in-depth analyses and detailed studies. The Nature Reserve "Bosco di S. Agnese" (Siena, central Italy) hosts a large *Cupressus sempervirens* old-established forest (271 ha) originating from an ancient plantation (dated back to the Etruscan-ancient Roman times). *Cupressus sempervirens* seems to have found a precise ecological niche thus forming communities where the species is dominant. The aim of this study is to assess whether *Cupressus sempervirens* forest of Sant'Agnese can be considered as the first example of habitat 9290 in Italy. We compared it with the *Cupressus sempervirens* forests of the eastern Mediterranean area attributed to the habitat 9290. In June 2022, we collected original vegetation data in our study area. Moreover, additional data from the literature were retrieved for the eastern Mediterranean. A dataset of 217 vegetation relevés from Italy, Greece, Turkey, and Cyprus was obtained. Multivariate analyses (modified TWINSPAN and NMDS ordination) highlighted how the *Cupressus sempervirens* forest in S. Agnese has remarkable floristic affinities with the ones from Crete and other Aegean islands. Italian and Greek *Cupressus sempervirens* forests were distinguished in species composition from those in Turkey and Cyprus due to the presence of several species with a western Mediterranean distribution, such as *Arbutus unedo*, *Pistacia lentiscus*, and *Quercus ilex*, and to the absence (in Italy) or poorness (in Crete) of many eastern species, e.g., *Acer sempervirens*. These preliminary results, as well as the naturalness of the understorey and the potential distribution of habitat 9290 that includes the western Mediterranean basin, support the hypothesis that the EU habitat 9290 is also present in Sant'Agnese Nature Reserve and in Italy. Our study also showed that more extensive and in-depth studies on the typical species and on the distribution of the habitat 9290 in Europe are needed.

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Biodiversity monitoring from above: linking spectral to local plant diversity

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Biodiversity monitoring is constrained by cost- and labour-intensive field sampling methods. Increasing evidence suggests that remotely sensed spectral diversity (SD) is linked to plant diversity. However, studies testing such a relationship reported conflicting findings, especially in challenging ecosystems such as grasslands. With the advances in aerial sensors, it is theoretically possible to capture the direct link between the spectral information at the canopy level and plant species characteristics. Yet, to use SD for biodiversity monitoring, a thorough investigation of the key factors (e.g., metrics applied, spatial resolution) and conditions under which such a relationship exists is necessary. Thus, this study aims at assessing the applicability of SD for plant diversity monitoring at the local scale by testing eight different SD metrics while considering spatial resolution effects. Functional and taxonomic diversity were calculated based on data collected in 161 1.5 × 1.5 m experimental mesic grassland communities. Spectral information was collected using a UAV-borne sensor measuring reflectance across six bands in the visible and near-infrared range at ~2 cm spatial resolution. Our results show that the relationship is significant and positive only when SD is calculated using categorical metrics. Despite the observed significance, the variance explained by the models had very low values, with no evident differences when resampling spectral data to coarser pixel sizes. Such findings suggest that new insights into the possible confounding effects on the SD~plant diversity in grassland communities are needed to use SD for monitoring purposes.

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THE GEODATABASE OF THE NATURAL ECOSYSTEMS CONSERVATION STATUS: A CARTOGRAPHIC BASE FOR THE ACHIEVEMENTS OF EU BIODIVERSITY STRATEGY FOR 2030

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The Habitats Directive (92/43/CEE) obligations require a detailed analysis of the conservation status of habitats and species, through widespread and standardized data collection from local to national scale. The rigorous technical-scientific commitment of recent years and the close collaboration between the Italian National Institute for Environmental Protection and Research (ISPRA), the Ministry of Environment and Energy Security (MASE), the Regions, the Autonomous Provinces, and the scientific societies, have made possible to collect, verify, integrate, and evaluate the data about habitats and species (1, 2). A common knowledge gap is found, however, in the lack of a unified and shared cartography of natural and semi-natural habitats.

In this context, the research project presented here had the following aims:

- to create a geodatabase of the natural ecosystems potentially referred to Habitats types, produced through the most recent cartography available at regional level and according with national standards;
- to develop an indicator of the Habitats' conservation status based on their current surface.

As main cartographic layer we used "Map of the Nature" (3), currently available for 16 out of 20 Regions. For the remaining Regions and Autonomous Provinces we relied on the Natura 2000 sites maps (when available) and other thematic maps free downloadable from online national and regional Geoportals (e.g. forests, rocky habitats, glaciers, rocky grasslands). The resulted cartography was processed at all administrative levels – region, province and municipality – and the surface in a favourable (FV), inadequate (U1), unfavourable (U2) and unknown (XX) conservation status (evaluated at biogeographical level) was calculated for each of them.

The geodatabase obtained could be considered as a "static view" of the current status of the natural ecosystems in Italy, which can be integrated and updated when new cartography will be released, and when new evaluation from reporting periods will be available.

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LIVING LABS FOR SYSTEMIC INNOVATION IN MEDITERRANEAN SILVOPASTORAL SYSTEMS

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Mediterranean silvopastoral systems are facing complex challenges generated by the increasing climate pressures and the abandonment of marginal land in northern Mediterranean countries. The consequences of these pressures are generating environmental risks (e.g., wildfires) and are threatening the livelihoods of rural communities and the conservation of habitats of community interests such as dehesas-type wooded grasslands (6310). In these contexts, the structural coupling of bio-physical and multi-stakeholder socio-economic processes generates complexity, interdependencies and uncertainties, which require integrated approaches. The concept of "living labs" is gaining popularity in addressing complex issues within socio-ecological systems. This concept, that was successfully developed and implemented in urban contexts, characterized by more structured situations, is being linearly translated to address complex socio ecological systems, but several open questions arise on the suitability of the living lab concept to be applied in such contexts and on the role of the researchers in the design, monitoring, and evaluation of the living labs. In this poster, we propose insights on the design of living labs to foster systemic innovation in Mediterranean silvopastoral systems. The objective is to generate business opportunities that are structurally coupled with soil and biodiversity conservation, as well as the valorization of ecosystem services. The study is being conducted in the context of the PRIMA SALAM-MED project (www.salam-med.org), which involves six living labs across the Mediterranean basin. In Sardinia, the living lab focus are the silvopastoral system, which comprises a mosaic of croplands (vineyards, cereals, forage crops), permanent grasslands, woodlands (cork oaks) and wooded grasslands. A stakeholder analysis was performed following some 20 semi-structured interviews with key actors. Additionally, field and lab experiments are being run to test microbial-based technologies to improve plant resilience to biotic (e.g. *Phytophtora* sp.pl.*)* and abiotic (e.g. drought/flooding cycles) stressors in wooded grasslands and to monitor the impact of sparse trees or woodlands on the hydrological balance. The field experiments were designed in the long-term observatory of Berchidda-Monti, where detailed measurements on plant and soil microbial diversity, aboveground biomass and other ecosystem services have been assessed in the last 15 years. The living lab was designed as a long-term process of engagement of stakeholders to test and validate the options generated through a co-researching process that integrates scientific and local knowledge. It also aims to generate new options through a social learning process between researchers and stakeholders. The stakeholder analysis revealed a significant imbalance in the capacity of the different stakeholders in responding to economic, climate, and ecological pressures. Vine growers, cork, and dairy factories owners were identified as the most influential stakeholders, while shepherds, beef cattle, and sheep breeders were identified as the least influential. However, the perception of the ecosystem services provided by silvopastoral activities was biased among the most powerful stakeholders due to their dominant economic and cultural position. Such imbalance contributes to the dramatic generational turnover and the lack of innovation in silvopastoral activities, exacerbating the impact of climate and socio-economic pressures. Consequently, pastoral and silvicultural activities are being abandoned, thus threatening the local economy and, indirectly, the habitat diversity structurally associated with such activities. The experience gained by the research team so far raises some critical questions on the design and management of the living labs applied to socio-ecological systems and recalls the need of a robust theoretical framework to inform the co-design and management of the living lab activities which should ideally persist far beyond the duration of a single research project.

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RESURVEYING MOST THREATENED ITALIAN HABITATS: PRELIMINARY RESULTS FROM THE LAZIO REGION

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The current acceleration in biodiversity loss is one of the most severe consequences of human activity [1]. To identify the causes of this decline and then implement efficient conservation plans, it is increasingly necessary to monitor how the composition and structure of biotic communities change over time. Given that many ecosystem functions and services strongly depend on plants, and that plant communities are key habitat components, reliable estimates of long-term vegetation change in plant communities in threatened habitats are urgently needed. Vegetation-plot data offer excellent opportunities to study temporal vegetation changes with fine resolution and across large areas over time by resurveying historical plots. In recent decades, an increasing number of studies have used resurvey approaches for studying large-scale vegetation change in response to pressures such as land use change, climate change and biological invasions. In the framework of the PNRR-NBFC a resurvey collaborative initiative has been proposed to collect new data of resurveyed vegetation plots in Italy focusing on most endangered habitats. According to the European Red List of Habitats, the most threatened habitat categories in Europe (Threatened and Near Threatened habitats) are swamps and bogs (85%), grasslands (53%), freshwater habitats (46%), and coastal habitats (45%) [2]. Here, we describe the first steps of this collaborative initiative in the Lazio Region, providing an overview of currently available data, investigating temporal trends in some of the most threatened habitats (in particular coastal herbaceous habitats) and outlining further steps, including potential research questions.

From a preliminary examination of national data repositories, we selected two available databases of historical coastal vegetation: Vegdunes (2806 plots) extracting those plots located in the Lazio Region and the Tenuta Presidenziale di Castelporziano vegetation data set (530 plots). For their rarity and high biodiversity value, we also extracted saltmarsh habitat data from literature (130 plots). We only focused on historical vegetation surveys with high geographic accuracy that were older than 15 years and had phenological periods and plot areas defined. Using these rules our final Lazio data source was of 314 plots. The plots belonged to the Natura 2000 habitats: 1210, 1310, 1410, 1420, 2110, 2120, 2210, 2230, 2240, 2250, 2260, 3170, 6420, 6430 and 7210* of the Habitat Directive. Then the selected historical plots were relocated in the field and we conducted a resurvey following
Kapfer et al. [4].

By comparing historical and resurveyed plots, we intend to analyze trends in Taxonomical Diversity (TD) as changes in the richness and cover of plant species and Functional Diversity (the diversity of species' functional roles in the community, FD) to capture long-term changes in multiple diversity facets. Preliminary results allow us to make inferences about plant species and habitat loss as well as some environmental changes in progress, thereby providing a fundamental contribution to
evaluating and managing the ecosystem's biodiversity and functioning.

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EFFECTS OF ROTATIONAL GRAZING ON PLANT COMMUNITIES

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Rotational grazing (RG) is a grazing method based on an intense grazing pressure for a small period of time (1; 2). By the application of RG animals graze in fenced paddocks that are arranged to have high grazing pressure for few days (1-3, depending on local conditions and livestock); the animals are so forced to eat also unpalatable species that are usually not grazed. Once the vegetation is totally grazed, the animals are moved in another neighboring paddock according to a "rotational" plan. Animals will be back in the same previously grazed paddock once the recovery of vegetation occurred. RG ensures maintaining a not over-exploited and a good conservation statusof both soil and biodiversity. For the latter reason, RG is considered a sustainable grazing system (3). Even if RG is applied in several countries, very few applications are reported in Italy, and little is known on the effects on vegetation (4). In this general framework, the A.M.I.P.A.E. multidisciplinary project (funded by the Campania Region within the Rural Development Programme 2014-2020) aims to assess the effects of RG on the soil-vegetation complex and the advantages in terms of milk and meat production and quality, animals' health, and economic features. The research started in 2021 and it is currently in progress in three different farms of inner hills of Campania. All the farms manage part of their property as rangeland, two of them are grazed by sheep, and one by cows. On each farm, two fenced paddocks were built, and two different grazing management were applied: Rotational Grazing *vs* Traditional grazing (TG). In the RG paddock only, several sub-paddocks were built to apply the rotation of the livestock. Floristic composition and cover values of plant species were assessed in 2022 within plots treated with different grazing management within the same farm. Preliminary results after the first sampling season did not show statistically significant differences of vegetation features in the RG plots compared to the TG plots. These results are likely due to the short period of the experiment. The research is still in progress.

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