# 57th INTERNATIONAL CONGRESS
# ITALIAN SOCIETY OF VEGETATION SCIENCE

Società Italiana di Scienza della Vegetazione

## VEGETATION SCIENCE IN THE ERA OF NATURE RESTORATION

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Ca' Foscari University of Venice, Campus Scientifico, Via Torino 155 Mestre, Venice, Italy

*Book of Abstracts*

*Ecosystem restoration is a hot topic in the scientific community and the urgency of a long-term and sustained recovery of biodiverse and resilient nature is increasingly recognised politically, with the European Nature Restoration Law being the first continent-wide law on ecosystem restoration. Venice has long been recognised as the stage of the world and, for its long history of resilience and integration with the natural environment, has been appointed the Sustainability Capital of the World. We are therefore delighted to welcome you to the 57th International Congress of the Italian Society of Vegetation Science, where Venice will once again become the world's stage on which ecosystem restoration will be the theme of the play.*

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## SESSION 1: *Habitat restoration*

**(Chair Edy Fantinato)**

## SESSION 2: *Ecological processes in plant communities*

**(Chair Marco Malavasi)**

## SESSION 3: *Habitat and species monitoring - Survey*

**(Chair Silvia Del Vecchio)**

## SESSION 3: *Habitat and species monitoring - Habitat*

**(Chair Marta Carboni)**

## SESSION 3: *Habitat and species monitoring - Species*

**(Chair Maria Guerrina)**

# POSTER SESSION

SESSION 1

# *Habitat restoration*

# OPHELIA IN VENICE: EXPLORING SHAKESPEARE'S WETLANDS

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**Keywords:** Shakespeare, Environmental Humanities, plants, cultural biodiversity



In this paper, a Shakespeare scholar, filled with curiosity, interest, and a modicum of discomfiture, sneaks into a vegetation conference to share thoughts and pedagogical practices on the relationship between environmental humanities and ecosystem restoration. The content is drawn from the experience of teaching Shakespeare in our university Master's Degree in Environmental Humanities, the first international program of its kind in Italy and Southern Europe.

Drawing from the pioneering environmental studies and extensive research on both Western and non-Western ecologies conducted at Ca' Foscari, this interdisciplinary program bridges the gap between traditionally separate spheres of knowledge. Our vantage points are the fragile ecosystem of the lagoon and the ancient tradition of Venice as a cosmopolitan city. As a case study, I present a brief overview of how scholars of Shakespeare have dealt with his botanical knowledge in reference to Ophelia, the character from the tragedy of *Hamlet* who drowns while gathering flowers and plants. This knowledge, typically empirical, found its first systematization in the herbals from Shakespeare's own time and became a cultural obsession in the Victorian age. Scholars of literature and ecology (also known as ecocritics) have recently reassessed the role and representation of vegetal life as part of a broader interest in the non-human element in all cultural representations. An ecocritical approach to Shakespeare also invites scholars and practitioners to perform his plays in connection to their own ecosystems, hence the experiment of doing *Hamlet* and re-enacting Ophelia in the Venice wetland. Some projects realized by students will illustrate this environmental humanities perspective on the conference theme.

# How do recovery actions improve meadows vegetation and pollinator community? The case study of LIFE PollinAction project

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**Keywords:** biodiversity, LIFE PollinAction, pollination, grassland restoration, time series



Pollination is one of the most important ecosystem services provided by insects. In the last decades, entomologists have documented alarming declines of insects. In this framework, several projects aim to improve environmental conditions for pollinators also through vegetation enrichment. These projects represent an opportunity to study the effects of ecological restoration of natural ecosystems focused on recovering pollination networks.

As part of Life PollinAction project, we monitored vegetation dynamics in grassland ecosystems in Friuli Venezia Giulia region between 2021 and 2023, with also focus to pollination network. Our study aimed to depict ecological mechanisms during meadows recovery and provide guidelines to future actions. Three different groups of habitats have been considered: dry grasslands, wet grasslands and alkaline fens.

We analyzed thirty-eight permanent plots of 4 $m^2$ surface distributed both in degraded meadows subjected to recovery actions (i.e., mowing, sowing, planting) and in meadows recovered during previous Life projects (i.e., Life Magredi Grasslands, Life Friuli Fens). For each plot phytosociological, phenological and entomological data were collected. We calculated plant biodiversity (species richness and Pielou index) and functional indices (exotic status, pollination agents, nitrate tolerance). Indices time series were analyzed using linear mixed effects models.

We found that species richness and percentage of species pollinated by insects increased over time, in contrast number of exotic and nitrate tolerant species decreased. Pielou's evenness index did not show significative effects. Moreover, we observed that old recovered meadows had higher species richness and lower number of exotic species than recent ones. However, thanks to Life project actions, these differences slowly decreased from 2021 to 2023. Finally, we found a significative interaction between species richness time series and recovery techniques. The use of local spontaneous seed mixtures (called "fiorume") showed a higher increase of species richness than commercial seed mixture. Also, pollination network improved in 2023, although not in all sampled plots.

These results underline the importance of vegetation monitoring during meadows recovery, first to assess the effectiveness of actions in terms of biodiversity and function, then to identify the most effective techniques for creating favorable and stable conditions for pollinating insects. Our findings open future perspectives for integrate floristic and entomological data to better define the pollination network and the effects of vegetation changes on pollinator community.

# RESTORATION OF DRY-ACIDIC CONTINENTAL GRASSLANDS AND HEATHLANDS IN NATURA 2000 SITES IN PIEMONTE AND LOMBARDIA: PRELIMINARY RESULTS OF THE LIFE DRYLANDS PROJECT

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**Keywords:** dry-acidic habitats, lowland, habitat restoration, multi-taxon monitoring



Open dry habitats, protected in Europe by the Habitats Directive (92/43/EEC), are increasingly rare and threatened throughout Europe. In the Po Plain, they are in a particularly critical situation: the high anthropic impact and the lack of management have led to their fragmentation and, in many cases, their disappearance. Here, these habitats (1) have a high phytogeographical value, being at the southern limit of their European distribution range, and (2) host communities rich in terricolous lichens, which at low altitudes are now exclusive to these habitats. The LIFE DRYLANDS project was proposed to conserve habitats 2330 ("Inland dunes with open *Corynephorus* and *Agrostis* grasslands"), 4030 ("European dry heaths") and 6210 ("Semi-natural dry grasslands and scrub-land facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites)")-acidophilous subtype in eight Natura 2000 sites in the western Po Plain. The general objective of the project is the restoration of the dry-acidic Continental open habitats to favourable conservation status. The main means used to achieve such goals are: (1) structural restoration of the target habitats (mowing and removing herbs; cutting native woody species; sod-cutting; topsoil inversion), (2) removal/reduction of invasive woody species (cutting, removal of stumps), (3) improvement of the floristic composition, (4) creation of new patches of the target habitats using suitable propagation material. A sampling design was defined to monitor *ex-ante* and *ex-post* vegetation in the intervention areas, i.e. 26 habitat patches. Vegetation structure and % cover of each vascular plant, bryophyte and lichen species were recorded in 99 circular plots of 3 m radius. Preliminary results of the monitoring activity show a clear improvement of the habitats' structure, with significant decreasing in the coverage of the tree and shrub layers. Regarding the floristic composition, an increase in the frequency of Therophytes was found: as expected, bare soil areas created by sod-cutting and topsoil inversion have been easily colonized by annual plants. Locally, such disturbances have also favoured a little increasing in annual non-native herbaceous species. Improvements in the floristic composition due to the planting of typical herbs are still not recognizable, because this action was realized in small plots in the intervention areas. Therefore, more time will be necessary before they can act as sources of seed dispersal over the entire areas. Future monitoring will allow to detect significant variation in the floristic composition.

# THE PROTECTED DUNE AREA "VITTORIA APUANA" IN FORTE DEI MARMI (TUSCANY): COASTAL VEGETATION EVOLUTION FROM 2002 TO 2023

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**Keywords:** coastal dune vegetation, EUNIS habitats, resurvey



The protected area of “Vittoria Apuana” represents the only stretch of coastal dunes north of Viareggio along the Tuscan coastline. Covering about 500 m in length and 175 m in width, this stable coastline hosts characteristic psammophilous vegetation typical of sandy shores. In 1995, WWF secured a lease for this area, leading to the installation of fencing and pathways to mitigate trampling.

A comprehensive floristic and vegetational study conducted during the 2002-2003 period revealed the presence of endemic species and habitats protected under Directives. In our study, conducted in 2023, we surveyed vegetation in this protected area to compare its current ecological status with that of around 20 years ago. We randomly placed 17 plots, each measuring 2 × 2 $m^2$, in the study area and recorded the percentage cover of all vascular plant species. Each plot was classified according to dune habitats using the EUNIS classification.

We compared the biological and chorological spectra of the two periods (2002 vs. 2023) using floristic lists from vegetation surveys. NMDS was performed on a 44 species × 42 plots matrix (25 relevés for 2002 and 17 relevés for 2023). PERMANOVA, based on Bray-Curtis dissimilarities of abundance data, assessed the effects of EUNIS habitat and sampling year on plant community composition. Finally, we quantified the contribution of each plant species to habitat and sampling year characterization using similarity percentage analysis (SIMPER).

Results showed an increase in therophytes from 32% in 2002 to 40% in 2023, coupled with a decrease in hemicryptophytes from 32% to 24% over the same period in the biological spectra. In the chorological spectra, Euri-Mediterranean plants rose from 32% in 2002 to 43% in 2023, while Steno-Mediterranean plants remained stable at 26% throughout. NMDS identified two main habitats: Mediterranean shifting coastal dunes (N14) and Mediterranean coastal dune grasslands (N16). PERMANOVA results indicated significant ($P<0.001$) effects of both habitat and sampling year on species composition, explaining over 73% of the total variation. SIMPER analyses highlighted species contributions within each habitat and year, with *Thinopyrum junceum* and *Convolvulus soldanella* most influential in N14, and *Seseli tortuosum* and *Lomelosia rutifolia* in N16. In 2023, *Silene canescens* and *Helichrysum stoechas* showed the highest contributions to N16.

In conclusion, coastal dune vegetation is heavily impacted by tourism, resulting in the near absence of *Cakile maritima* communities along the shoreline. Furthermore, the presence of an inland coastal road impedes the natural progressions of dune vegetation. Currently, only mobile dunes (N14) and interdunal grasslands (N16) persist in the area. Over the span of 20 years, notably shifts in vegetation occurred, especially in N16, with an increase in *Silene canescens* and *Festuca fasciculata* therophytic communities, at the expense of perennial vegetation. Further investigation is needed to understand these changes, potentially linking them to increased anthropogenic disturbance or the impacts of climate change.

# RESTORATION OF HABITAT 7230 LOW ALKALINE FENS: AN EXAMPLE IN THE COLFIORITO MARSH CARRIED OUT WITHIN THE LIFE IMAGINE (PROJECT LIFE19 IPE/IT/000015 "INTEGRATED MANAGEMENT AND GRANT INVESTMENTS FOR THE N2000 NETWORK IN UMBRIA")

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**Keywords:** habitat restoration, Nature 2000 network, Habitat EEC 7230



As part of the LIFE IMAGINE project included in the program "LIFE 2014-2020: for the environment and climate action", the Department of Chemistry, Biology and Biotechnology of the University of Perugia (DCBB) and the Umbria Regional Forestry Agency (AFOR) have developed activities aimed at designing active interventions for the maintenance and restoration of rare habitats in the Umbrian territory. Specifically, this contribution aims to raise awareness about the activities developed for the restoration of habitat 7230 Alkaline fens in the Colfiorito marsh (PG) which falls within the homonymous Natura 2000 SAC/SPA IT5210072 site.

This habitat is characterized by the presence of plant communities, which can be classified in the *Caricion davallianae* alliance, of great naturalistic value and rarity, with very few sites of presence in Central Italy, several of which fall in the karst wetlands of the Apennines at altitudes above 700 m a.s.l. [1]. These communities remain relegated to areas with a high/medium water ground level and where traditional management practices such as mowing and cutting of woody species are maintained, so preventing their recolonization by species such as *Deschampsia cespitosa*, *Phalaris arundinacea*, *Phragmites communis*, and shrubs such as *Rhamnus cathartica*. Unfortunately, these traditional practices are less and less implemented today.

The action of restoration and improvement is part of the conservation measures to be encouraged for the conservation of this habitat, as reported in the Management Plan of the Natura 2000 site (D.G.R. n. 405 of 16/04/2012: "Environmental restoration and recovery interventions, also for educational, informative and eco-tourism purposes").

The reconstruction of the habitat 7230 in the Colfiorito marsh is the long-term goal of the intervention, while the short-term one is to recreate, in areas where it is rarefied, the conditions suitable for its restoration. The project was divided into several phases. Preparatory: an accurate *ante operam* assessment of the conservation status of the habitat 7230 in the area, also considering the water regime and identifying the pressures to which it is subject, as well as analyzing the evolution dynamics of the vegetation, have been performed. Executive: procedures have been activated for the preparation of the soil as well as the multiplication of some typical species of the habitat, i.e. *Eriophorum latifolium*, *Carex panicea*, *Carex flava* aggr., *Epipactis palustris*, *Anacamptis laxiflora*, etc., through the on-site collection of seeds and other propagules and their subsequent *ex situ* cultivation to be able, once the environmental restoration measures have been completed, to proceed with planting.

[1] Ciaschetti, G., Praleskouskaya, S., & Venanzoni, R. (2024). Relicts of Threatened Biodiversity: Similarities and Differences among the 7230 EU Habitat Plant Communities on Montane Plateaus of Central Apennines, Italy. *Plants*, 13(10), 1282.

SESSION 2

# *Ecological processes in plant communities*

# POST-MINING VEGETATION REHABILITATION UNDER STRESSFUL ENVIRONMENTAL CONDITIONS: LESSONS FROM SPECIES-RICH SHRUBLANDS OF WESTERN AUSTRALIA

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**Keywords:** functional traits, kwongan shrublands, monitoring, post-mining rehabilitation, species diversity, vegetation science



Australia is often dubbed 'the lucky country'. This epitheton roots in low unemployment, social peace, and high level of security Australia is experiencing these days. This 'luck' is underpinned by wealth generated by export of commodities, attraction, and commodities. Mining and energy sectors are the major contributor. Mainly surface mining has, however, a profound impact on natural vegetation and the mining sector has a legal obligation to rehabilitate impacted areas. Implementing science-based measures of rehabilitation are vital to achieve this goal and therefore are becoming increasingly important.

Focusing on mineral-sands mining in Western Australia, we shall demonstrate how the mining industry (with help of scientists) is facing challenges in restoring biodiversity and ecosystem functionality, particularly in rehabilitation of impacted vegetation. The main impacted vegetation type in this context is so called kwongan shrublands – undoubtedly one of the species-richest temperate shrublands of the world. This vegetation develops on extremely nutrient-poor sandy soils, experiencing regular rejuvenation fires, and regular prolonged periods of drought each summer. These shrublands are a prime example of mediterranean-type ecosystems (MTE), comparable to garrigue, phrygana, matorral, and the like, typical of other of the five MTEs. Our research focuses on the mining tenement of Iluka Resources in the Eneabba region (250 km N of Perth, Western Australia).

The vegetation has been rehabilitated using a combination of large-scale (topography landscaping, return of topsoil, mulching, fertilization) and fine-scale (seed harvesting and local broadcast, planting of seedlings) measures. At present, mulching and fertilization are downplayed and the focus shifts towards exploring the functional biology of species and understanding of processes of plant community assembly to assist the vegetation recovery.

Traditional rehabilitation targets, across the mining rehabilitation sector at least, used to evaluate the success of restoration by counting species and increasing vegetation density. In challenging circumstances such as the species-rich kwongan shrublands this appears as impractical. We suggest that rather to focus on species counts, we should pay attention to assisting recovery functional composition of the rehabilitated vegetation using tools such as plant functional traits and plant functional groups. Because the vegetation recovery is very much dependent on available regional species pools, we also pay attention to understanding the patterns of dark diversity and community completeness. In my talk, I shall present some results of our rehabilitation endeavours and outline further avenues of research which should assist building new deep-machine learning tools of monitoring of post-mining vegetation recovery.

# FROM TAXONOMIC, THROUGH EVOLUTION TO FUNCTIONALITY: ASSEMBLY PROCESSES OF PLANT COMMUNITIES IN ALPINE PASTURES

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**Keywords:** vegetation science, community ecology, phylogeny, functional traits



Here, we provide an understanding of how anthropogenic disturbance (i.e., pastoral activities) and natural successional processes occurring in post-disturbed communities (i.e., grazing abandonment) determine plant communities' composition in alpine seminatural grasslands. Since grasslands are highly dynamic systems due to the effect of natural and anthropogenic disturbances, these habitats are suitable for the advancement on the knowledge on vegetation dynamics. Grazing disturbance have direct effects on species assemblages, and on the complexity of interactions within the habitat, by acting as an environmental filter. Furthermore, according to Connell and Slatyer's model of ecological succession, the relative importance of ecological processes in shaping post-disturbed communities change over time, leaving space to competitive exclusion to rule out species aggregation and coexistence. As an overall, a better understanding of the processes that govern community assembly is increasingly important to enable us to predict ecosystem responses to future disturbance events.

Our study uses vegetation data from different alpine pastures in the European Alps to evaluate how the diversity of plant communities' composition respond across different grazing pressure (i.e., extensive, intermediate and intensive) and to varying stages of succession in abandoned pastures. To test this, our approach applies three diversity metrics: 1) taxonomic diversity; 2) phylogenetic diversity; and 3) functional diversity. Also, we explore changes within and among plant communities since they both provide information on the spatial and temporal heterogeneity of habitats. Thus, those analysis enable us to explore patterns of phylogenetic/trait convergences or divergence, unveiling mechanisms and processes driving community assembly.

The highest values in all three facets of diversity (i.e., taxonomic, phylogenetic and functional) were detected in the extensive grazed plots, whereas intensive pressure of grazing resulted to be detrimental for plant diversity, leading to a reduction in evolutionary diversification, functionality and species richness. Although minor, we detected a diversity recovery in sites with more advanced successional stages compared to earlier ones. Interestingly, abandonment resulted in a high variability within plots in both past and recent abandoned grasslands, fluctuating from sites with very low diversity in all three facets to significantly higher values, probably reflecting communities 'development at different phases of succession. Differently, in intensively grazed plots, plant community assembly seems mainly driven by habitat filtering. On the contrary, in extensively grazed grasslands we detected high variation within communities, suggesting that species sorting is determined by a combination of stochastic, deterministic and competitive processes. The absence of a dominant mechanism can, thus, enhance evolutionary diversification, ecosystem multifunctionality and species richness.

# COMPLEX RELATIONSHIPS BETWEEN BEDROCK GEOLOGY AND ALPINE VEGETATION IN THE WESTERN ALPS OF ITALY

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**Keywords:** Alpine grasslands, lithology, species composition



Relationships between plant species performance and bedrock geology are paramount for structuring alpine plant communities. The seminal studies carried out in the European Alps have primarily focused on compositional differences between alpine plant communities on carbonate rocks and crystalline rocks, i.e. calcareous vs. siliceous vegetation. In more recent years, increasing attention is being paid to bedrock types other than calcareous or siliceous bedrocks, viz. bedrock types presenting somewhat intermediate geochemical features between pure calcareous and pure siliceous bedrocks. The Western Alps exhibits one of the largest petrologic variety among the European mountains. We selected a number of sites in the northern Cottian Alps, the whole Graian Alps and the middle Pennine Alps (about 45° to 46° North latitude), after inspecting geological maps. At each site we selected three to seven 1 × 1 m square plots for recording the cover of all vascular species. In order to minimise other effects than lithology, we located all plots at 2500 ± 100 m, at all aspects on flat to moderately inclined terrain. We only sampled areas covered by low stature vegetation with maximum total shrub cover < 10%, except for dwarf willows (*Salix herbacea*, *S. reticulata*, *S. retusa*, *S. serpillifolia*) and alpine azalea (*Kalmia procumbens*). Geochemical analyses, combined with steromicroscope examination of bedrock samples, revealed a much wider range of bedrock types than that recognized by inspection of geological maps (limestone, calc-schist, serpentine, slate, micaschist, gneiss and granite). For example, serpentinites presented notable heterogeneity, encompassing geochemically different bedrock types such as talcschist, actinolitic chloroschist and eclogite. On the other hand, part of micaschist, calc-schist and gneiss showed surprising geochemical similarities because of the common origin of protoliths. Such pattern strongly affected species composition in alpine grasslands.

# CHARACTERIZATION OF MEDITERRANEAN PERMANENT GRASSLANDS THROUGH LAND SURFACE PHENOLOGY

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**Keywords:** Permanent grasslands, land surface phenology, vegetation, management, TIMESAT, NDVI

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Mediterranean permanent grasslands play a key role in biodiversity conservation and offer a range of ecosystem services [1, 2]. However, they are under threat in southern Europe due to abandonment and environmental pressures [3, 4]. In this study, we explored the hypothesis that a set of Land Surface Phenology (LSP) parameters derived by high spatial and temporal resolution Copernicus Sentinel-2 satellite data, can provide a fine characterization and long term monitoring of a variety of vegetation and management systems of permanent grasslands, to support the design of conservation and agronomic improvement programs. We focused on LSP parameters against ground proofs based on vegetation and agronomic surveys, to obtain useful information from agronomic and ecological perspectives. Forty-nine polygons, representing eleven sites characterized by different grassland vegetation, soil, climate, and management types, were selected in Sardinia (Italy). Six years Sentinel-2 satellite images were processed to derive NDVI, and LSP parameters were obtained using TIMESAT 3.3 software. The results showed a clear correspondence between LSP parameters and a set of indicators relevant from the vegetation and agronomic points of view, including: 1) grassland vegetation, as described by a principal component analysis, 2) managed vs. abandoned grasslands, 3) wooded vs. open grasslands, 4) climatic gradients (elevation) and specific management practices (mown vs. not mown). In conclusion, LSP provides a promising proxy to characterize relevant vegetation and agronomic features of Mediterranean permanent grasslands, useful to support conservation and improvement programs, as well as the monitoring of grassland-related habitats threatened by management or environmental pressures.

[1] Bagella, S., Caria, M. C., Seddaiu, G., Leites, L., & Roggero, P. P. (2020). Patchy landscapes support more plant diversity and ecosystem services than wood grasslands in Mediterranean silvopastoral agroforestry systems. *Agricultural Systems*, 185, 102945.
[2] Pulina, A., Campus, S., Cappai, C., Roggero, P. P., Salis, L., & Seddaiu, G. (2022). Tree cover influences the soil C balance in Mediterranean cork oak-based silvopastoral systems. *Soil and Tillage Research*, 215, 105234.
[3] Dibari, C., Pulina, A., Argenti, G., Aglietti, C., Bindi, M., Moriondo, M., ... & Roggero, P. P. (2021). Climate change impacts on the Alpine, Continental and Mediterranean grassland systems of Italy: A review. *Italian Journal of Agronomy*, 16(3).
[4] Schils, R. L., Bufe, C., Rhymer, C. M., Francksen, R. M., Klaus, V. H., Abdalla, M., ... & Price, J. P. N. (2022). Permanent grasslands in Europe: Land use change and intensification decrease their multifunctionality. *Agriculture, Ecosystems & Environment*, 330, 107891.

# SMALL-SCALE SPATIAL PATTERNS OF FUNCTIONAL TRAITS IN FULLY MAPPED SEMI-NATURAL DRY GRASSLAND PLOTS

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**Keywords:** point pattern analysis, plant functional traits, assembly rules, mark correlation, mark variogram, density correlation, ITV, TPD



In the search for community assembly rules, biological constraints on coexistence can be reflected in similarity or dissimilarity in functional traits. The contrasting hypotheses of limiting similarity [1] and habitat filtering [2] have been proposed, resulting in trait divergence and convergence, respectively. In general, biotic and abiotic processes can drive functional trait patterns at different scales [3]. At small scales (≤ 20 cm), limiting similarity has been identified as the dominant process in grassland communities, especially for resource-acquisition traits (e.g., SLA) [3], while weaker-competitor exclusion can induce similarity in traits related to competition ability (e.g., vegetative height) [4]. The limitations in previous studies are: 1. the focus on larger scales, where abiotic effects prevail; 2. the use of a quadrat-based approach, which sets *a priori* the potential spatial scale of plant interactions and the resolution limit; 3. the reliance on species means for traits. The present study addresses these limitations by utilizing 10 fully mapped 50 × 50 cm plots, where the position and traits for each aboveground functional unit (n = 1094) are measured. The plots are distributed across two semi-natural dry grasslands (habitat 6210), representing an open and eroded, and a closed community. The traits considered are vegetative plant height, leaf area, and specific leaf area, covering independent axes of trait variation, i.e., plant size and resource economics [5]. The availability of coordinates for each functional unit allows the application of statistics for point pattern analysis, in particular mark correlation, mark variogram and cumulative density correlation. Individual trait measurements allow for the consideration of intraspecific trait variability (ITV), and to dispense with using species as a stepping stone in a purely functional analysis. ITV was estimated, and the Trait Probability Density [6] of each species was found to have on average a high overlap with that of the respective community, indicating high ITV and justifying the chosen approach. While many of the considered functions did not detect a significant difference from the independent marking null model, significant trait similarity was found for height in the open community, with a departure between 8 and 10 cm, along with a negative correlation with the density of individuals up to 8 cm for both height and leaf area. Combining functional and spatial analyses of plant communities allows to find patterns supporting assembly rules, even at smaller scales than usually considered. Future perspectives include integrating taxonomic information into this analysis.

[1] MacArthur, R., & Levins, R. (1967). The limiting similarity, convergence, and divergence of coexisting species. *The American naturalist*, 101(921), 377-385.

[2] Keddy, P.A., 1992. Assembly and Response Rules: Two Goals for Predictive Community Ecology. *Journal of Vegetation Science*, 3 (2): 157–64.

[3] De Bello, F., Vandewalle, M., Reitalu, T., Lepš, J., Prentice, H. C., Lavorel, S., & Sykes, M. T. (2013). Evidence for scale‐and disturbance‐dependent trait assembly patterns in dry semi‐natural grasslands. *Journal of Ecology*, 101(5), 1237-1244.

[4] Mayfield, M. M., & Levine, J. M. (2010). Opposing effects of competitive exclusion on the phylogenetic structure of communities. *Ecology letters*, 13(9), 1085-1093.

[5] Puglielli, G., Bricca, A., Chelli, S., Petruzzellis, F., Acosta, A. T., Bacaro, G., ... & Tordoni, E. (2024). Intraspecific variability of leaf form and function across habitat types. *Ecology Letters*, 27(3), e14396.

[6] Carmona, C. P., De Bello, F., Mason, N. W., & Lepš, J. (2016). Traits without borders: integrating functional diversity across scales. *Trends in ecology & evolution*, 31(5), 382-394.

# PREDICTING CHANGES IN ECOSYSTEM FUNCTIONING IN COASTAL DUNES USING LONG-TERM CENSUS DATA

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**Keywords:** ecosystem function, protected areas, plant biodiversity



Protected areas are generally designed to conserve biodiversity. However, how well they also contribute to maintaining ecosystem functions and services that plant diversity supports has been rarely explicitly tested. Here, we used a trait-based approach to reconstruct past ecosystem functioning and examine changes in ecosystem functions occurred over the last 15 years in protected and unprotected coastal dune ecosystems, which are among the most threatened ecosystems in Europe. First, we resurveyed vegetation in quasi-permanent plots and collected several ecosystem function variables related to erosion control, productivity, carbon, water, and nutrient cycling, across six coastal dune sites in Central Italy. Second, using these data, we assessed Biodiversity-Ecosystem Function (BEF) relationships and employed them to hindcast past ecosystem functioning based on historical vegetation surveys. Finally, we assessed temporal changes in ecosystem functioning under three protection regimes: national protected areas, Natura 2000 sites, and non-protected areas. Productivity, carbon, and water cycling increased in non-protected areas, likely due to an expansion of productive and non-native species. Within Natura 2000 sites communities showed a decrease in erosion control potential, due to the loss of important dune-building species. Only within national protected areas functions did not undergo significant temporal changes. These results suggest that on coastal dunes only high levels of protection effectively maintain ecosystem functioning stable over time.

SESSION 3

# *Habitat and species monitoring - Survey*

# MEDITERRANEAN COASTAL DUNES: PAST TRENDS AND FUTURE PERSPECTIVES

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**Keywords:** coastal dune ecosystems, endangered habitats, historical vegetation plot resurvey, long-term changes



Coastal dune systems, situated at the interface between terrestrial and marine ecosystems, are characterized by strong environmental gradients which determine the coexistence of various plant communities within a relatively confined space. Despite harboring habitats crucial for European conservation objectives, Mediterranean coastal dune ecosystems have experienced significant alterations, rendering them among Europe's most endangered habitats. This presentation delves into major plant communities inhabiting Mediterranean coastal dunes, examining shifts over recent decades through a combination of remote sensing and field approaches. Emphasis is also placed on identifying major knowledge gaps and charting future research directions. The analysis reveals a marked temporal decline in both herbaceous and woody coastal dune vegetation types, indicating substantial habitat loss and fragmentation, particularly from the 1950s to the 1980s. Agricultural activities and afforestation predominantly impact the inland areas of the coast, while urban sprawl extends across the entire coastal landscape. Using different field data collection methods, including permanent transects, historical phytosociological surveys and revisitation studies, the disappearance of historical vegetation plots and the widespread impact on typical dune species across all habitats could be highlighted. Rapidly proliferating species, including annuals, ruderals, and non-native plants, are displacing iconic dune builders such as *Calamagrostis arenaria*, with pioneer habitats facing the highest vulnerability. Lastly, we outline critical knowledge gaps and propose avenues for further research within the framework of the National Biodiversity Future Center.

# RESURVEYING HISTORICAL VEGETATION PLOTS TO TRACK COMMUNITY CHANGES IN SARDINIAN COASTAL DUNES: A CASE STUDY IN LA MADDALENA NATIONAL PARK

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**Keywords:** Habitat Directive, habitat monitoring, resurveying study, temporal changes



Repeating historical surveys provides a unique opportunity to estimate vegetation and environmental changes over the past decades [1]. Resurveying studies, i.e. the re-sampling of historical vegetation plots, are increasingly used to detect temporal changes in the vegetation of plant communities [2] and are particularly effective in ecosystems where installing permanent plots would be highly demanding, if not technically and/or economically unfeasible.

In 2023 we performed a resurveying study on six coastal dune sites located on La Maddalena National Park (Sardinia, Italy) to track vegetation dynamics and evaluate changes in their conservation status.

In total, we relocated and resurveyed 293 plots (organized along 49 georeferenced transects covering the whole coastal dune zonation), originally sampled in 2011. The sampling was conducted following the same methods used by the original surveyors.

To investigate changes in conservation status, we assessed trends in typical and ruderal species, and analysed changes in habitat types. Moreover, to quantify shifts in community composition and structure, we computed dissimilarity metrics based on both presence/absence and abundance data. Our results suggest that, in the last 12 years decade, coastal dune ecosystems of La Maddalena National Park experienced notable changes, likely induced by the combined action of both natural and anthropogenic stressors.

While offering valuable insights for understanding vegetation dynamics, our study highlights the need for increased and continuous monitoring in highly threatened ecosystems such as coastal dunes.

[1] Kapfer, J., Hédl, R., Jurasinski, G., Kopecký, M., Schei, F. H., & Grytnes, J. A. (2017). Resurveying historical vegetation data–opportunities and challenges. *Applied Vegetation Science*, 20(2), 164-171.

[2] Sperandii, M.G., Bazzichetto, M., Gatti, F., Acosta, A.T.R. (2019). Back into the past: Resurveying random plots to track community changes in Italian coastal dunes. *Ecological Indicators*, 96: 572-578

# VEGTRENDS: ASSESSING LONG-TERM TRENDS IN EUROPEAN VEGETATION AND EVALUATING PROTECTED AREA EFFECTIVENESS

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**Keywords:** temporal dynamics, vegetation change, European habitats

Reliable estimates of long-term vegetation change are urgently needed as a benchmark for monitoring and reporting on the conservation status of terrestrial habitats, as well as to plan and undertake effective conservation measures. We introduce the EU-funded project VegTrends ("Assessing long-term trends in vegetation and evaluating protected areas effectiveness") and illustrate results from its first work package. Building on an unprecedented number of previously-disconnected datasets now included in the ReSurveyEurope database, we assessed compositional shifts characterising the vegetation of European open (i.e. non-forest) habitats in the last decades. Besides quantifying community-level changes in taxonomic, functional and phylogenetic diversity metrics, we tracked trends in the occurrence and cover of individual species. We also identified the driving mechanisms (species gain vs loss) and tested for the exceptionality of observed changes. Our results suggest that, in the last decades, European open habitats underwent important changes in all the analysed diversity facets, with notable differences across vegetation types. At the community level, most habitats have experienced considerable shifts in both species' composition and dominance structure, in most cases driven by species loss. Significant changes were also detected at the level of individual species. Although trends differed across vegetation types, our findings indicate an overall increase in generalist and competitive species at the expense of habitat specialists. While offering unprecedented insights into long-term vegetation dynamics at the European scale, our results highlight the importance of temporal analysis for an effective and targeted biodiversity conservation.

## GRASSLAND RESURVEY ALONG AN ELEVATION GRADIENT OF THE ALPS

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***Keywords:*** elevation gradient, grasslands, grazing, plant diversity, land-use changes, species richness, vegetation change, vegetation resurvey

Alpine valleys have faced escalating land-use changes in recent decades combined with a remarkable decline in traditional management. Grasslands are likely the most affected by these transformations. This study investigates the multifaceted changes in communities and species over the past three decades in a major valley of the Italian Eastern Alps and examines whether changes occur uniformly across different elevations. In 2022, we resurveyed 133 vegetation plots (including vascular plants, mosses and lichens) originally sampled in 1986-1988. Plots were mostly in grasslands and span along an elevation gradient ranging from 430 to 2408 m a.s.l.. We analysed the variation in life forms, species richness and beta diversity along elevation gradient and over time. We also quantified the number of winning, stable and losing species, and woody and alien species. We observed elevation-dependent changes in community and floristic composition. Many grassland types were transformed into different grassland types or different vegetation types such as forests and man-made habitats. Species richness varied along the elevation gradient over time, with a marked change at low and high elevation. Therophytes increased in the lowest elevation belt, while hemicryptophytes increased in the highest belt. Overall, we noted significant increases in thermophilic, nitrophilous and generalist species. In the middle elevation belt, many dry grassland species were replaced by alien, nitrophilous and woody species. High elevations witnessed species loss, primarily of mountain specialists. Communities and flora of sampled grasslands have undergone substantial changes over three decades due to land-use alterations.

# TRENDS IN VEGETATION DYNAMICS AS A TOOL FOR SCIENTIFICALLY BASED MANAGEMENT OF CENTRAL APENNINE GRASSLANDS

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**Keywords:** EU Habitats Directive, habitat status, protected area management



In 2023, the current dynamic trends and conservation status of the primary and secondary grasslands in the "Monte Genzana Alto Gizio" Regional Nature Reserve (Abruzzo, Italy) were studied and mapped on behalf of and in cooperation with the *Rewilding Apennines* Association. Fifty-one vegetation relevés were carried out between 1400 and 2170 m a.s.l., investigating the presence of the dynamic trend indicator species already identified for the "Monte Velino" State Nature Reserve [1]. The trends in vegetation dynamics (fluctuation, primary and secondary succession, regeneration, degeneration and regression) were assessed and mapped according to the prevailing process identified in each relevé, based on the system proposed and adopted for Poland [2], the Gargano [3], the Abruzzo National Park [4] and the Velino massif in Abruzzo [4]. Assessment of the conservation status of the corresponding habitats of EU interest was compared with the relevant information provided in the Standard Data Forms of the relative SACs, as well as with the assessment provided for the entire Alpine Biogeographical Region by the 4th National Report on the State of Implementation of the EU Habitats Directive (2013-2018). The results clearly show that the conservation status of most (approximately 80%) of the Reserve's grasslands is poor or inadequate, given that the prevailing dynamic process is degeneration caused by intensive spring and summer livestock grazing. Particularly for cattle and horses, this results in a load which the Reserve's grassland plant communities are unable to support due to their low carrying capacity. On the other hand, moderate itinerant sheep grazing does not apparently cause significant damage, as it represents an ecological substitute for the numerous wild ungulates (red and roe deer, chamois) that populated the area until several centuries ago and now reduced to a few units. The large area in a state of degeneration is largely occupied by habitats protected as priority by the EU Habitats Directive and these are in a poor state of conservation. These results should lead to a profound rethinking of the Reserve's pasture management policies, indispensable to improve their conservation status, a fundamental objective in a protected area and mandatory under the EU Habitats Directive.

[1] Petriccione, B., & Claroni, N. (1996). The dynamical tendencies in the vegetation of Velino Massif (Abruzzo, Italy). *Doc. Phytosoc*, 16, 365-373.

[2] Falinski, J. B. (1989). Le temp et l'éspace dans les recherches écologiques sur la dynamique de la végétation. *Giornale botanico italiano*, 123(1-2), 81-107.

[3] Faliński, J. B., & Pedrotti, F. (1992). The vegetation and dynamical tendencies in the vegetation: The example of Bosco Quarto in the Promotorio del Gargano (Italy). *Phytocoenosis NS*, 3, 65-70.

[4] Canullo, R., & Pedrotti, F. (1993). The cartographic representation of the dynamical tendencies in the vegetation: a case study from the Abruzzo National Park, Italy. *Oecologia Montana*, 2(1-2), 13-18.

# CLIMATE AND VEGETATION CHANGE EFFECTS ON THE DISTRIBUTION OF THE NARROW-SPECIES *SANTOLINA LIGUSTICA*

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**Keywords:** climate change, endemic species, land-use change, NDVI, species distribution models



The Mediterranean Basin has long been recognized as one of the world's hotspots of plant biodiversity and it harbours several endemic species. The high richness of this area is due to its environmental features and to human activities, that have influenced environmental components and dynamics for centuries. Despite conservation efforts, diversity in the Mediterranean region is still highly threatened by climate and land use changes. In particular, land-use change is considered the main current driver of biodiversity change because it is expected to be a major threat in the short term. Differently, climate change will be more important on a longer time scale. Among the array of species occurring in the Mediterranean Basin, narrow-ranged species are expected to be more sensitive to change in the environment because they usually have a narrow ecological niche, occurring in small areas and specific habitats. However, relatively few studies have investigated how recent land-use change and human-induced climate change have already affected present-day distributions of endemic species.

In this study, we used historical distribution data, SDMs, NDVI and land-cover patterns to unravel the relative role of climate and vegetation changes in determining the distribution of *S. ligustica*, an endemic species, growing in sunny pseudo-garrigues on ophiolitic outcrops in the Eastern Liguria (Italy).

Our results show that *S. ligustica* currently occurs in different climatic conditions than in the past. The discrepancy between the current distribution modelled based on past distribution and the observed current distribution suggests a shift in the realized niche over time. Nevertheless, this observed change in climatic conditions and habitat suitability does not result in a dramatic decrease in the distribution of the species. We mainly recorded a shift (roughly 50%) in areas with climatic conditions far from those under which the species grew in the past, and only a weak overall contraction in the distributional range. This result suggests that climate change is not the main driver of distributional changes. We recorded a negative relationship between the increase in vegetation cover and complexity (i.e., the increase in forested cover) and the presence of *S. ligustica*. NDVI and land cover analysis show that the species disappeared in areas where vegetation cover increased, suggesting that its distribution is mainly driven by the availability of open vegetation areas. As occurred in other parts of NW Italy, socioeconomic changes mainly occurring over the last 50 years caused changes in land use favouring the spread of mixed woodland, a habitat not suitable for *S. ligustica*. These results are in line with the expectation that, although all factors can influence the distribution of species, land-use change is the main factor that most contributes to short-term change of distribution of several Mediterranean species.

Taken together our findings suggest that human management may result in differences between actual and potential distributions of species, affecting the range of environmental conditions over which species may occur. This inconsistency may be particularly frequent in areas where human activities have had an impact on the biota for a long time such as the Mediterranean basin.

SESSION 3

# *Habitat and species monitoring - Habitat*

## INTERCALIBRATION TRAINING DECLINES OBSERVER ERROR: EVIDENCE FROM A FOREST ECOSYSTEM

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**Keywords:** intercalibration, long-term monitoring, pseudoturnover, quality assurance, species composition



Species richness and abundance among vertical vegetation layers remain key parameters in measuring and monitoring the diversity of ecological communities [1]. Survey and re-survey activities are prone to several types of errors that can lead to misleading conclusions. Inter-observer error refers to different results obtained by different surveyors, and the variation in error rates remains largely unknown [2]. It is also unclear how effective intercalibration training among teams is in reducing the rate of inter-observer error. Here, we present the results of an intercalibration course conducted as part of the Life ModerNEC project, which aims to test indicators for studying the impact of air pollution on forests (CONECOFOR LII sites).

Four teams, each composed of two botanists, surveyed four 10m × 10m forest plots in turn, recording species presence and coverage among three vertical vegetation layers (herb, shrub, and tree). A fifth team, not directly involved in the exercise, compiled the most comprehensive species list for the same forest habitat. The first exercise session was called the "pre-training" session, while the second session was termed the "post-training" session. A briefing meeting was held between these sessions to discuss problems and self-perceived errors, including taxonomic issues. In total, sixteen datasets were available for each session (four plots per team). Quantitative Euclidean and Bray-Curtis dissimilarity indices were used to account for joint absences, or not, respectively (i.e., “double zero” problem), furthermore, Jaccard dissimilarity was used to test for qualitative differences. Then, we assessed whether the dissimilarity among all teams across all plots differed between the pre- and post-training exercises. Additionally, the coefficient of variation (CV) of species richness was calculated for all plots across all teams, comparing pre- and post-training values.

Significant differences were found between the pre- and post-training exercises, with reduced dissimilarity among teams observed in the post-training only using Euclidean distance, suggesting a general positive effect of the intercalibration exercise, particularly a higher team alignment on species detection. Lower CVs were detected after the briefing meeting, indicating a higher precision (a lower dispersion of observations).

We recommend adopting quality assurance procedures, including standard survey protocols and intercalibration training in monitoring programs and re-survey approaches, where different teams alternate in space and time.

[1] Seidling, W., Hamberg, L., Máliš, F., Salemaa, M., Kutnar, L., Czerepko, J., ... & Canullo, R. (2020). Comparing observer performance in vegetation records by efficiency graphs derived from rarefaction curves. *Ecological Indicators*, 109, 105790.
[2] Boch, S., Küchler, H., Küchler, M., Bedolla, A., Ecker, K. T., Graf, U. H., ... & Bergamini, A. (2022). Observer-driven pseudoturnover in vegetation monitoring is context-dependent but does not affect ecological inference. *Applied Vegetation Science*, 25(3), e12669.

# MEASURING CANOPY STRUCTURAL COMPLEXITY THROUGH UAS-BASED PHOTOGRAMMETRIC POINT CLOUDS TO ASSESS ITS EFFECTS ON UNDERSTORY VEGETATION OF RIPARIAN FORESTS

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**Keywords:** 3D point clouds, canopy gap analysis, riparian vegetation, canopy rugosity, Unmanned Aircraft System (UAS)



Riparian corridors are defined as environmentally heterogeneous zones of transition between terrestrial and aquatic ecosystems. Native riparian vegetation hosts high levels of biological diversity, contributing unevenly to regional biodiversity. Riparian areas are subjected to human and natural disturbances, such as unregulated cuttings, landscape fragmentation and flooding, which contribute to create uneven riparian woodlands with different structural characteristics. One of the most important drivers of understory plant species richness and community composition is light availability and its heterogeneity. In forested areas such as some sections of riparian zones, light availability is mediated by the arrangement of canopy elements. In this study we aim to investigate the influence of canopy structural complexity on understory plant species richness and community composition. Traditional methods to assess the structural characteristics of woodland communities use visual field inspections and/or rely on simple metrics such as basal area, tree height and canopy cover. Data obtained in these ways are useful to characterise the local structural features of the plant community. However, novel methods that consider the 3D arrangement of tree elements improve and enhance the possibilities in which scientists quantify, view, and characterize forest canopy structure. In this work, the multidimensional data obtained from photogrammetric flights with small Unmanned Aerial Systems (UAS), coupled with Structure from motion Multi View Stereo methods allowed to quantify the spatial arrangement of riparian canopy elements in higher details, describing in novel and functionally expressive ways the effects of canopy structure on shrubs and herbaceous species. Here we describe the template used for conducting an extensive aerial survey in a complex landscape such as riparian ecosystems. We selected as study area the Arbia river (Siena, Italy). In its 65 km, the water course flows at relatively low elevations (550 to 140 m), across a gradient of increasing human-altered landscape. Aerial surveys were carried out with a Phantom 4 Advanced by DJI equipped with a 20MP camera. Coupled with aerial surveys, we carried out a plot-based vegetation survey using 44 25x2 m (50 $m^2$) plots randomly positioned inside sectors of 4 ha (500 m-length and 80 m-width) along the entire length of our study river. Trees were the dominant vegetation structure (exceeding 50% of the overall cover) in each plot centre. Eight to ten Ground Control Points (GCPs) per sector ensured an accuracy of <10 cm of the aerial survey. Aerial images were captured by carrying out three different sets of flights using nadir, oblique, and horizontal imagery, and combining manual and autonomous flights. The first set was performed 30 to 40 m above ground level (AGL) with a Ground Sampling Distance (GSD) of 1cm/px. The camera was tilted 65 to 70°, with a front overlap of 70% and a side overlap of 80%. Nadir imaging was used in the second flight, at the average height of 80 m AGL (GSD: 2.2 cm/px). Front overlap was 85%, side overlap 70%. The third flight set was performed manually with horizontal and oblique images taken at the sides of sector boundaries.

We will use the 3D point clouds obtained from UAS flights to accurately measure plot-based metrics related to the canopy cover (gap number, gap fraction, overall canopy cover), height (mean outer canopy height) and heterogeneity (top canopy rugosity). We will test if these predictors significantly affect the species richness and diversity of plant communities in the understory.

# APPLYING FUZZY APPROACHES TO MAP NATURA 2000 AND EUNIS HABITATS ON COASTAL DUNES FROM WORLDVIEW-3 IMAGERY

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**Keywords:** coastal dunes, habitat mapping, Habitats Directive, fuzzy classification



Habitat mapping on coastal dunes, which are highly endangered and crucial ecosystems, demands objectivity and repeatability, elements still lacking in the implementation of the Habitats Directive. While remote sensing holds promise, the effectiveness of distinguishing Natura 2000 habitats on coastal dunes from satellite imagery remains untested. Fuzzy approaches to image classification could improve habitat mapping but have not yet been applied to coastal dunes for this purpose. The aim of this work is to compare crisp and fuzzy classification methods using WorldView-3 satellite imagery to map coastal dune habitats in two Parks of Tuscany (Italy).

Vegetation data were collected from 244 plots and classified into Natura 2000 habitats using both expert assessment and noise clustering, and into EUNIS habitats through the EUNIS Expert System. Using field data as a reference, we classified WorldView-3 images with a crisp Random Forest method and three fuzzy methods, comparing the results through overall accuracy (OA) and Mantel tests.

The highest accuracy (OA = 0.90) was achieved for EUNIS habitats, due to their simpler classification scheme. We observed a great disparity among habitats, with coastal dune scrubs and white dunes generally exhibiting the highest accuracy (maximum = 1.00). Although fuzzy classifications produced lower accuracy than crisp ones (mean OA = 0.40 vs 0.58), they provided a more realistic representation of vegetation patterns (mean R = 0.36 vs 0.32), indicating the fuzzy nature of vegetation in coastal dunes. Despite challenges concerning habitat heterogeneity and spatial resolution of images, the integration of field surveys and satellite imagery allowed to produce a detailed cartography, suitable for monitoring the area, structure and functions of dune habitats, as required by Article 17 of the Habitats Directive.

# COENOLOGICAL VARIABILITY OF HABITAT 3170* (MEDITERRANEAN TEMPORARY PONDS) IN CENTRAL ITALY: CONSERVATION ISSUES, PHYTOSOCIOLOGICAL INTERPRETATION AND SYNTAXONOMY

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**Keywords:** Habitat Directive, *Isoëto-Nanojuncetea*, temporary ponds, phytosociology



Habitat 3170* (Mediterranean temporary ponds) is still to be considered as partially "enigmatic" among those included in Annex I of the 92/43/EEC Directive, and one of the most threatened in conservation terms. In fact, where identified, Habitat 3170* often exhibits an unsatisfactory state of conservation. On the one hand, due to the extremely small size of its plant communities and the fragility and of its guide-species, this habitat is particularly sensitive to anthropogenic disturbance and meso-microclimatic changes. On the other hand, the very high level of floristic replacement during the survey season together with the fragmentation and small size of the community stands (sometimes 1 $m^2$ or less) do not allow to establish 3170* communities total cover at both local and regional levels. In this research we present new phytosociological data concerning plant communities directly or indirectly assignable to 3170* coming from sites (both within and outside the Natura 2000 network) where this Habitat was not yet reported. The communities investigated refer to three different floristic types, which are ecologically distinguished from each other on the basis of the pools depth and, accordingly, on the duration of the water's presence. The first community type characterizes the deeper pools, where the leading species are *Isoëtes longissima* accompanied by other macrophytes such as *Callitriche* (*C. stagnalis, C. palustris, C. brutia*), and some wide-distribution hygrophilous species, such as *Juncus articulatus, Agrostis canina* and *Glyceria notata*. These communities tend to occupy minimum areas of several square meters. The other two types of 3170* communities display significantly much smaller stands and are related to soils that are dry for a longer period if compared to the 3170* type listed previously. These are typical of two different ecological situations. The first one is undoubtedly pertaining to Habitat 3170* and occurs within sub-flat or slightly depressed profiles in open environments characterized by few centimetres of water stagnation which dry out early. In physiognomic terms these communities are characterized by the dominance of *Isoëtes durieui* and/or *I. histrix*, often associated with annual rushes, such as *Juncus bufonius, J. capitatus, J. pygmaeus, J. tenageja* and other diagnostic or preferential species for 3170 * such as *Cicendia filiformis, Isolepis cernua, Lythrum hyssopifolia*, *Serapias lingua, Eudianthe laeta*. In late spring, these communities are almost completely replaced by communities belonging to different classes, ranging from *Molinio-Arrhenatheretea* to *Stipo-Trachynietea*. The second coenological type is found within the undergrowth of forest communities (in most cases dominated by *Quercus cerris* and *Q. frainetto*) subject to temporary flooding or at the edge of Mediterranean maquis communities. Both of these "pseudo" 3170* communities exhibit minimum areas of few $dm^2$ and are floristically characterized by the abundant presence of bryophytes. *Isoëtes durieui* and *I. histrix* act normally as the only taxa diagnostic for the *Isoëto-Nanojuncetea*. The classification of this second vegetation type is rather complex. In fact, these can be interpreted as a single forest community with a peculiar presence of *Isoëtes* within the understorey herb layer, or, using a more detailed scale, as small synusiae characterizing peculiar micro-environmental situations within communities belonging to vegetation types completely different from a physiognomic-structural point of view, which are therefore susceptible to being sampled separately.

# PLANT ASSEMBLAGES AND CONSERVATION STATUS ASSESSMENT OF HABITAT 9510* SOUTHERN APENNINE *ABIES ALBA* FORESTS

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**Keywords:** vegetation science, habitat assessment



The spruce-fir dominated forests of central and southern Italy are included in the priority habitat of Directive 92/43/EEC: 9510* "Southern Apennine *Abies alba* forests". The majority of the habitat is located in the Mediterranean bio-region of southern Italy, but in central Italy some fir forest nuclei also fall within the continental and alpine bio-regions. In the Habitat assessments at EU biogeographical level the overall conclusion for Mediterranean and Alpine bio-region is unfavourable-inadequate (U1), while for the Continental bio-region is unfavourable-bad (U2)

The study aims to evaluate the floristic and ecological characteristics of the habitat through a phytosociological analysis of the forest vegetation dominated by *Abies alba*, and to assess the habitat conservation status using a set of indicators based on the analysis of biodiversity as the Shannon-Wiener index and the Naturalness index.

*Abies alba* is usually associated with *Fagus sylvatica, Pinus nigra* subsp. *laricio*, *Quercus petraea* subsp. *austrotyrrhenica, Quercus cerris, Sorbus aucuparia* subsp. *praemorsa*, but only dominates in certain ecological contexts, forming fragmented nuclei of a relic nature within the beech forest belt between 800 and 1600 m. The analysis of the relevés matrix highlights two different ecological contexts, both with the meaning of a particular edafoclimax. A first group of relevés is located on the steep slopes with fresh exposures on poorly developed soils with an acid or sub-acid reaction and belongs to the class *Querco roboris-Fagetea sylvaticae* Br.-Bl. & Vlieger in Vlieger 1937. A second group is instead located in the cacuminal areas beaten by the winds, or on bumps where the slopes are notable, occupying limited surfaces between 1600 and 1800 m and fall into the class *Junipero sabinae-Pinetea sylvestris* Rivas-Martínez 1965 nom. inv. Propos. Rivas-Martínez, & al. 2002. The Shannon-Wiener index shows low biodiversity values, which correlates with the difficult ecological conditions of the habitat, while the naturalness values are quite high.

# VEGETATION CLASSIFICATION AND SURVEY OF THE ALCANTARA VALLEY (SICILY): FIRST OUTCOMES

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**Keywords:** aquatic vegetation, conservation, habitat, protected area, riparian community



The Alcantara valley, located between the Mts. Peloritani and Mt. Etna (NE Sicily), represents one of the most important Sicilian basins with permanent waters. The surveyed area ranges from the sea level up to 1,200 m a.s.l. and falls between the thermomediterranean and supramediterranean bioclimatic belts [1]. From the geological viewpoint, the valley is characterized by volcanic and sedimentary rocks. This area partly falls within the "Parco Fluviale dell'Alcantara" and N2K protected areas network.

Main objectives of our study are: 1) to classify the vegetation, and 2) to identify and map the habitats according to the Habitat Directive (EEC 92/43).

Thanks to several field investigations (2020-2024), 346 phytosociological relevés using the Braun-Blanquet approach were performed. Original Braun–Blanquet sampling scale was transformed into the ordinal scale according to Van der Maarel [2]. All relevés were analysed using multivariate methods (PC-ORD 6 software). Quantum GIS software version 3.6 and GPS Garmin Montana were used to geolocalize the surveyed plant communities. The syntaxonomic classification follows Mucina et al. [3].

As a first result, a high vegetation diversity, although fragmented, is detected. The main vegetation types occurring the Alcantara valley are: aquatic plant communities (*Charetea intermediae, Platyhypnidio-Fontinaletea antipyreticae, Lemnetea minoris, Potametea pectinati*), rupicolous vegetation (*Adiantetea capilli-veneris, Asplenietea trichomanis*), riparian forests and scrubs (*Salicetea purpureae, Alno glutinosae-Populetea albae, Nerio-Tamaricetea, Crataego-Prunetea spinosae*), herbaceus hygrophylous vegetation (*Phragmito-Magnocaricetea, Isoeto-Nanojuncetea*), thermo-mesophylous wood and scrub vegetation (*Carpino-Fagetea sylvaticae, Quercetea pubescentis, Quercetea ilicis, Cytisetea scopario-striati*), scree vegetation (*Drypidetea spinosae, Bidentetea tripartitae*), dry grasslands (*Lygeo sparti-Stipetea tenacissimae*), and coastal vegetation (*Crithmo maritimi-Limonietea, Juncetea maritimi, Cakiletea maritimae*).

Moreover, some woody plant communites/habitats dominated by *Ostria carpinifolia*, *Laurus nobilis*, *Alnus glutinosa*, *Platanus orientalis*, *Fraxinus angustifolia* subsp. *oxycarpa*, *Quercus suber*, *Bupleurum fruticosum* are geolocalized in order to implement, in collaboration with the Park authority, a monitoring plan of the most threatened plant communities.

[1] Bazan, G., Marino, P., Guarino, R., Domina, G., & Schicchi, R. (2015). Bioclimatology and vegetation series in Sicily: a geostatistical approach. *Annales Botanici Fennici*, 52, 1–18.

[2] Van der Maarel, E. (1979). Transformation of cover-abundance values in phytosociology and its effects on community similarity. *Vegetatio*, 39, 97-114.

[3] Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J. P., Raus, T., Čarni, A., ... & Tichý, L. (2016). Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Applied vegetation science, 19, 3-264.

# How severe wildfires and climate change could drive post-fire recovery of low-elevation vegetation: data from the first field campaign of a monitoring survey in the Karst (North-East Italy)

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**Keywords:** fire-resilient landscape, post-fire vegetation recovery, vegetation dynamics, wildfires



Wildfires are a major ecological factor shaping vegetation and landscape, and their impacts are projected to escalate due to global warming: the intensity, frequency and extent of fires are increasing all over the world, with dramatic consequences on habitats. In summer 2022, severe fires burnt over 4000 hectares of the western Karst between Italy and Slovenia, a submediterranean low-hilly area near the coast. In spring 2023, we started a survey to analyze the consequences of the 2022 fires on plant communities and to monitor post-fire vegetation dynamics. This study aims to investigate the possible effects of interactions of severe fires, climate change and alien species on the floristic composition of habitats and on the typical processes of post-fire vegetation recovery in a low-elevated area.

The study was focused on 4 major habitats of the western Karst, 3 of which dynamically related: the thermophilous karst grassland *Centaureo cristatae-Chrysopogonetum grylli*, the thermophilous shrubland *Pruno mahaleb-Paliuretum spina-christi*, and the karst downy oak wood *Aristolochio luteae-Quercetum pubescentis*. Black pine plantations were also included due to their large extent. Permanent plots were installed in the most intensively burnt areas mapped by satellite remote sensing data using a stratified random sampling, by placing 7 x 7 $m^2$ squared-plots in the four major habitat types identified on the basis of available habitat maps and photo-interpretation. In each plot the percent cover of total vegetation, bare soil and of all species was recorded.

At the habitat level, the highest total species richness and the lowest one for alien species were both found in the dry karst grassland, which also exhibited excellent quantitative and qualitative recovery, confirming itself as a highly resilient habitat. Shrubland showed a strong recovery of native shrub species, a rather high number of total species and alien species compared to the investigated habitats, however with alien species occurring with low cover values. The downy oak woodland had similar species richness values to shrubland, but higher abundance of alien species, esp. *Robinia pseudoacacia* and *Ailanthus altissima*, and of native ruderal species: therefore strong modifications of the floristic structure with deviations from the typical secondary succession are possible. Black pine plantations were found to be characterized by the lowest total species richness, the highest number of native ruderal and alien species, poor recovery of native species and unclear dynamic trajectories.

The study is meant to provide information *i)* to identify interventions to support and eventually correct the post-fire recovery of habitats, *ii)* to support land management policies to enhance the resilience and resistance of the Karst landscape to wildfires.

# THE HIGH-ALTITUDE VOLCANIC CAVES OF MOUNT ETNA (EASTERN SICILY, ITALY): A REFUGE FOR PTERO-BRYOPHYTIC COMMUNITIES

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**Keywords:** Etna caves, conservation, plant communities



Caves represent a peculiar habitat of great attractiveness and of historical, landscaping, naturalistic and conservation meaning. According to the Natura 2000 network of the European Union (Habitats Directive 92/43/EC), caves fall within the Habitat 8310 (Caves not open to the public) and Habitat 8320 (Fields of lava and natural excavations) and, therefore, are important for plant conservation [1]. The caves are characterized by many physical and ecological factors leading to a selection of the flora and vegetation, especially in less enlightened parts. Among the plants, bryophytes are the most significant taxonomical group able to adapt to the hard environmental conditions of the cave habitat [2]; the ferns are less tolerant but some of them can live in this type of habitat together with bryophytes.

Mt. Etna, located in eastern Sicily (Italy), is a geologically recent volcano (Late Quaternary), very interesting for studying plant colonization processes which are favoured by its important altitudinal development (highest peak at 3,328 m a.s.l.), geographic isolation, geo-lithological isolation, and the incessant volcanic activity leading to a continuous creation of new, bare land. On Mt. Etna there are a lot of caves formed by lava flows. Due to the basic lava and the mainly effusive activity of the volcano, most of the Etnean caves are lava tubes (natural conduits formed by flowing lava which moves beneath the hardened surface of a lava flow).

In this study we have investigated the plant communities surveyed in volcanic caves of Mt. Etna, located at an altitude of 1,400-2,200 m a.s.l. The phytosociological analysis was based on literature data and unpublished relevés carried out in the early autumn 2023. A total of 147 phytosociological relevés were processed and analysed using classification and ordination methods. Classification of the relevés, supported by ordination, showed two main vegetation groups: the first one with exclusive bryophyte component, and the other one with prevalent bryophyte component and presence of some pteridophytes. Ten communities were recognized, diversified by ecological exigencies and floristic composition; a new association for Mt. Etna is proposed, too. These communities host a set of moss species, e.g. *Amphidium mougeotii* (Schimp.) Schimp., *Thamnobryum alopecurum* (Hedw.) Gangulee, *Isopterygiopsis pulchella* (Hedw.) Schimp., well adapted to the cave environment and showing a troglophilous character, as well as some phytogeographically interesting bryophytes (boreo-arctic montane, and boreal-montane species), very rare in Italy.

[1] Puglisi, M., Kürschner, H., & Privitera, M. (2018). Phytosociology and life syndromes of bryophyte communities from Sicilian caves, a clear example of relationship between bryophytes and environment. *Plant Sociology*, 55(1), 3-20

[2] Puglisi, M., Privitera, M., Minissale, P., & Costa, R. (2019). Diversity and ecology of the bryophytes in the cave environment: a study on the volcanic and karstic caves of Sicily. *Plant Biosystems-An International Journal Dealing with all Aspects of Plant Biology*, 153(1), 134-146.

SESSION 3

# *Habitat and species monitoring - Species*

# Assessing Phenological Patterns and Impacts of *Ailanthus altissima* Using Copernicus Satellite Mission on Invaded Ecosystems in a Mediterranean Island

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**Keywords:** Invasive alien plants, vegetation monitoring, ecophysiological spectral parameters



Invasive alien plants (IAPs) may impact ecosystems through occupying vacant phenological or functional niches and disrupting ecosystem functioning [1]. The Copernicus mission delivers free remote sensing data, facilitating cost-effective and timely monitoring of invaded areas. This study deploys multispectral (Sentinel-1) and thermal (Sentinel-3) Copernicus satellites to characterize ecophysiological and biophysical parameters of patches invaded by the alien tree *Ailanthus altissima* in Sardinia. Furthermore, it tracks the ecophysiological and biophysical temporal changes in the native vegetation caused by invasion. A total of 176 invaded patches and their non/invaded buffer areas were identified on aerial orthophotos, digitized and rasterized at the resolution of 20 x 20 m. Invaded cells dominated by *A. altissima* and Not Invaded cells dominated by native vegetation were classed according to the second level of the legend of the regional vegetation map (Carta della Natura). This vegetation map is based on the legend Corine Biotopes (CORINE). In particular, *A. altissima* tends to invade in Sardinia six vegetation classes: Mediterranean maquis (32.11, 32.12, 32.211, 32.23, 32.3, 32.4), Mediterranean sub nitrophilous grassland (34.81), Deciduous woody vegetation (41.72, 41.732), Evergreen woody vegetation (45.1, 45.21, 45.317), Agricultural herbaceous areas (82.1, 82.3), Agricultural woody areas (83.11, 83.15, 83.16, 83.21, 83.31, 84.6). After, we calculated a set of uncorrelated spectral indices for invaded patches and buffer areas as proxy of leaf chlorophyll and carotenoid content (CVI, SIPI), productivity and canopy biomass (EVI, LAI), leaf water content (NMDI, MSI), soil features (CI), and daily evapotranspiration. We analyzed the monthly trends of these indices in invaded patches and buffer areas as proxies for analyze phenological trends of *A. altissima* and its seasonal impacts on native vegetation, using linear mixed models (LMMs), two-way ANOVA, and Tukey's post-hoc test. Our results highlighted the potential of Copernicus mission in capturing the temporal trends of ecophysiological and biophysical spectral parameters' changes in the patches invaded by *A. altissima*, as the high conditional $R^2$ values of LMMs ranged from 0.522 of CVI to 0.776 of LAI. Furthermore, invaded patches featured as most affected by *A. altissima* invasions during summer, in particular for higher productivity and canopy biomass, for greater leaf water content, for lower leaf carotenoid content, for lower bare soil presence when comparing invaded cells to native vegetation in the buffer non-invaded cells. These results confirmed that *A. altissima* can strongly interfere with native vegetation, especially during the summer drought period of the Mediterranean basin [2].

[1] Daly, E. Z., Chabrerie, O., Massol, F., Facon, B., Hess, M. C., Tasiemski, A., ... & Renault, D. (2023). A synthesis of biological invasion hypotheses associated with the introduction–naturalisation–invasion continuum. *Oikos*, 2023(5), e09645.

[2] Pepe, M., Crescente, M. F., & Varone, L. (2022). Effect of water stress on physiological and morphological leaf traits: A comparison among the three widely-spread invasive alien species *Ailanthus altissima*, *Phytolacca americana*, and *Robinia pseudoacacia*. *Plants*, 11(7), 899.

# PHYTOSOCIOLOGICAL RE-CONSIDERATION OF THE *CHEIROLOPHUS CRASSIFOLIUS* (ASTERACEAE, CARDUEAE) PHYTOCOENOSES IN MALTA

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**Keywords:** phytosociology, rupicolous vegetation, vegetation statistical analysis



*Cheirolophus crassifolius* is a chasmophytic shrub that is a narrow endemic for Malta and is listed among the top 50 plants in the Mediterranean by the IUCN [1]. Its population is facing severe fragmentation and threats from various anthropic factors. Despite its ecological significance, there is no clear statistical phytosociological classification of this species in the existing literature. This study aims to fill this gap by formally classifying the phytocoenoses dominated by *C. crassifolius*. From a phytosociological viewpoint, phytocoenoses comprising *C. crassifolius* are referred to the *Dianthion rupicolae* S. Brullo & Marcenò 1979 alliance [2]. We assessed the ecology of this species through a phytosociological and statistical approach. A hierarchical classification was performed using data extracted from published literature, unpublished relevés, and field surveys. Our preliminary results suggest different phytocoenoses relative to the current framework of this Maltese vegetation type. This study contributes to a better understanding of the ecological context of *C. crassifolius* but also provides a foundation for improved conservation and restoration strategies for the species, offering valuable insights for future research and management initiatives.

[1] de Montmollin, B., & Strahm, W. (Eds.). (2005). The Top 50 Mediterranean Island Plants: Wild plants at the brink of extinction, and what is needed to save them. *IUCN/SSC Mediterranean Islands Plant Specialist Group*. Gland, Switzerland and Cambridge, UK.
[2] Brullo, S., Brullo, C., Cambria, S., & del Galdo, G. G. (2020). The vegetation of the Maltese Islands. *Springer*. Cham, Switzerland.

# MONITORING SPECIES OF COMMUNITY INTEREST - AN EXAMPLE FROM THE COMBI PROJECT

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**Keywords:** number of individuals, Habitat Directive, *Himantoglossum adriaticum*



The Emilia-Romagna Region, in accordance with DPR 357/97 art. 7, is currently undertaking the development of an adaptive and statistically sound long-term regional monitoring plan (RMP) for species delineated in the Habitats Directive (92/43/EEC) and those of regional conservation importance. The establishment of this plan is becoming increasingly essential for determining appropriate data collection methods and producing standardized, reliable estimates for key parameters such as area and the number of individuals. This initiative, conducted within the framework of the COMBI (Conoscere e Monitorare la Biodiversità) project, entails the formulation of monitoring strategies that encompass preferred survey methodologies, representative stations, and sample surveys. For species included in the sample surveys, the initial framework relies on the varying probability sampling design proposed by Fattorini et al. [1] within the framework of the National Monitoring Plan (PNM). This design has been adapted to the regional context, incorporating the estimation of both occupied surface and individual counts as outputs. The monitoring of Himantoglossum adriaticum serves as an illustrative example. To delineate the sampling plan, the territory of the Emilia-Romagna Region was partitioned into a grid of 10 km2 squares, further subdivided into 100 cells of 1 km2 each, serving as the statistical units for sampling. We developed a two-phase sampling strategy to estimate quantities approximating the occupied surface and the number of individuals. We aimed to select samples with cells evenly spread throughout the region of habitat presence, thus achieving spatial balance. Moreover, to maximize the likelihood of encountering the species within the selected cells, Habitat Suitability Score (HSS) values were adopted as auxiliary information to guide cell sampling. However, estimating the number of individuals poses a significant statistical challenge within the proposed sampling framework by Fattorini et al. (2022) [1], alongside considerations regarding survey costs. To address this challenge, an additional spatial sample was taken within each sampled cell to count individuals. This approach was motivated by the impracticality of statistically counting individuals across entire cells. For each sampled square, a random probability sample extraction comprising 4 cells of 25 m2 pixels was conducted. The unbiased Hoarvitz-Thompson estimator was utilized for both population parameters, incorporating different weights for sampling units based on inclusion probabilities within the sample contingent upon HSS. Additionally, dispersion indices were computed to evaluate the precision and variability of estimates, including variance, confidence intervals, and the coefficient of variation. These quantities provide crucial insights into estimate precision and variability around the mean estimate. The statistical process revealed a total of 52 sampled cells of 1 km2. It enables us to assert that H. adriaticum is present within an area spanning 2,210 km2 of the region. It is important to observe that variance and coefficient of variation values generally exhibited higher magnitudes for individual count estimates compared to area estimates, resulting in correspondingly wider confidence intervals. This underscores the increased sampling effort required to achieve estimates with satisfactory precision for individual count estimations.

[1] Fattorini, L., Cervellini, M., Franceschi, S., Di Musciano, M., Zannini, P., & Chiarucci, A. (2022). A sampling strategy for assessing habitat coverage at a broad spatial scale. *Ecological Indicators*, 143, 109352.

# UNRAVELLING THE BIASES: A SARDINIAN PERSPECTIVE ON TAXONOMIC, SPATIAL, AND TEMPORAL BIASES IN VASCULAR PLANT BIODIVERSITY DATA FROM GBIF

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**Keywords:** spatial bias, taxonomic bias, temporal bias, citizen science



On a worldwide basis, biodiversity data is rapidly expanding. Despite their expanding utility and popularity, biodiversity repositories may have inherent biases and high degrees of uncertainty. As a result, the reliability and accuracy of biodiversity assessments may be compromised, making global biodiversity databases difficult to manipulate. Recognising and accounting for such biases in biodiversity databases are critical steps towards increasing the accuracy and utility of these key resources for biodiversity research and conservation initiatives.

In this study, we used plant occurrence records from the Global Biodiversity Information Facility (GBIF; [1]), an open-access database, to quantify the bias associated with vascular plant biodiversity data from Sardinia (Italy), which is a Mediterranean hotspot of biodiversity. We considered three dimensions of bias, taxonomic, temporal, and spatial. We used Pielou's evenness to estimate the taxonomic and temporal bias and the Nearest Neighbor Index (NNI) to estimate the spatial bias. We estimated the relationship between the biases and several environmental predictors such as road density, standard deviation of Normalised Difference Vegetation Index (NDVI), and mean roughness.

Furthermore, the contribution of each data source within GBIF (namely Wikiplantbase [2], PlantNet [3], and iNaturalist [4]) was assessed alongside the environmental predictors.

Our results revealed that the facets of biases varied throughout Sardinia, as did the different roles played by environmental predictors in determining biases. The dataset of vascular plant occurrence records was mainly dominated by spatial and temporal bias, and to a lesser degree taxonomic bias. Road density explained the variance of taxonomic and temporal bias, NDVI explained the variance of taxonomic bias, mean roughness explained all types of bias. The sampling effort associated with PlantNet explained both temporal and spatial bias. Finally, we believe that our methodology may be repeated to identify biases in plant biodiversity databases at both local and global sizes, and to drive efforts to enhance data quality, and hence biodiversity estimation.

[1] https://www.gbif.org
[2] Peruzzi, L., Bagella, S., Filigheddu, R., Pierini, B., Sini, M., Roma-Marzio, F., ... & Bedini, G. (2017). The Wikiplantbase project: the role of amateur botanists in building up large online floristic databases. *Flora Mediterranea*, 27, 117-129.
[3] Li, D., Shi, G., Li, J., Chen, Y., Zhang, S., Xiang, S., & Jin, S. (2022). PlantNet: A dual-function point cloud segmentation network for multiple plant species. *ISPRS Journal of Photogrammetry and Remote Sensing*, 184, 243-263.
[4] Nugent, J. (2018). iNaturalist: Citizen science for 21st-century naturalists. *Science Scope*, 41(7), 12-15.

# MONITORING POPULATIONS OF ORCHID SPECIES IN THE PO DELTA REGIONAL PARK EMILIA-ROMAGNA

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**Keywords:** habitats, Orchidaceae, protected areas



Orchids are among the most threatened plants by anthropic impact which is among the main causes of fragmentation and disappearance of habitats [1]. Therefore, orchid species are protected worldwide by CITES and national or regional laws as well as the Natura 2000 Network to protect their habitats with the Habitats Council Directive 92/43/EC. In the Po Delta Regional Park in Emilia-Romagna (Ferrara province) there are approx. 30 orchid species spread mostly along the coast in semi-dry grasslands (6210*, *Festuco-Brometalia*) and/or sand dunes (2130*, grey dunes). The presence of this protected area in a heavily anthropized region (both for agriculture and tourism), creates a situation in which protected and unprotected habitats often interpenetrate each other in a mosaic or border each other. For this reason, in 2021 we decided to investigate the amplitude of the ecological niches of seven wild orchid species (*Anacamptis coriophora, A. laxiflora, A. morio, A. palustris, A. pyramidalis, Ophrys apifera* and *O. sphegodes*) along the North-Adriatic coast from the northern border with Veneto to the Reno River (Ferrara-Ravenna province). For the ecological characterization of orchid species, we used the Ellenberg-indicator values in association with some parameters measured in the field, e.g. volumetric water content, salinity, soil nutrient contents, temperature and pH. The ecological amplitude together with the adaptive capacity allows orchids to colonize several sites outside protected areas [2]. We also estimated the density of wild orchid populations. In several cases, the richest populations were located in unprotected areas (e.g., meadows inside villages or green areas at the edge of roads). These results were also related to vegetative and reproductive vitality of the populations which were in turn affected by various types of environmental threats such mowing, alien species invasion and herbivory [3]. Our results demonstrate the need to change the way we conceive unprotected habitats or urban green areas to increase the protection of orchids and biodiversity.

[1] Gale, S. W., Fischer, G. A., Cribb, P. J., & Fay, M. F. (2018). Orchid conservation: bridging the gap between science and practice. *Botanical Journal of the Linnean Society*, 186(4), 425-434.

[2] Štípková, Z., & Kindlmann, P. (2021). Factors determining the distribution of orchids–a review with examples from the Czech Republic. *European Journal of Environmental Sciences*, 11(1), 21-30.

[3] Scramoncin, L., Gerdol, R., & Brancaleoni, L. (2024). How Effective Is Environmental Protection for Ensuring the Vitality of Wild Orchid Species? A Case Study of a Protected Area in Italy. Plants, 13(5), 610.

# DISTRIBUTION AND CONSERVATION STATUS OF *IPOMOEA IMPERATI* COMMUNITIES IN SOUTHERN ITALY AND IN SICILY

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**Keywords:** biodiversity, coastal flora, coastal vegetation, Convolvulaceae, Sicily, Southern Italy



*Ipomoea imperati* (Vahl) Griseb. (Convolvulaceae) is a pantropical species with distribution in several warm-temperate and tropical coastal areas of all continents [1]. In the Red Lists of the Plants of Italy published in 1997 it was considered extinct in the Italian territory [2]; consequently, in addition to a distributional update of the species, a survey of the new populations found in Sicily and in the Italian Peninsula led to a more detailed biological and ecological characterization, as well as an assessment of risk factors.

The species, here relegated to the sandy systems of Mediterranean, Thyrrenian and Ionian coastlands, occurs in particularly sensitive and vulnerable environments, such as the "*Embrionic shifting dunes – cod. 2110*", included in EU Habitats Directive 92/43/EEC (Annex I). In the new places of discovery of southern Italy [3,4] and Sicily [5,6] *I. imperati* is linked to psammophilous aspects referable to the *Ammophiletea* Br.-Br. & R. TX 1943 class, creating almost monospecific plant communities and alternating with individuals of *Convolvulus soldanella* L. in the Calabrian population on Mediterranean embryonic dunes (CORINE Biotopes Code 16.21), characterized by *Thinopyrum junceum* (L.) Á.Löve. *Ipomoea imperati* shows a very fragmented distribution, with five disjoint subpopulations located several hundred kilometers away from each other, three in Sicily, one in Calabria and another in Campania. They are very small subpopulations with no significant variation in the number of individuals recorded during the five-year of field surveys.

Moreover, a phytosociological interpretation of 15 vegetation relevés to all Italian population of *I. imperati,* is presented.

[1] https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:60442184-2 (last access 14.04.2024)
[2] Conti F., Manzi A. & Pedrotti F. (1997). Liste Rosse Regionali delle Piante d'Italia. *WWF Italia, Società Botanica Italiana, Università di Camerino*. Camerino, Italy.
[3] Bartolucci, F., Domina, G., Adorni, M., Andreatta, S., Angiolini, C., Bacchetta, G., ... & Lastrucci, L. (2022). Notulae to the Italian native vascular flora: 14. *Italian Botanist*, 14, 119-131.
[4] Bartolucci, F., Domina, G., Alessandrini, A., Angiolini, C., Ardenghi, N. M., Bacchetta, G., ... & Nepi, C. (2019). Notulae to the Italian native vascular flora: 7. *Italian Botanist*, 7, 125-148.
[5] Aleo, M., (2023). Società Botanica Italiana – Botanici Italiani – *Ipomoea imperati* (Vahl) Griseb. *Post 11th september 2023*. Facebook. https://www.facebook.com/share/p/A9qm53CDWgrtFvGw/. [Accessed: 28/4/2024]
[6] Caldarella, O., La Rosa, A., & Di Trapani, E. (2021) New data adout the distribution of *Ipomoea imperati* (Vahl) Grieseb. (Convolvulaceae) in Sicily. *Biodiversity Journal*, 12(4): 899-903.

# POSTER SESSION

# LONG TERM EFFECTS OF MUNICIPAL SOLID WASTE COMPOST ON PLANT AND SOIL MICROBIAL DIVERSITY IN MINING SOILS

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**Keywords:** enzymatic activity, molecular soil bacterial communities, municipal solid waste, potential toxic elements, vegetation



Abandoned mining sites have generated large quantities of mine wastes containing high concentrations of potentially toxic elements (PTEs) such as Sb, As, Pb, Zn, and Cd. These elements can have long-lasting detrimental effects on soil functionality by altering the biomass, composition, structure, and activity of resident microbial communities[1], and plant growth. *In situ* immobilization of PTEs using organic amendments, such as municipal solid waste compost (MSWC), has been shown to reduce contaminant mobility[2] and mitigate toxic effects on plants and microbial communities[3]. Previous studies have demonstrated that soil amendment with MSWC positively influences plant growth and enhances the biological and biochemical properties of soils under mesocosm conditions[1]. However, limited research has investigated the effects of MSWC in open-field settings and long term. The objective of this study was to assess the long-term effects, under field conditions, of MSWC addition to a PTE-contaminated mining soil on microbial and plant diversity. The study was conducted at the former Argentiera mining site in Sardinia, Italy. The experiment commenced in 2015, with the area divided into 12 plots (each approximately 1500 $m^2$). Increasing concentrations of MSWC were added to a depth of 0-30 cm: 0%-control (T0); 1.5%, 3.0%, and 4.5% w/w: T1, T2, and T3, respectively) with the replicates. In 2020, soil samples were collected from each plot (0-30 cm depth), and pooled to obtain 12 composite samples for soil analysis. C microbial biomass, selected enzymatic activities (e.g., deidrogenase, β-glucosidases, and urease activities) and molecular soil bacterial communities were determined for each sample. Vegetation surveys were conducted in spring 2020 and 2021 using the "point quadrat" method along 50 m permanent transects randomly located within each plot. Along each transect, points were marked at regular 1 m intervals, and all plant species encountered were recorded to assess their Specific Contribution of Presence. We found significant differences in plant assemblage composition between treated and control plots (Pperm=0.012), but not among different levels of MSWC. MSWC had a long-lasting positive effect on microbial respiration (e.g. +408% in T3 compared to T0) and soil biochemical properties (e.g. deidrogenase +12.5-fold in T3 soils *vs* T0). Soil bacteria populations were characterized by NGS-based metabarcoding on 16S rRNA amplicons. PcoA applied to ASV data separated control from treated samples. Analysis of alpha diversity (Shannon index) revealed that MSWC treatment has a positive effect on soil microbial biodiversity.

[1] Garau, G., Silvetti, M., Vasileiadis, S., Donner, E., Diquattro, S., Deiana, S., ... & Castaldi, P. (2017). Use of municipal solid wastes for chemical and microbiological recovery of soils contaminated with metal (loid) s. *Soil Biology and Biochemistry*, 111, 25-35.

[2] Caporale, A. G., Porfido, C., Roggero, P. P., Di Palma, A., Adamo, P., Pinna, M. V., ... & Diquattro, S. (2023). Long-term effect of municipal solid waste compost on the recovery of a potentially toxic element (PTE)-contaminated soil: PTE mobility, distribution and bioaccessibility. *Environmental Science and Pollution Research*, 30(58), 122858-122874.

[3] Garau, G., Roggero, P. P., Diquattro, S., Garau, M., Pinna, M. V., & Castaldi, P. (2021). Innovative amendments derived from industrial and municipal wastes enhance plant growth and soil functions in potentially toxic elements-polluted environments. *Italian Journal of Agronomy*, 16(2).

# QUANTIFYING UNCERTAINTY ASSOCIATED WITH VARIANCE PARTITIONING

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**Keywords:** bootstrap, variance partitioning, uncertainty



Variance partitioning is a statistical technique that allows teasing apart the individual and/or shared contribution of regression predictors in explaining variation in the response variable. This tool is widely used in vegetation science as a means to identify the most important correlates of vegetation patterns and processes. However, the values representing the relative contribution of predictors derived from a given regression model are estimates of the true (yet unknown) relative contribution (i.e., the population value). In other words, being a function of the data, these values will change as the data change. These estimates should therefore be combined with a measure of uncertainty to quantify how much they vary from one sample to another, and, in turn, how precisely the true contribution of predictors is estimated. Importantly, this uncertainty is expected to depend on sample size (number of observations) and the correlation between regression predictors.

Here, we used bootstrap to derive a non-parametric estimate of the uncertainty associated with the relative contribution of regression predictors. Using simulations, we tested how this uncertainty changes under different combinations of sample size and correlation between predictors. Specifically, we simulated 9 datasets (consisting in a response variable and two predictors) having sample sizes 50, 500 and 5,000, and being characterised by low, medium and high correlations between the two predictors. We then bootstrapped the value of the individual and shared contribution of the predictors (under the different combinations of sample size and correlation) and derived the first and third quartile of the resulting distribution of the estimates as a measure of uncertainty.

Our results show that the precision in the estimation of the individual (and shared) contribution of the predictors increases with sample size. In particular, the uncertainty associated with predictors' contribution is largest at a low sample size and under a low-to-medium correlation between predictors. Our findings highlight the importance of reporting uncertainty associated with the contribution of regression predictors derived from variance partitioning. This would prevent over-emphasising inference on the contribution of predictors in explaining vegetation patterns and processes.

# THE *QUERCUS ILEX* ROCK COMMUNITIES OF THE APUAN AREA: IDENTIFICATION AND SURVEY BY UAVS TECHNOLOGY

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**Keywords:** chasmophytic vegetation, evergreen oak woodland, survey methods, UAV



The Apuan Alps are located in the northwestern part of Tuscany, where the transition between the middle European and Mediterranean biogeographic zone takes place. The Apuan Alps, elongated from NW to SE, are detached from the Apennines to the west, establishing a strong geographical isolation. The particularly steep morphology, the geographical position, and the lithological heterogeneity are the main causes of the remarkable floristic and vegetational variety of these mountains (1). The plant landscape is quite varied and composite: the sclerophyll formations of the Mediterranean scrub of the maritime side, as soon as you rise in altitude, leave room for the woods mixed with *Ostrya carpinifolia* dominant, *Quercus pubescens* and *Quercus cerris*. In this same low-mountain and medium-mountain belt, however, the artificial woods of *Castanea sativa* still prevail. The summit formations of casmophytic and glareic vegetation, interprenatrate the forests of *Fagus sylvatica,* especially on the inner side of the chain, as well as primary and secondary grasslands with traces of suprasilvatic *Vaccinium myrtillus* groves. The different climatic changes, the natural history, and the ancient anthropization of the complex have determined also the appearance of heterotopic coenoses, in particular of *Quercus ilex* and of *Juniperus phoenicea* in higher parts of the chain and on the walls of limestone reliefs (2). These contexts, often characterized by phenomena of superficial and deep karst, detect the presence of underground cavities frequented by man since the post-glacial. As part of the PRIN project "Underlandscape"(3), UAVs technology has been used as a tool for the implementation of investigations on the vegetation communities in order to a possible diachronic reconstruction of the plant landscape surrounding the underground cavities.

In this context, field surveys were carried out and with the aid of drone footage, in some Apuan localities (Tenerano, La Gabellaccia, Castelvenere) where these particular geotopes, locally defined as "tecchie" or "holes" are found. The vegetation in the rocky outcrops is mainly represented by two types attributable to the following habitats: 9340 *Quercus ilex* and *Quercus rotundifolia* forests; 8210: Calcareous rocky slopes with chasmophytic vegetation. The surrounding vegetation is mainly a mosaic of *Ostrya carpinifolia* woods and ancient, now abandoned, chestnut groves.

The use of the drone proved to be particularly functional for the precise identification and localization of the different species that populate the tops and vertical walls of the rocky outcrops. Through the orthophotographic restitution of the footage, it is possible to draw a precise picture of the coverage, as well as the 3D reconstruction, using specific software, of the geotopes investigated.

These environments often constitute a floristic and vegetational peculiarity of the Apuan territory, guaranteeing the permanence of endemics (such as for example *Atadinus glaucophyllus*) or of coastal species that have adapted to internal high-altitude environments (*Juniperus phoenicia*) or, in any case, of heterotopic phytocoenoses, linked probably due to post-glacial climatic fluctuations in the mountainous territory of the Apuan Alps. The inaccessibility of the orographic typology has allowed the permanence of these habitats for a long time. However today, the spread of free clambing in these contexts seems to compromise the conservation of these habitats.

[1] ISPRA.https://www.isprambiente.gov.it/it/progetti/cartella-progetti-in-corso/suolo-e-territorio-1/tutela-del-patrimonio-geologico-parchi-geominerari-geoparchi-e-geositi/i-geoparchi/apuane-alps-geopark [Accessed 11/04/2024].
[2] Arrigoni, P.V.(1956). Sui limiti altimetrici dei consorzi rupestri di leccio in Garfagnana. Giornale Botanico Italiano, 63 (4), 531-590.
[3] Progetto PRIN 2020, n. 2020428LS8. *ICCOM-CNR, Università di Pisa, ISTP-CNR Bari, Università dell'Insubria*, Italy.

# AGRICULTURAL INTENSITY AND LOCAL FACTORS INFLUENCE PLANT DIVERSITY OF FARMLAND PONDS

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**Keywords:** agricultural landscape, plant community, species richness, wetland



Wetlands rank among the world's most vulnerable ecosystems. Permanent farmland ponds represent remnants of natural habitats or man-made ecosystems that often have high conservation values in heavily human-modified landscapes as Mediterranean basin. However, in different agricultural systems their plant diversity still needs to be explored, as for example in Italy despite its key contribution to maintaining a significant share of macrophyte diversity at the European and global scales. We aimed to evaluate the relative importance of agricultural land-use intensity and local factors related to the pond, such as direct pond management and the water-land gradient, in influencing species richness and composition of aquatic and riparian plant communities. We carried out a vegetation survey in 45 farmland ponds in three agricultural areas with different levels of agricultural land-use intensity in Tuscany, central Italy. We tested if the selected factors influence species richness and composition using the PERMANOVA test, against the whole communities, wetland indicator species and synanthropic species. The species richness and composition of plant communities varied among the different land-use intensities, with aquatic plots in intensively managed areas generally exhibiting lower species richness and a higher presence of species associated with disturbed environments. Many alien species also occur. On the contrary, ponds in areas with lower land-use intensity hosted better preserved plant communities with abundant helophytes. Although agricultural land-use intensity influenced plant species richness and composition, it was not the most important driver of variation. Indeed, in most cases plot position resulted as the most important factor in shaping both aspects, followed by pond identity and agricultural land-use. More precisely, local factors related to the pond itself, including direct management and anthropogenic disturbance, along with local gradients like the transition from terrestrial to aquatic environments, play a more significant role in varying plant species richness and composition. Our research highlighted how ponds in areas with lower agricultural land-use intensity harbour higher plant diversity, hosting semi-natural habitats that deserve conservation efforts mainly focused on the key factor of management.

# THE RELATIONSHIP BETWEEN TEMPORAL DYNAMICS OF LANDSCAPE PATTERN AND PLANT BIODIVERSITY IN COASTAL DUNES OF PROTECTED AREA "CASTELPORZIANO PRESIDENTIAL ESTATE"

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**Keywords:** coastal habitats, aerial images, historical vegetation plot resurvey, long-term changes, landscape ecology



Coastal dunes are dynamic ecosystems located along sandy shorelines following strong sea-inland environmental gradients. Conservation status of coastal plant communities is crucial for habitat preservation, biodiversity protection and to provide essential ecosystem services [1]. Worryingly, these communities are facing significant threats from human activities leading to strong landscape alterations [2]. Improvements on monitoring with innovative cost-effective tools are a challenge for coastal plant communities. The availability of open access, remotely sensed data with increasing temporal and spatial resolution is promising in this context. Our aim is to better understand the long-term relation between landscape pattern and plant biodiversity of coastal plant communities in the protected area "Castelporziano Presidential Estate" over time 35 years by combining aerial orthophotos and on field resurveyed data. Inside the protected area, 58 plant community plots were sampled between 1988 and 2000 and resurveyed in 2023. At the same time, we mapped the protected area using free aerial orthophoto of 1988, 1998 and 2023 coeval to plot surveys. According with literature [3], we identified the following landcover classes: Beach Pioneer Vegetation, Herbaceous Dune Vegetation, Woody Dune Vegetation, Forests, Afforestation, Artificial, River, Sea, Semi Natural Vegetation. We calculated landscape metrics (e.g. Pland, Mean Patch Area, Patch density and Edge density) on land cover map buffers of increasing diameter (from 25 to 150 m) around the resurvey sites for analysing the temporal landscape pattern dynamics. In each past and present plot, we calculated diversity using Shannon index (S) both at taxonomical and landscape level on buffers. Thereafter we fitted Linear Mixed Models (LMM) for analysing diversity changes of habitat classes over the years. Our preliminary results show a decreasing trend in artificial cover, related to natural encroachment and the creation of new natural patches. Overall, our models show that variability is well explained ($R^2$> 0.85), with higher values for larger buffers. Specifically, we mostly assessed significant differences between 1998 and 2023 showing a general trend of decrease in landscape diversity; we can interpret this result as a consequence of natural habitats encroachment which drives to larger homogeneous patches over the years. In fact, we observed a combination between increasing in Patch Area and a concomitant decreasing trend in Patch Density at the landscape level across the habitat classes. At taxonomical level, our results demonstrated a general habitat homogenization associated with forest canopy closure. Further analyses are needed to better understand the relationship between landscape and plant species diversity.

[1] Acosta, A., Carranza, M. L., & Izzi, C. F. (2009). Are there habitats that contribute best to plant species diversity in coastal dunes?. *Biodiversity and Conservation*, 18, 1087-1098.
[2] Defeo, O., McLachlan, A., Schoeman, D.S., Schlacher, T. A., Dugan, J., Jones, A., Lastra, M., & Scapini, F. (2009). Threats to sandy beach ecosystems: A review. *Estuarine, coastal and shelf science*, 81(1), 1-12.
[3] Malavasi, M., Santoro, R., Cutini, M., Acosta, A. T. R., & Carranza, M. L. (2016). The impact of human pressure on landscape patterns and plant species richness in Mediterranean coastal dunes. *Plant Biosystems*, 150(1), 73-82.

# THE *STIPA* MOUNTAIN GRASSLANDS IN THE CENTRAL APENNINES

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**Keywords:** Central Apennines, grasslands, Stipa



The *Stipa* mountain grasslands represent an interesting vegetation form whose remains along the Apennine chain date back to the last Pleistocene glacial phases [1]. These are extrazonal fragments present in xeric sites, which host entities of considerable biogeographic interest [2]. There are few cenological and phytosociological studies in the peninsular area, despite presenting a strong floristic and chorological characterization, and constituting one of the characteristic features of the central Italy landscape.

The present study focused on the phytosociological description of *Stipa dasyvaginata* subsp. *apenninicola* (an endemic entity of the central Apennines) and *Stipa capillata* (an entity with an Eurasian distribution) communities, whose Apennine chain sites represent its western limit. The surveys come from Lazio-Abruzzo Apennines, which overlook the Fucino Basin. In similar environmental conditions, in marginal areas of the PNALM, various steppe entities have been reported [3, 4], confirming the floristic and vegetational importance of the internal areas of the Apennines.

The comparison with others steppic grasslands described in the Apennines [5, 6, 7], made by a synoptic table, has allowed us to define more clearly the floristic and physiognomic variability of these communities, confirming the eastern character of this vegetation. The notable floristic richness of the *Stipa* grasslands seems to correspond to a relative structural homogeneity, which can be codified through few associations that underline the xeric character of these communities. The vegetation studied appears to belong to the *Lino tommasinii-Stipetum apenninicolae* association, that identify both primary and secondary mountain grasslands and *Globulario meridionalis-Stipetum capillatae* association, that described a secondary form of grassland. The last one is generally localized on marginal areas no longer cultivated, in correspondence with abandoned almond groves and generally used in a variable way for grazing (of sheep, cattle and horses).

To confirm the importance of these vegetations, we underline the opportunity to frame the Apennine *Stipa* grasslands within the priority habitat 6240* (Sub-Pannonic steppic grasslands), as recently reported in the PNALM [8]. This habitat, not yet recognized in the central Apennines, is reported for the internal valleys of the Alpine arc.

[1] Kirschner, P., Záveská, E., Gamisch, A., Hilpold, A., Trucchi, E., Paun, O., ... & Schoenswetter, P. (2020). Long-term isolation of European steppe outposts boosts the biome's conservation value. *Nature communications*, 11(1), 1968.
[2] Spada, F., Cutini, M., & Paura, B. (2011). Considerazioni fitostoriche sulla zonazione altitudinale della vegetazione di alcuni rilievi dell'Appennino meridionale e della Sicilia. *Biogeographia*, 30(1), 95-112.
[3] Cancellieri, L. S. M. G., Sperandii, M. G., & Filibeck, G. (2017). First record of the steppic relict Astragalus exscapus L. subsp. exscapus in the Apennines (Abruzzo, Italy), and biogeographic implications. *Plant Biosystems*, 151(6), 944-948.
[4] Filibeck, G., Cancellieri, L., Bartolucci, F., Becker, U., Conti, F., Maestri, S., ... & Becker, T. (2020). *Festuca valesiaca* Schleich. ex Gaudin newly discovered in the Central Apennines (Italy): a further example of steppe relict in the Abruzzo "dry valleys". *Plant Biosystems*, 154(5), 593-600.
[5] Tammaro F. (1984). Vegetazione dei pascoli aridi a Stipa capillata L. nell'Appennino centrale. *Informatore Botanico Italiano*, 16 (2-3): 191-197.
[6] Pirone, G., Corbetta, F., Ciaschetti, G., Frattaroli, A. R., & Burri, E. (2001). Contributo alla conoscenza delle serie di vegetazione nel piano collinare della Valle del Tirino (Abruzzo, Italia Centrale). *Fitosociologia*, 38(2), 3-23.
[7] Ballelli, S., Gatti, R., Raponi, M., & Catorci, A. (2006). Aspetti vegetazionali e floristici del territorio nursino (Umbria—Italia centrale): le serie di vegetazione della roverella (Quercus pubescens sl). *Webbia*, 61(2), 305-323.
[8] Filibeck, G., Cancellieri, L., & Rosati, L. (2023). Guida al Paesaggio Vegetale del Parco Nazionale d'Abruzzo, Lazio e Molise. *Edizioni del Parco*, Pescasseroli, Italy.

# EXTENSIVELY MANAGED MEADOWS ACHIEVE THE SAME COOLING EFFECT AS TREE-PLANT COMMUNITIES

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**Keywords:** ecosystem services, extensive management, landscape planning, sustainability



In urban and rural areas, mitigating the negative effects of the heat island (UHI) phenomenon is an important ecosystem service that is essential for coping with the impacts of climate change. Plant communities play a central role in lowering temperatures through shading and evapotranspiration. This cooling effect offsets the heat absorption and retention of concrete surfaces that contribute to exacerbating UHI effects.

Although the cooling effect of plant communities has been extensively studied, there is still a lack of knowledge about the specific contributions of different plant communities. Most studies have broadly considered the cooling effect of tree and herbaceous plant communities; however, contrasting results have been found. In the present study, we investigated the cooling effect of different plant communities that differ by their species pool and not only by their structural attributes.

The sampling was carried out in Cartigliano, a municipality in north-eastern Italy characterized by a very heterogeneous landscape. Overall, we collected 95 plots randomly selected on semi-natural grasslands, urban green spaces, and hedgerows. Vegetation surveys were conducted in spring 2023, while summer temperatures were measured on eight days between 2018 and 2022 using remote sensing thermal imagery to determine the cooling effect of each vegetation patch.

We identified five different plant communities: two tree communities (i.e., *Robinia pseudoacacia*-dominated and *Platanus hispanica*-dominated hedgerows) and three herbaceous communities (xerophilous community of urban green spaces, extensively managed meadows and intensively managed meadows). Significant differences were found between the plant communities in terms of cooling effect; specifically, xerophilous communities of urban green spaces showed the lowest cooling effect. Conversely, no significant differences in cooling effect were found between the extensively and intensively managed meadows and tree communities. Interestingly, among the herbaceous communities, extensively managed meadows showed cooling effect values comparable to the cooling effect of tree communities, which are considered the best performing plant communities in the supply of cooling effect. This emphasises that, in addition to their importance for biodiversity conservation, extensively managed meadows also provide another important ecosystem service, namely the cooling effect, which further underpins the opportunity of their conservation and restoration for people's quality of life.

# EVALUATING ARBUSCULAR MYCORRHIZAL FUNGI (AMF) ASSOCIATED WITH *AMMOPHILA ARENARIA* (L.) LINK SUBSP. *ARUNDINACEA* (HOST) H. LINDB. IN SARDINIAN COASTAL DUNES ACROSS DIFFERENT DISTURBANCE INTENSITY

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**Keywords:** Habitat Directive, habitat 2120, disturbance, dune restoration, symbiotic association



Coastal dunes are vulnerable to degradation and most of the habitats they host show a decreasing trend [1]. According to the Habitat Directive, *A. arenaria* subsp. *arundinacea* is the typical dominant species of the *Habitat 2120 - Shifting dunes along the shoreline with Ammophila arenaria* (white dunes). By promoting sand deposition and extending its dense root system, it plays a decisive role in dune construction and manteinance [2].

In the harsh conditions of coastal environments, vital support for vegetation survival is provided through the symbiotic relationship established between plants and Arbuscular Mycorrhizal Fungi (AMF) [3]. This support is evident in terms of enhanced tolerance to biotic and abiotic stresses such as increased water retention [4]. In addition, AMFs contribute to the formation of soil aggregates, by improving soil structure, and support plant metabolism by facilitating nutrient uptake [5].

Many studies have reported the presence of AMF associated with *A. arenaria* highlighting their pivotal role in the ecological succession and consolidation of coastal dunes [6]. However, significant knowledge gaps persist regarding fungal community dynamics and their responses to disturbances in these environments.

This study aims to investigate the variability of the composition of mycorrhizal communities to potential sources of disturbance, resulting from the fruition of the beach, and to relate these changes with the conservation status of *A. arenaria* subsp. *arundinacea* and of the Habitat 2120.

We selected, as study sites, two coastal dune sites located in Sardinia (Italy) characterized by the presence of Habitat 2120. At each site, starting from the beach access point, we surveyed the vegetation along ten transects, five on the right and five on the left side and perpendicular to the coastline, placed at regular distances (50 m). At each transect, we sampled the rhizosphere of the first *Ammophila* clump encountered in front of the sea and we measured the extension and eight functional traits (CAN-H, SLA, LA, LDMC, LDW,$L_{th}$ , inflorescence lenght, number of spikelets) of the plant.

Understanding how fungal communities respond to environmental disturbances could enable designers to adopt more effective strategies for restoring coastal dunes.

[1] Gigante, D., Acosta, A.T.R., Agrillo, E., Armiraglio, S., Assini, S., Attorre, F., ..., & Viciani D. (2018). Habitat conservation in Italy: the state of the art in the light of the first European Red List of Terrestrial and Freshwater Habitats. *Rendiconti Lincei. Scienze fisiche e naturali,* 29, 251-265.

[2] Huiskes, A.H.L. (1979). *Ammophila arenaria* (L.) Link (*Psamma arenaria* (L.) Roem. et Schult.; *Calamgrostis arenaria* (L.) Roth). *Journal of Ecology,* 67(1), 363-382.

[3] Smith, S.E., & Read, D.J. (2008). Mycorrhizal symbiosis. *Academic Press*, New York, London, Burlington, San Diego.

[4] Bennett, A.E., & Bever; J.D. (2007). Mycorrhizal species differentially alter plant growth and response to herbivory. *Ecology,* 88(1), 210-218.

[5] Koske, R.E., Polson, W.R. (1984). Are VA mycorrhizae required for sand dune stabilization? *Bioscience,* 34(7), 420-424.

[6] Sridhar, K., & Beena, K. (2001). Arbuscular mycorrhizae in coastal sand dunes – A review. *Proceedings of the National Academy of Sciences*, 71, 179-205.

# PATTERNS OF $\alpha$ AND $\beta$-DIVERSITY HIGHLIGHT UNIQUENESS-BASED CONSERVATION PRIORITIES FOR PLANT COMMUNITIES IN ITALIAN AGRICULTURAL LANDSCAPES

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Agrosilvopastoral management can enhance biodiversity in agricultural landscapes by promoting ecosystem diversification[1]. To assess their conservation priority based on contribution to plant diversity, we surveyed plant communities in 25 $m^2$ plots across croplands, grasslands, shrublands, forests, and wetlands in 50 agricultural areas all over Italy in the spring-summer of 2023. We compared the plant communities in terms of α-diversity, β-diversity, and species composition using analysis of variance (PERMANOVA) and Indicator Species Analysis (INSPAN). Grassland plant communities had the highest α-diversity and wetland plant communities had the lowest. All ecosystem types contributed to β-diversity; however, we observed a negative correlation between local contribution to β-diversity (LCBD) and α-diversity. Wetland plant communities had the highest LCBD and species uniqueness, followed by croplands and grasslands. Wetland species such as *Phragmites australis*, *Myriophyllum spicatum*, and *Lemna minor*, along with woody species like *Prunus spinosa*, *Rubus ulmifolius*, and *Quercus* spp., were key contributors to β-diversity. Each ecosystem type had a distinct plant community composition (PERMANOVA) and indicator species (INSPAN). Based on our evidence, wetland plant communities had the highest conservation priority due to their unique species composition. Nevertheless, our findings highlight the importance of maintaining diverse agricultural landscapes encompassing a range of anthropogenic, natural, and semi-natural ecosystems to safeguard the overall plant diversity. Conservation efforts should prioritize the preservation of such diversified agricultural landscapes.

[1] Benton, T.G., Vickery, J.A., Wilson, J.D. (2003). Farmland biodiversity: is habitat heterogeneity the key? *Trends in ecology & evolution*, 18(4), 182-188.

# DISCOVER THE IMPACT OF GRASSLAND MANAGEMENT ON LOCAL PLANT AND POLLINATOR BIODIVERSITY: LESSONS FROM LIFE POLLINACTION.

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**Keywords:** agricultural intensification, grassland management, plant community, pollinator community, Biodiversity, pollination



Extensively managed grassland ecosystems are a biodiversity hotspot for plants and pollinators in the northern hemisphere. However, in Europe, socio-economic changes have led to a sharp decline in extensively managed grasslands, which have undergone two major changes: the introduction of large-scale intensive agricultural practices on the most productive grasslands and the abandonment of marginal grasslands. Understanding how changes in grassland management affect plant and pollinator communities is increasingly important for their conservation and the provision of pollination service.

In this study, we compared extensively managed grasslands (i.e., not fertilized, mown twice a year), intensively managed grasslands (i.e., fertilized, mown three times a year), and abandoned grasslands (i.e., not fertilized, rarely mown) in terms of spatial attributes (i.e., area of the grasslands and the length of woody edges along their perimeter), plant community attributes (i.e., number of flowering entomophilous species and number of flowers), and pollinator community attributes (i.e., richness of pollinator orders, richness of pollinator species, pollination contacts, pollination contacts of each order). Intensively managed grasslands were characterised by visually larger areas and more scattered woody edges compared to extensively managed and abandoned grasslands. In comparison, abandoned grasslands had smaller areas than extensively managed grasslands. Regarding plant community, no significant difference has been shown in the number of flowers and number of flowering entomophilous species between extensively managed and abandoned grasslands, while intensively managed grasslands showed a lower number of floral displays compared to extensively managed grasslands and lower richness of entomophilous plant species compared to extensively managed and abandoned grasslands. Regarding pollinator community, extensively managed grasslands showed significantly higher values of the richness of pollinator orders, the richness of pollinator species, pollination contacts and lepidopteran contacts than intensely managed grasslands, but not compared to abandoned grasslands.

Our findings indicate that the intensive management of grasslands has a negative impact on plant and pollinator communities. Preserving extensive management practices of abandoned grasslands is crucial for maintaining a greater variety and larger quantity of food sources for pollinators. Additionally, the reduced disturbance in these areas allows for the persistence of pollinator species vulnerable to frequent cutting and grassland fertilisation. From a landscape perspective, the presence of a variety of different grasslands supports different food sources, as well as nesting and refuge areas for pollinators that support the entire pollinator community.

# EFFECT OF PINE LITTER AND PREDATION ON ACORNS OF *QUERCUS ILEX* L.: A CASE STUDY FROM GIGLIO ISLAND (TUSCANY, ITALY) WITHIN THE PROJECT LIFE LETSGO GIGLIO

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**Keywords:** vegetation science, ecosystem restoration, germination



Holm oak (*Quercus ilex* L.) is an important species in the Mediterranean vegetation since it is both a pivotal component of the maquis and one of the main species in sclerophyllous evergreen forest. Its success in the Mediterranean climate is due to the many adaptations to grow under different harsh conditions, such as dry periods and high insolation. It also presents recalcitrant acorns with a high nutrients and energy reserve reflected in a medium-high germination rate [1], that plays a central role in holm oak forest regeneration.

Nevertheless, acorn germination success may be compromised by different interspecific interactions as conifer litter and herbivorous predation. In particular, pine litter may reduce soil moisture and solar radiation levels [2], so as to compromise oak establishment.

In many island contexts, holm oak forests in past and recent time have been reduced due to many anthropogenic activities, such as agriculture, pasture that nowadays have been replaced by tourism as main form of livelihood for population [3]. For example, in Giglio Island (Tuscan Archipelago, Italy) this has led to changes in composition and dynamics of vegetation, whose climax stages is represented by *Q. ilex* forest, due to several factors including pine reforestation in early 80s (*Pinus pinea*, *P. pinaster* and *P. halepensis*) that negatively affects soil conditions. Moreover, repeated introduction of invasive alien species as rat and rabbits contributed to alter the island ecosystem.

The aim of our study is to evaluate the germination rate of *Q. ilex* acorns and its seedling growth under the effect of pine litter and of predation by rodents and rabbits on the Giglio Island.

To do this, we conducted two experiments, one *in situ* and the other one in the Botanical Garden of Florence. For *in situ* experiment, we selected five sites at Giglio Island where we constructed three squared subplots (0,5 m x 0,5 m) representing different predation pressures (open fences, closed fences and control), and 60 acorns (20/each subplot) were sown and monitored for 5 months to evaluate the acorn germination. At the same time, in laboratory the germination tests were carried out to evaluate the influence of pine litter on acorns in four trays: i) with Giglio soil, ii) with Giglio soil + pine litter, iii) control topsoil and iv) control topsoil + pine litter. In each tray 96 acorns from three different Giglio holm oak populations were sown and checked weekly for 5 months.

*In situ*, preliminary results did not show significant effects of predation on acorn germination. On the other hand, the preliminary laboratory results showed a significant lower acorn germination rate ($p = 0.01$) in trays containing control topsoil, indicating an optimal adaptation of the local *Q. ilex* population for germination under *Pinus* plantation.

Such evidence suggests a higher effect of soil properties than predation on the germination success of holm oak and it can contribute to the management and preservation of biodiversity within the Natura 2000 ecological network.

[1] Navarro, F. B., Caño, A. B., Gálvez, C., Kazani, A., Carbonero, M. D., & Jiménez, M. N. (2023). Key factors in direct acorn seeding for the successful restoration of open oak woodlands. *Forest Ecology and Management*, 546, 121314.

[2] Maestre, F. T., & Cortina, J. (2004). Are *Pinus halepensis* plantations useful as a restoration tool in semiarid Mediterranean areas?. *Forest ecology and management*, 198(1-3), 303-317.

[3] Médail, F. (2022). Plant biogeography and vegetation patterns of the Mediterranean islands. *The Botanical Review*, 88(1), 63-129.

# THE UNDERSTORY VEGETATION OF CONIFEROUS PLANTATIONS OF NON SITE-NATIVE TREES: THE CASE OF *CUPRESSUS SEMPERVIRENS* FORESTS IN ITALY

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**Keywords:** old-established plantations, non-native forest vegetation, plantation impacts, understory composition

*Cupressus sempervirens* occurs naturally in the eastern Mediterranean basin and Tunisia. In Europe, *C. sempervirens* forests are protected by the Habitats Directive where the species is native. However, the species was widely planted outside its native range, where it can naturalise and form pure forests. In Italy, some old-established *C. sempervirens* plantations have also been included in protected areas. Cultivated stands of coniferous trees planted for the production of wood, composed of exotic conifer species or of European conifers out of their natural range are ecologically interesting. Some of them are probably established for millennia. They occur at different latitudes, from the central to the southern part of the Italian Peninsula. Besides descriptive studies, there is still a lack of knowledge on the ecological mechanisms occurring in *C. sempervirens* plantations. Therefore, comparing *C. sempervirens* old and recent plantations with natural forests occurring nearby in similar environmental conditions represents an opportunity to disentangle their naturalness and to assess their impact on native flora. Understanding if and how the understory of old-established plantations of non-native tree species became similar to the understory of natural forests can help explain ecological processes.

# MULTIFORDIV PROJECT: PATTERNS AND DRIVERS OF MULTI-TAXON FOREST DIVERSITY

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**Keywords:** functional trait, fungi, global changes, lichens, vascular plants



Forest ecosystems are widespread in Europe and provide essential ecosystem services, but they are threatened by global changes. The need to maintain forest diversity is included in all international and national policies; however, many diversity components are still overlooked, and their patterns and drivers are largely unknown. Among these diversity components, understorey plants, fungi, and lichens are extremely important, as they contribute to forest ecosystem functioning, encompass a large portion of forest diversity, and are potentially sensitive to a range of environmental changes and human-induced disturbances over short- and long-time scales.

Like all life on our planet, the mentioned organisms are affected by energy (i.e., light), water, and nutrient availability. In forests, these conditions are determined by microclimate (i.e., sub-canopy temperature and precipitation), soil features, canopy, and forest structure. However, very few studies have focused on patterns and drivers of multi-taxon forest diversity considering all such variables.

The aim of MultiForDiv project is to fill this gap by using a functional approach (i.e., through the use of functional traits). Indeed, indicators based only on species identity implicitly assume that all species are equally dissimilar, disregarding the fact that species have different ecological functions, contributing differently to ecosystem processes.

We will use Italy as a model region. Italy spans a huge climatic gradient associated with complex historical and evolutionary scenarios, resulting in high diversity. It is also characterized by a relatively high forest cover (36.7% of the country) and has experienced a very long management history. We will benefit from the long availability of data (> 20 years) offered by the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) system and dataset.

The existing response variables and predictors will be analyzed and integrated with additional samplings to increase the available diversity facets, extend time series, and include new soil and forest structural parameters. Project results are intended to provide benchmarks, indicators, and management strategies, and can be beneficial for a broad audience of scholars and stakeholders. Additionally, the results can be applied to meet the needs and commitments related to national and international conventions, regulations, and strategies (e.g., Forest Europe, NEC Directive 2016, EU Biodiversity Strategy, Testo Unico Forestale, Strategia Forestale Nazionale).

# URBAN SPRAWL IN INTENSIVE AGRICULTURAL LAND: ABUNDANCE OF POLLINATORS BENEFITS FROM URBAN GREEN SPACES

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**Keywords:** flowering community, landscape heterogeneity, pollinators, urban green spaces, urban sprawl, urbanisation



The process of urbanisation is an important driver of landscape transformation, with multiple cascading effects on biodiversity. Recently, it has been hypothesised that urban sprawl in an intensive agricultural landscape may have positive effects on pollinator richness and pollination interactions, possibly due to an increase in habitat and resource availability. Using the eastern Po Plain (north-eastern Italy) as a model system, we investigated the relationship between landscape context (i.e., composition and configuration), pollinator richness, and plant-pollinator interactions in 39 randomly selected permanent plots involved in the LIFE PollinAction. Contrary to expectations, we found no direct relationship between landscape context and pollinator species richness. Conversely, descriptors of urban sprawl such as landscape heterogeneity and the proportion of urban green spaces directly influenced the number of pollinator visits. Moreover, landscape heterogeneity and urban green spaces did not directly influence the richness of pollinator species and the number of pollinator visits, but they were positive correlated with the local availability of floral resources. This suggests that urban sprawl, when occurring in an intensive agricultural landscape, has a positive effect on the abundance of local pollinator populations, while it may not promote pollinator richness due to limited immigration opportunities in the matrix of intensive agricultural land. Given the importance of urban green spaces and landscape heterogeneity, particular attention should be paid to flowering communities when planning grey infrastructure to ensure an appropriate number of different flowering plant species throughout the year to maximise the probability of pollinator presence.

# HABITATS OF COMMUNITY INTEREST IN ALTA VAL D'ELSA NATURAL AREA (ELSA RIVER, TUSCANY - ITALY)

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**Keywords:** vegetation science, Habitat Directive 92/43 EEC, riparian habitats



Wetland environments represent important reservoirs of floristic richness and diversity. Among them, riverine ecosystems not only host a wide biodiversity, but also constitute a valuable resource of goods and services in terms of environmental, public health and safety, economic, cultural, aesthetic, scientific and educational, of fundamental importance to society. Elsa river is a Tuscan watercourse that originates from three different springs on the south-eastern slope of the Montagnola Senese (525m a.s.l.), in the municipality of Sovicille, Siena. Supplied by the contribution of numerous small tributaries, the river greatly increases its flow and crosses the Valdelsa, to finally flow into Arno River. The Parco Fluviale Alta Val d'Elsa covers an area of 203.62 hectares in the municipality of Colle Val d'Elsa. Intensive vegetation surveys were conducted during the period 2022-2023 to update and integrate already available data from previous studies [1]. Part of the activities are included in the actions planned and financed by the agreement between the Municipality of Colle di Val d'Elsa and the University of Siena, and by the NatNet project promoted by the Tuscan region.

These activities resulted in the identification of the following habitats of Community interest:

3140 - *Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.*
3150 - *Natural euthrophic lakes with Magnopotamion or Hydrocharition-type vegetation*
3260 - *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation*
3270 - *Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation*
3280 - *Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba*
5130 - *Juniperus communis formations on heaths or calcareous grasslands*
6420 - *Mediterranean tall humid herb grasslands of the Molinio-Holoschoenion*
6430 - *Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels*
7220* - *Petrifying springs with tufa formation (Cratoneurion)*
91AA* - *Eastern white oak woods*
91E0* - *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)*
91L0 - *Illyrian oak-hornbeam forests (Erythronio-Carpinion)*
92A0 - *Salix alba and Populus alba galleries*

The identification of 13 habitats of Community interest, some of which are rare or scarcely known in Tuscany, makes the natural area of the Upper Elsa Valley a site of great interest for biodiversity and of high conservation priority; which deserves to be included in the Natura 2000 network.

[1] Angiolini, C., Chiarucci, A., De Dominicis, V., Gabellini, A., Morocchi, D., & Selvi, F. (1999). Lineamenti vegetazionali dell'area naturale protetta del fiume Elsa. *Atti Accademia Fisiocritici Siena*, Serie XV(XVIII), 101-122.

# PROJECT LIFE TETIDE ON CAPRAIA, MANAGEMENT OF INVASIVE PLANTS SPECIES IN MEDITERRANEAN ISLAND ECOSYSTEMS

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**Keywords:** LIFE project, ecosystem restoration, alien plants



Biological invasions pose substantial threats to biodiversity by disrupting the composition and functionality of native ecosystems, especially on islands more vulnerable to this process[1,2]. An important financial tool that makes feasible the conservation of habitats and species throughout the management of biological invasions is the EU LIFE program, which funds projects for the environment and climate action. The project TETIDE "Turning Eradication Targets Into Durable Effects" is a LIFE project involving numerous partners throughout the Mediterranean basin (in Italy, Malta and Croatia) and focusing on the conservation of habitats and native species through the management of invasive alien species and the involvement of island communities in active conservation efforts. Among the project tasks, the work package 3 aims to increase the conservation status of 7 Natura 2000 habitats on Capraia Island throughout the control and eradication of invasive alien plants (IAPs: *Opuntia stricta*, *Opuntia ficus-indica*, *Zantedeschia aethiopica*, *Nicotiana glauca* and *Chasmanthe floribunda*).

To fulfil this purpose the WP3 foresees i) the creation of an updated map of the target invasive species, in preparation for their removal ii) local control of *Chasmanthe floribunda* in public areas of Capraia settlement iii) planting of native species in areas subjected to removal of IAS iv) distribution of native plants with ornamental values to the citizen.

As a first step towards the drafting of an executive project for the interventions of removal, in collaboration with the Company NEMO srl, we conducted a detailed map of the current distribution of the target invasive plants. Further experimental trials for the correct management of the waste material will be crucial for choosing the type of intervention and its costs.

As revealed by mapping, invasive species were more prevalent in areas of the island with higher levels of anthropogenic pressure and disturbance, while only *O. stricta* also spread to natural habitats. Overall, the invasion extends over 71 hectares (3.6% of the island's surface), of which approximately 70 hectares are invaded by *O. stricta*. The habitats most impacted by alien plant invasion include 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* spp.", and 6220* "Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*", all primarily invaded by *O. stricta*.

Furthermore, WP10 foresees the monitoring of the habitats most impacted by this species. To date, the impacts of these species have been analyzed within the PNRR CN5-NBFC-spoke 7 project. The results regarding the impact on native vegetation show that, although value for species richness and Shannon diversity index were not found significant, the species composition is significantly different between invaded and control plots. In particular, the plant community is more homogeneous in the invaded plots than in the controls, maybe because of the apparent replacement of the shrub layer of Mediterranean scrub vegetation due to the *O. stricta* occurrence.

[1] Kumar Rai, P., & Singh, J.S. (2020). Invasive alien plant species: Their impact on environment, ecosystem services and human health. *Ecological Indicators*, 111, 106020.

[2] Russell, J.C., Meyer, J.Y., Holmes, N.D., & Pagad, S. (2017). Invasive alien species on islands: impacts, distribution, interactions and management. *Environmental Conservation*, 44, 359–370.

# REVISITING PIANOSA (ITALY): HOW VEGETATION OF A SMALL MEDITERRANEAN ISLAND HAS CHANGED IN THE LAST 15 YEARS

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**Keywords:** vegetation science, functional traits, resurvey



Resurveying historical vegetation plots has become a fundamental methodology in ecological research as it provides a unique opportunity to estimate vegetation and environmental changes over the past decades (Kapfer et al., 2017). Indeed, this approach allows to evaluate how the vegetation dynamics are affected by anthropogenic factors, such as land-use change, invasion of alien species and climate change (Hédl et al., 2017). Small islands are among the ecosystems in which the effects of these processes might be more detectable and less predictable. One of these cases is Pianosa (Tuscan Archipelago, Italy), a small Mediterranean island that hosted intense human activity in the form of an agricultural penal colony until the end of the 1990s, after which the process of the abandonment of the land began. Moreover, in the last decades, many conservation measures have been implemented on the island, such as alien species control or eradication and restoration of natural habitats. This research aimed to use this island context to evaluate how different types of vegetation occurring on the island (rocky cliffs *Crithmo-Limonietum* communities, Mediterranean *Thero-Brachypodietea* xeric grasslands, and Mediterranean scrub) changed in the last 15 years, both in terms of species and functional composition.

The vegetation of Pianosa has been thorouhgly described by Foggi et al (2008), who carried out several vegetation relevés, and it has been resurveyed in spring 2023. The original methodology was followed and a total of 30 georeferenced vegetation plots revisited, ensuring a strong correspondence between the location of the old and the new sampling points (Verheyen et al., 2018). Moreover, the literature information has been complemented with personal feedback provided by the botanists that sampled the historical plots.

The preliminary results a significant compositional shift for all the considered types of vegetation. The main processes which has been detected as responsible of such changes in species composition are: i) the spread of some alien species (e.g. *Pinus halepensis*) which colonised and drastically changed the physiognomy of some contexts (e.g. from garigues to woody stands of pine); ii) a significant encroachment of the grasslands by typical shrub species, with their transition from open areas with herbaceous species to Mediterranean maquis; iii) a decrease of the abundance of *Jacobaea maritima* and *Mesembryanthemum nodiflorum* in rocky cliff communities. Such changes in species composition of the vegetation have been also found, even stronger, at a functional level, and can be probably explained by the changes in vegetation physiognomy. These results are relevant for research on the main drivers of changes occurring in small island contexts and might provide pivotal information for the conservation of Tuscan Archipelago habitats.

[1] Kapfer, J., Hédl, R., Jurasinski, G., Kopecký, M., Schei, F. H., & Grytnes, J. A. (2017). Resurveying historical vegetation data–opportunities and challenges. *Applied Vegetation Science*, 20(2), 164-171.

[2] Hédl, R., Bernhardt-Römermann, M., Grytnes, J. A., Jurasinski, G., & Ewald, J. (2017). Resurvey of historical vegetation plots: a tool for understanding long-term dynamics of plant communities. *Applied Vegetation Science*, 20(2), 161-163.

[3] Foggi, B., Cartei, L., & Pignotti, L. (2008). La vegetazione dell'Isola di Pianosa (Arcipelago Toscano, Livorno). *Braun-Blanquetia*, 43, 3-41.

[4] Verheyen, K., Bažány, M., Chećko, E., Chudomelová, M., Closset-Kopp, D., Czortek, P., ... & Baeten, L. (2018). Observer and relocation errors matter in resurveys of historical vegetation plots. *Journal of Vegetation Science*, 29(5), 812-823.

# UNVEILING THE FUNCTIONING OF FOREST ENDEMICS: A COMPARATIVE AND MULTI-TRAIT APPROACH

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**Keywords:** plant strategies, above- and belowground traits, forest endemics



The largest portion of plant diversity in temperate forests is found in the understorey. This forest layer plays a pivotal role for ecosystem functioning, but it is threatened by global changes. As a consequence, conserving the diversity and processes of the understorey is a priority to reach the goals of the EU biodiversity and forest strategies for 2030. Italian woodlands harbor remarkable endemic plants (134 taxa – 1), many of which living in the understory. This rich Italian forest endemic flora is however under pressure as these plants are often geographically restricted, stenoecious and thus senstitive to forest management, wildfires and climate change. Nevertheless, knowledge about distribution, size, population trends, reproductive biology, genetics and conservation status of these forest endemics is still largely unclear and incomplete. Moreover, even less is known about their ecology and their functional role in forest ecosystems. One of the main scope of the FORENDEMICS Project is the study of the functional traits of endemic forest species, in order to allow the implementation of effective conservation strategies. In this study, we used an innovative trait-based approach comparing endemic species and their taxonomically closest non-endemics in order to understand the magnitude and direction of functional divergence (if any). Specifically, we investigated the functional traits of 3 endemics characterised by different life forms and phenology, namely: *Crocus etruscus*, *Glechoma sardoa* and *Knautia gussonei*, and their closest non-endemics *Crocus neglectus*, *Glechoma hederacea* and *Knautia drymeia*, respectively. We collected and measured 11 functional traits belonging to the above- and belowground plant compartments, representing key and independent functional strategies (2,3). These traits are linked to whole-plant (plant height), leaf (leaf area, leaf mass per area, leaf N concentration, specific leaf area), flower (flower size, flower mass per area), root (root N concentration, specific root length) and clonal organs (lateral spread, bud bank size), allowing us to evaluate multiple plant responses in terms of resource economics, sexual reproduction, vertical and horizontal space occupation, and resprouting capacity after disturbance. We defined a standard sampling protocol by adapting the already available procedures (4,5) and established to sample at least 4 different populations for each species (20 individuals for each population). These results will allow us to have a global and innovative picture of the functional space of the populations studied, in relation to their endemic status as well.

[1] Selvi, F., Campetella, G., Canullo, R., Chelli, S., Domina, G., Farris, E., ... & Carrari, E. (2023). The Italian endemic forest plants. *Plant Ecology and Evolution*, 156(1), 29-45.
[2] Díaz, S., Kattge, J., Cornelissen, J. H., Wright, I. J., Lavorel, S., Dray, S., ... & Gorné, L. D. (2016). The global spectrum of plant form and function. *Nature*, 529(7585), 167-171.
[3] Chelli, S., Klimešová, J., Tsakalos, J. L., & Puglielli, G. (2024). Unravelling the clonal trait space: Beyond above-ground and fine-root traits. *Journal of Ecology*, 112(4), 730-740.
[4] Perez-Harguindeguy, N., Diaz, S., Garnier, E., Lavorel, S., Poorter, H., Jaureguiberry, P., ... & Cornelissen, J. H. C. (2016). Corrigendum to: New handbook for standardised measurement of plant functional traits worldwide. *Australian Journal of botany*, 64(8), 715-716.
[5] Klimešová, J., Martínková, J., Pausas, J. G., de Moraes, M. G., Herben, T., Yu, F. H., ... & Ottaviani, G. (2019). Handbook of standardized protocols for collecting plant modularity traits. *Perspectives in Plant Ecology, Evolution and Systematics*, 40, 125485.

# NATURAL AND SEMI-NATURAL GRASSLANDS OF VALLEVECCHIA (CAORLE, VENETO, ITALY)

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**Keywords:** natural and semi-natural grasslands, ecosystem services, management practices



Natural and semi-natural grasslands are a wealth of high nature conservation value. While natural grassland develops under minimum human interference, the maintenance of semi-natural grasslands depends on management practices. Natural and semi-natural grasslands provide also important ecosystem services, such as biomass production, carbon sequestration and pollination. However, agricultural intensification, land abandonment and increasing land conversion have widely compromised grassland conservation.

Vallevecchia is an 800 ha area in the eastern part of the Venetian Plain in the Municipality of Caorle (Venice). Vallevecchia stretches inland from the sea and features a complex mosaic of natural and semi-natural grasslands. The great diversity of grassland communities makes Vallevecchia an important site for the conservation of biodiversity, but at the same time presents a challenge for the development of consistent conservation and management practices.

Our objectives were: a) to describe the natural and semi-natural grassland communities of Vallevecchia; b) to quantify their importance for the provision of different ecosystem services provided by plant biodiversity (i.e., biomass production for foraging and animal-mediated pollination); and c) to formulate appropriate conservation and management practices tailored to each grassland community.

We surveyed a total of 50 randomly selected vegetation plots in the Vallevecchia grasslands. Using a cluster analysis, the vegetation plots were categorised and grouped into five communities, for which the contribution to the provision of ecosystem services and appropriate management strategies were defined. In particular, Vallevecchia is characterised by the presence of mesophilous hay meadows, ruderal grasslands dominated by *Elymus* sp., xerophilous grasslands of fixed coastal dunes, wet grasslands of infradunal downs, and *Phragmites australis* reeds. The co-occurrence of these communities in the study area results in the provision of various ecosystem services, such as biomass production by hay meadows and pollination by xerophilous grasslands of fixed coastal dunes. Management measures include the mowing and removal of hay for the hay meadows and the ruderal grasslands dominated by *Elymus* sp. as well as the control of alien species in the wet grasslands of the infradunal downs and xerophilous grasslands of the fixed coastal dunes.

# IS THE NATURA 2000 NETWORK REPRESENTATIVE OF HABITAT DIVERSITY ACROSS EUROPE?

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**Keywords:** Natura 2000; Habitat diversity; Matching technique; Biodiversity conservation; European Vegetation Archive



The Natura 2000 protected area network, established as the primary tool for biodiversity conservation in Europe, is a critical component in addressing the challenges posed by habitat loss, fragmentation and isolation [1]. Despite the pivotal role of habitat in supporting a greater variety of species, the extent to which the Natura 2000 network effectively represents habitat diversity across European biogeographical regions remains uncertain. Therefore, a thorough comprehension of the role played by the Natura 2000 network in maintaining habitat diversity is indispensable for advancing biodiversity conservation strategies across Europe [2, 3].

Here, we used 287,168 vegetation plots from the European Vegetation Archive (EVA) database to evaluate the role of protected areas within the Natura 2000 network in preserving habitat diversity. Habitats were defined using the third hierarchical level of the EUNIS (European Nature Information System) Habitat Classification. Matching techniques were used to account for confounding variables related to the location of plots. Matching provides a useful technique to compare vegetation plots between protected and unprotected areas that belong to the same environmental condition and excluding those that are not matched. Matching was based on climate and environmental covariates that are usually linked to plant and habitat distribution including: altitude, annual mean temperature, annual precipitation, minimum distance from rivers and biogeographical regions. Following the matching process, we aggregated the vegetation plots by biogeographical regions, enabling a more precise estimation of the total, exclusive, and shared number of habitats within both protected and unprotected areas. The preliminary results suggested higher habitat diversity in protected areas even if this pattern is not consistent across biogeographical regions. Our results can inform EU-wide conservation planning in the context of the EU Biodiversity Strategy for 2030 by highlighting areas where habitat diversity is inadequately represented.

[1] Hoffmann, S. (2022). Challenges and opportunities of area-based conservation in reaching biodiversity and sustainability goals. *Biodiversity and Conservation*, 31, 325–352.
[2] Geldmann, J., Deguignet, M., Balmford, A., Burgess, N. D., Dudley, N., Hockings, M., ... & Watson, J. E. (2021). Essential indicators for measuring site-based conservation effectiveness in the post-2020 global biodiversity framework. *Conservation Letters*, 14(4), e12792.
[3] Geldmann, J., Byaruhanga, A. B., Gregory, R. D., Visconti, P., & Xu, H. (2023). Prioritize wild species abundance indicators. *Science*, 380(6645), 591-592.

# FORTY-YEAR COASTAL VEGETATION DYNAMICS IN THE CASTELPORZIANO PRESIDENTIAL ESTATE: AN ANALYSIS OF BIODIVERSITY CHANGES

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**Keywords:** coastal dune vegetation, resurveying studies, diachronic analysis, vegetation re-sampling



By occupying the transition zones between the marine and terrestrial worlds, coastal dunes are valuable ecosystems with highly specialized flora and fauna, providing crucial services to humans. However, despite their high naturalistic value, coastal dunes are among the most threatened ecosystems in Europe. Extensive urbanization, coastal erosion, trampling, and the intentional and unintentional introduction of exotic species are among the most important drivers that have led to the widespread degradation and loss of coastal dune ecosystems. Quantifying such alterations, along with identifying and monitoring main trends, is a crucial task in the protection and management of coastal dune systems and is therefore considered a priority issue in European conservation ecology.

In this concerning context, the Natural Reserve" Castelporziano Presidential Estate" represents an exception as it still maintains a well-preserved coastal dune system. Thanks to limited human access for more than 100 years, the Estate has never been affected by mass tourism and could be regarded a rare example of coastal dunes in a relatively good state of conservation in the entire Mediterranean basin. Consequently, this area could be considered an ideal model for analyzing long-term temporal changes in coastal dune vegetation with limited anthropic pressure.

Resurveying studies, consisting of the re-sampling of vegetation plots historically surveyed by other authors, are increasingly being used to detect temporal changes in the vegetation of many ecosystems [1]. By resurveying 78 historical phytosociological relevés along the complete sequence of coastal dune habitats, in this study, we assessed changes in plant species occurrence and cover over the last 40 years, from 1985 to 2023. Temporal changes were analyzed through ordination techniques (Detrended Correspondence Analysis, DCA), species rarefaction curves, and Indicator Species Analysis (ISA). Moreover, we calculated an ecosystem function index concerning the "erosion control" service, mainly operated by rhizomatous geophyte grasses that, through a dense root network, entrap sandy sediments and stabilize the dune.

Most of the historical plots have been found and revisited. Notwithstanding the high levels of protection, results show that the coastal dune communities of the Estate underwent significant changes during the analyzed timespan. Major transformations were related to positive successional trends with a significant decrease in the typical species of embryonic dunes in favor of the species of fixed dunes. The xerophytic garrigues of Mediterranean scrub dominated by *Cistus salvifolius* evolved into holm-oak forests. Species richness decreased only for woody fixed dune environments, while focal species cover decreased in all communities. In particular, the lower coverage of pioneer dune species may be a warning, leading to less control of erosion by dune plants.

Given the low anthropogenic disturbance in the area, we hypothesize that the observed differences in species composition are due more to natural succession. Moreover, this work shows how resurveying approaches can efficiently reveal useful insights into vegetation dynamics in these fragile and threatened habitats, providing a solid basis for the implementation of effective conservation strategies.

[1] Kapfer, J., Hédl, R., Jurasinski, G., Kopecký, M., Schei, F. H., & Grytnes, J. A. (2017). Resurveying historical vegetation data–opportunities and challenges. *Applied Vegetation Science*, 20(2), 164-171.

# EFFECT OF ANTHROPOGENIC DRIVERS OF CHANGE ON THE LOCAL PLANT COMMUNITY DIVERSITY OF CHESTNUT GROVE ON ELBA ISLAND

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**Keywords:** remote sensing, land abandonment, plant ecology



Chestnut groves have a long history in Europe. They have been cultivated and managed for centuries for their suitability to produce wood and fruit, as well as for their landscape and natural value. In Italy, the products of chestnut groves have been the basic sustenance of many local populations, especially in the mountains. Initially, many chestnut groves were planted well outside the climatic optimum of the species but managed and cultivated in such a way that they thrived for a long period. However, the socio-cultural changes of the last century have led to a progressive decrease in chestnut cultivation and thus to the abandonment of chestnut groves. In Tuscany, there are 32 thousand hectares of chestnut groves of which more than half are abandoned. Furthermore, the depopulation of the mountains and the outbreak of aggressive phytopathologies, such as the American cortical cancer and the Chinese gall, are the most common reasons for the abandonment.

This study investigates the consequences of the stresses potentially caused by the abandonment of chestnut groves, on Elba Island, in the Tuscan Archipelago. The chestnut tree's presence on the island is of anthropic origin and has been documented for a long time. Chestnut groves are primarily located on the northern slopes of Monte Capanne. However, these areas are not within the optimal climatic conditions for the chestnut tree, there are only a few remaining groves, generally surrounded by Mediterranean maquis, and chestnut cultivation is infrequent. Despite their often compromised health status, chestnut groves have an important ecological and naturalistic value. Understanding how anthropic and climatic stresses, as well as abandonment or current management, can influence the development of these environments will help preserve their naturalistic value and understorey biodiversity. Towards these aims, we combined remote sensing analysis correlated with floristic characterization of the abandoned areas through ground surveys to assess the status of conservation of Elba's chestnut groves.

Correlating the normalised difference vegetation index (NDVI) calculation and the vegetation map for the island, it was possible to delineate the chestnut groves on the northern and eastern sides of Monte Capanne and to assess their vegetative cumulative stress. We then surveyed the chestnut groves on the island with a probabilistic sampling design, to represent the different levels of stress identified in the analysed areas. 10 x 10m plots were sampled to estimate the presence and relative cover of species in the understorey layers. An assessment of plot stress was also conducted, with stressors including damage caused by Chinese gall and/or cortical cancer, management status of the area (abandoned or not), and damage to vegetation and topsoil caused by ungulates. The preliminary results indicate varying levels of species richness based on the degree of site disturbance.

In addition, the fragile health of chestnut trees results in leaf loss and openings in the canopy, which allows more light to pass through and nourish the herbaceous layer. However, this can lead to an increase in grazing ungulates and subsequently impoverish the undergrowth.

# THE WETLANDS OF MAREMMA (TUSCANY, ITALY): RESURVEYING STUDIES AND INVESTIGATIONS ON NEW BIOTOPES

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**Keywords:** vegetation, flora, phytosociology, conservation, Mediterranean wetlands, resurveying



In the Mediterranean, wet environments are habitats strongly dependent on meteoric contributions and often ephemeral in nature. The wetlands of southern Maremma (Tuscany, Italy) have peculiar aspects and characteristics that are quite different from each other. Previous studies, dating back more than 15 years ago on the Lagaccioli and Marruchetone ponds, had confirmed the presence of species that have now almost completely disappeared in Tuscany, such as *Damasonium alisma* Mill., *Elatine alsinastrum* L. and some taxa of *Isoetes* spp. [1]. More recently, the study of the vegetation of Acquato Lake [2] had allowed the identification of interesting associations such as *Ranunculetum rionii* Hejný et Husák in Dykyjová et Květ 1978 or *Veronico anagalloidis-Lythretum hyssopifoliae* Wagner ex Holzner 1973.

Due to their temporary nature, the proximity for some wetlands to cultivated areas or the use of others as watering holes for livestock, these environments are rather disturbed and subject to rapid transformations which, also following the more or less rapid seasonal drying, imply the succession of different vegetation types, from aquatic to xerophilous ones.

With the collaboration of the Maremma Natural History Museum, a floristic-vegetation study campaign has begun, aiming on the one hand at comparative vegetation resurveying studies in previously investigated areas (Lagaccioli and Marruchetone ponds, Uccellina Lake) and on the other hand to investigate new biotopes, often located in private areas and therefore difficult to access. So far, coenoses belonging to the order *Ranunculion aquatilis* Passarge 1964 and *Potamion pectinati* (W.Koch 1926) Libbert 1931 have been preliminarily identified, as well as several communities of the class *Phragmito-Magnocaricetea* Klika in Klika & V. Novák 1941 and others hygrophilous coenoses of humid meadows.

[1] Lastrucci, L., Foggi, B., Selvi, F., & Becattini, R. (2007). Contributo alla conoscenza della vegetazione e della flora delle aree umide nel comprensorio di Capalbio (provincia di Grosseto, Italia Centrale). *Archivio Geobototanico,* 10(1-2)(2004), 1-30.

[2] Lastrucci, L., Ferretti, G., Mantarano, N., & Foggi, B. (2019). Vegetation and habitat of conservation interest of the lake Acquato (Grosseto – Central Italy). *Plant Sociology*, 56(1), 19-30.

# CAROLINA CLIMATE RESILIENCE OVER LANDUSE CHANGE IN SEMI-NATURAL GRASSLANDS

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**Keywords:** plant functional traits, pastures biodiversity, grazing



Grasslands represent species-rich plant communities in Europe and their loss is one of the primary causes of terrestrial biodiversity depletion in the Mediterranean Basin. In Italy the abandonment of agro-pastoral activities has an important role in this process, leading to the wood encroachment and loss of grasslands cover [1, 2]. Furthermore, one hypothesis is that grazing makes the system climate-resilient by diversifying the ecological niches.

The project CAROLINA (ClimAte Resilience Over Landuse change In semi-Natural grAsslands) aims to explore the potentiality of the grassland's extensive management under different climate conditions in terms of biodiversity conservation and C sequestration and to examine changes in ecosystem resilience to climate change with land-use variation. In this project 3 sites are object of both remote sensing studies on ecosystem scale and taxonomic and functional biodiversity analyses. They are in different climatic zones of Italy: alpine pastures with moist cool climate (Pieve Tesino, TN), Mountain-Mediterranean pastures (San Rossore, Massaciuccoli, PI) and Mediterranean pastures with warm and dry climate (San Venanzo, Orvieto, TR). A chronosequence approach is used to evaluate the impact of grazing and abandonment, considering areas abandoned in different time frames.

Portions of grasslands in each site are excluded from grazing through the installation of fences to evaluate short-term changes, while small portions of grazed areas are object of climate manipulation with structures that lead to a reduction of precipitation, to simulate the future climate trends expected for Italy, different for each site, considering local climate characteristics.

About vegetation, the focus is on the connections between functional and taxonomic diversity and physiological characteristics, indicative of possible long-term changes in the community. The niches diversification grade and climate adaptability along the chronosequence is assessed by plant communities' functional and taxonomic diversity and remote sensing is applied to link changes in plant and soil diversity with the multispectral diversity.

The surveys in the year 2024 are at zero point allowing to assess the diversity and functioning of the grasslands before the start of the manipulations that will simulate the removal of grazing and the decrease in water availability.

[1] Salvati, L., & Carlucci, M. (2015). Towards sustainability in agro-forest systems? Grazing intensity, soil degradation and the socioeconomic profile of rural communities in Italy. *Ecological Economics*, 112, 1-13.

[2] Bracchetti, L., Carotenuto, L., & Catorci, A. (2012). Land-cover changes in a remote area of central Apennines (Italy) and management directions. *Landscape and Urban Planning*, 104(2), 157-170.

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