

CHANGE

Global Change and Sustainability Institute

*Science
CHANGing
Policy*

Book of Abstracts

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CHANGE

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Preface

The world faces a series of different global changes, which are complex in nature and require urgent action from Academia, Public and Private Organizations and Governments.

The Institute for Global Change and Sustainability, Associated Laboratory CHANGE, integrates researchers from multidisciplinary areas of expertise that shall enable the development of appropriate solutions targeting the present and future environment and natural resources management, forestry and farming systems, energy and climate, as well as demographic and social challenges.

The Mission of CHANGE is the development of scientifically supported solutions for public policy and governance targeting an environmentally friendly, resource-efficient, and competitive economy, in the context of existent global changes. These should be innovative and up-to-date policies, implemented at multiple scales.

For fulfilling this Mission, the integration of knowledge, synergies and complementary aspects of the research undertaken within the three R&D units, CENSE, cE3c and MED, is fundamental. Innovative solutions for a changing world require often interdisciplinary approaches and combinations of knowledge not seen before. Therefore, we believe that exchange and networking, within the CHANGE community itself, is key in strengthening our skills and competences, and our capacity to respond to changing societal challenges.

The event *Science CHANGing Policy* was a showcase of CHANGE capabilities and a platform to boost the interaction and collaborative work between the researchers from CHANGE.

This event included past, present and future work covering the areas of biodiversity and ecosystem services restoration, promotion of sustainable food and biomass systems, preservation and restoration of natural resources, circular economy and energetic transition and territorial cohesion enhancement.

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&

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Cristina Máguas
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Program

9h30 **Opening Session**

Hermínia Vasconcelos Vilar
Rector University of Évora

Teresa Pinto-Correia
Chairman, Board of Directors CHANGE

09h45 **Keynote Lecture: Science, Impact and Public Policies**

José Manuel Mendonça
Chairman of the Board, INESCT TEC

10h30 **CHANGE**

Teresa Pinto-Correia

10h50 **Exploratory Ideas Competition**

Susana Filipe

11h00 **Coffee Break**

11h30 **Parallel Sessions Part I**

Thematic Line 1: Safeguarding and promoting biodiversity and ecosystem services

Thematic Line 3: Ensure the preservation and regeneration of natural resources

Thematic Line 5: Strengthen territorial cohesion to reduce disparities

12h30 **Lunch & Poster Session**

14h00 **Parallel Sessions Part II**

Thematic Line 2: Ensure sustainable food and biomass systems

Thematic Line 4: Promote a circular and carbon neutral economy

Thematic Line 1: Ensure the preservation and regeneration of natural resources

15h00 **World Café**

17h00 **Closing Session**

Board of Directors CHANGE

Teresa Pinto-Correia

Cristina Máguas

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Abstracts (Oral Presentations)



Making the invisible visible: impacts of human activities in subterranean ecosystems

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Abstract

Below the surface extends the largest ecosystems in our planet: the subterranean domain. Groundwater, the so-called “ocean under our feet”, harbours 97% of the world’s freshwater available for direct human consumption. All land ecosystems depend on it. Groundwater ecosystems are rich in endemic biodiversity (stygo fauna), fundamental for monitoring the ecosystem status and to link organisms’ functions to ecological processes. Stygo fauna has specific traits, intimately connected to the vulnerability of groundwater and groundwater-dependent ecosystems to global change. This constitutes one of the most poorly known and unprotected natural resources of our planet, omitted from public agendas. Our research program aims to understand the impact of anthropogenic activities in subterranean ecosystems, generating a framework for their future ecological and ensuring its sustainability. We have tested lethal and sublethal effects of a wide range of anthropogenic stressors (e.g., temperature, xenotoxics, metals, veterinary and human medicinal products, salinity) on stygo fauna, to estimate their effects on groundwater ecosystems across different biomes. Moreover, we perform a groundwater Environmental Risk Assessment on pollutants found in groundwater at european level. This research line generates valuable information on the sensitiveness of groundwater species from habitats strategically selected to be representative of different climatic, geographical and impacted conditions. Thus contributing to evaluate, to predict, to mitigate and to establish new public policies for the impacts of human activities in groundwater and dependent ecosystems, particularly relevant in the context of ongoing global changes.

Birds shine as biodiversity indicators and tools for environmental conservation and sustainability

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Abstract

Birds are the target biological group of the Laboratory of Ornithology (LabOr), which carries out applied research on several topics, including ecology, nature conservation, ecotoxicology, education, and sustainability of human activities. At LabOr we developed ecological studies focused on birds that contribute to recognize their strong potential as indicator species, understand their ecological functions and the ecosystem services they provide. The knowledge on community ecology has contributed to improve the sustainability of human activities, in particular agriculture, where we highlight the role of landscape heterogeneity on biodiversity. Our work on ecotoxicology has contributed to strengthen the relevance of using top predators as sentinels of chemical substances and monitoring tools of environmental and human health. Our projects also include monitoring the composition of communities, understanding interactions in ecological networks (predation and competition), and assessing the impact of invasive exotic species. The team has contributed to the current knowledge on distribution and population trend of birds (atlases, red data book, Natura 2000 reporting and management plans), which are essential to define nature conservation and biodiversity policies, namely the conservation status and the definition and management of protected areas. The team is also involved in developing policies for invasive exotic birds. In addition, our work has demonstrated how birds can contribute to environmental education and human wellbeing.

Solar farms as biodiversity conservation opportunities?

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Abstract

European countries are expanding utility-scale solar farms to reduce carbon emissions and increase energy independence. However, the expansion of these facilities raises concerns about competition for land for other uses, including biodiversity conservation. This clash could be particularly significant in the European southern regions, including the Iberian Peninsula, given its high potential for photovoltaic production and vast areas of well-preserved habitats. Thus, quantitative assessment of the friction between renewable energy development and conservation potential is an important step towards the sustainable development of the energy sector in this region. Here, we discuss a prioritization framework based on solar potential and human footprint to identify zones where the development of solar farms may cause a negative impact on biodiversity (conflict zones), and areas where they may have beneficial outcomes (opportunity zones). Based on these results, we highlight how different synergies among CHANGE research groups can provide new knowledge and information required by decision makers for designing public policies, namely on biodiversity conservation, sustainable development, 'agrivoltaic farming', climate change adaptation, and landscape planning.

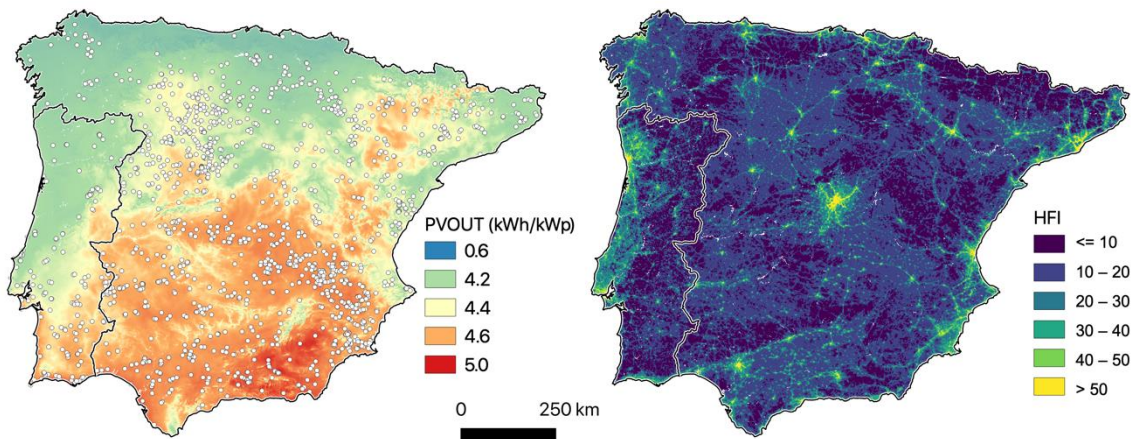
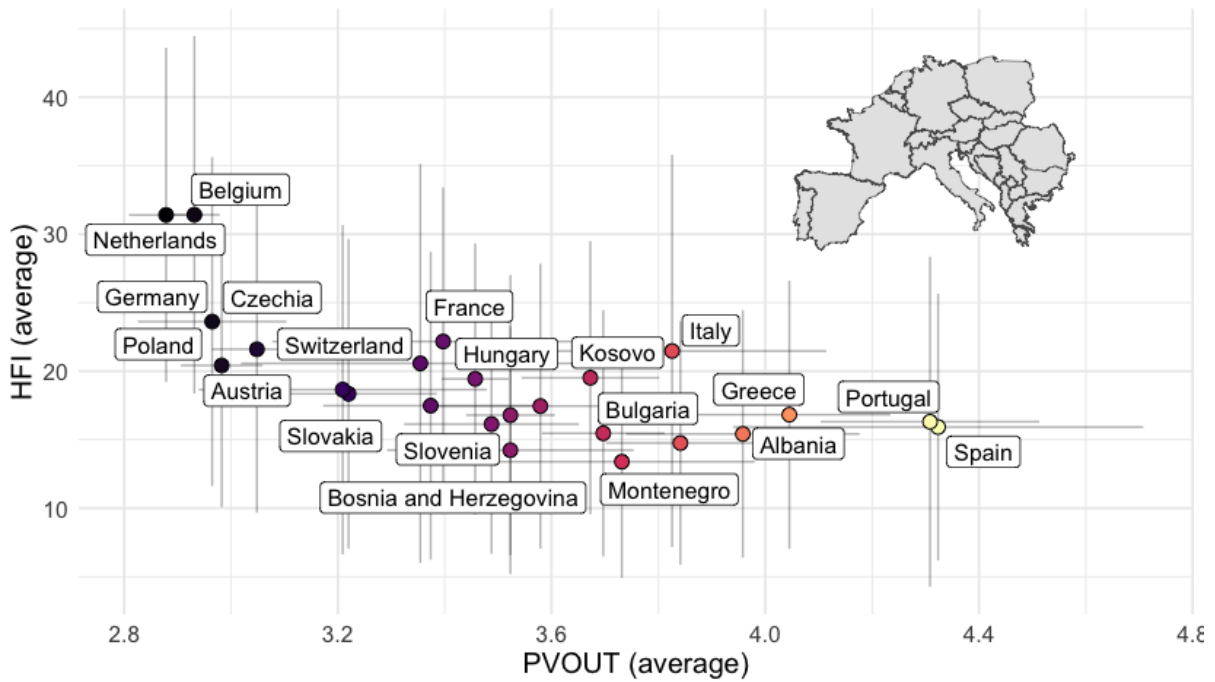


Figure 1 – Top: Relation between Photovoltaic Power Output (PVOUT; mean±SD) and Human Footprint Index (HFI; mean±SD) for a collection of European countries (focal countries in the inset). Iberian countries stand out as having the largest solar potential while also having a low mean HFI when compared to the other countries. Bottom: Spatial distribution of PVOUT (left) and HFI (right) across the Iberian Peninsula. White dots in the bottom left panel stand for PV solar locations according to the harmonized global dataset of solar farm locations (Dunnnett et al. 2020).

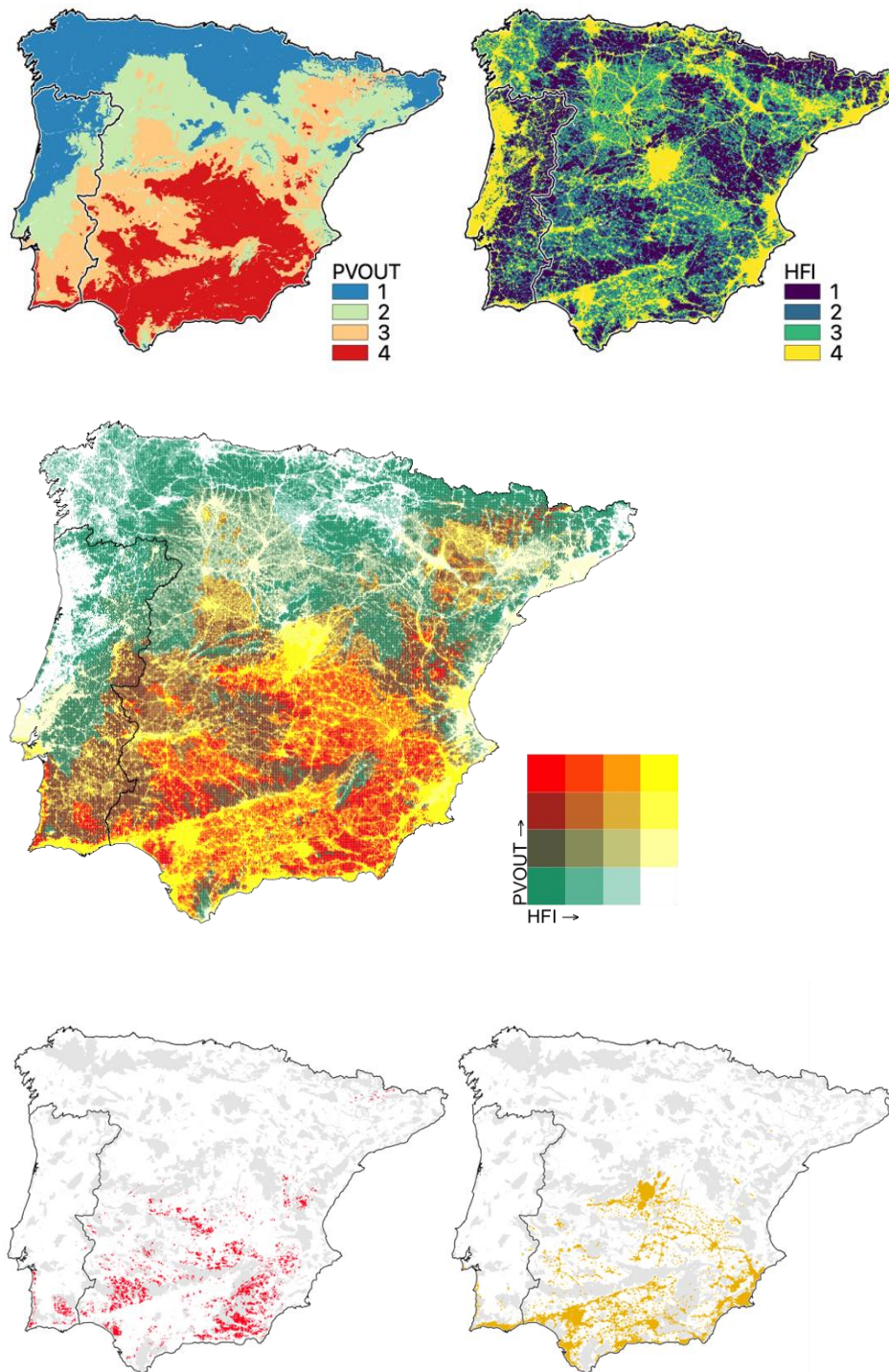


Figure 2 – Top panel: Information on Photovoltaic Power Output (PVOUT) and Human Footprint Index (HFI) transformed into quartiles (1: 0-0.25, 2: 0.25-0.50, 3: 0.50-0.75, 4: 0.75:1). The overlap of these layers results in the bivariate map in the middle panel, reflecting the distribution of both layers across the territory. From the bivariate map, we obtain the potential conflict and opportunity areas for building solar PV facilities, as depicted in the bottom panel (conflict zones on the left and opportunity zones on the right). Grey areas in the bottom images stand for protected areas (including Natura 2000 and IUCN areas).

Ecological restoration in Portugal: network collaboration to inform national and European nature restoration policies

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Abstract

Recent global political initiatives on nature restoration by the United Nations and in the European Union highlight the urgency of going beyond conservation efforts, recognizing ecosystem restoration as a priority to halt the loss of biodiversity, combat the climate crisis, and ensure human security and well-being in the near future. The nature restoration law under discussion in the EU sets binding targets for all member states including Portugal, and it is essential that the future national plan for nature restoration builds on and integrates the scientific knowledge and expertise gained in the various restoration projects implemented in Portugal, involving all key actors. This work will present: i) examples of scientific support provided by the team to restoration projects in Portugal promoted by different stakeholders, involving the restoration of dunes, quarries, mines, agroforestry systems and burned areas; ii) a synthesis of restoration projects implemented in Portugal; iii) the initiatives promoted by the Portuguese Ecological Restoration Network (ResECO) to compile information on nature restoration and make it available, to promote communication between the different actors involved in restoration activities, and to facilitate knowledge transfer between academia, the society and policy-makers in Portugal, including providing support for the discussion and setting of targets of the EU Nature Restoration Law. Hereby, we intend to provide a basis for the discussion about the state of ecosystem restoration in Portugal, identifying the main limitations, opportunities, and solutions to tackle the challenges and support public policies and governance for nature restoration at the national and EU levels.

Validating the space-for-time approach using ecological indicators for climate change impacts

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Abstract

Climate change increasingly impacts biodiversity and ecosystems services and functions. In response to several UN conventions, efforts have been made to develop universal ecological indicators capable of quantifying how biodiversity and ecosystems are affected by, and respond to, these impacts. However, understanding ecological responses at multiple spatial and temporal scales is difficult without long-term observations. The space-for-time approach, which assumes that changes in biodiversity patterns over spatial gradients (e.g. climatic gradient) can be used to infer similar changes over time, is commonly used when long-term data is absent. Thus, the application of ecological indicators to monitor the impacts of climate change requires validation. For that, we analysed how epiphytic lichens communities, a commonly used ecological indicator, are changing in space and time. Lichens sampling was conducted for almost thirty years (1994-2022) in a semi-arid ecosystem in southern Portugal, in response to shifts in climate (temperature, precipitation, relative humidity and others climate variables). Lichen-based metrics (taxonomic and functional) were modelled with the same climate variables along spatial climatic gradients. Spatial and temporal models were then compared. Our results show that the metrics changing along space, in response to these climate variables, also change over time, in response to those same variables. This long-term study suggests that lichen-based ecological indicators for the impacts of climate change, developed using a space-for-time approach, can be used to quantify changes over time, further supporting its use as universal ecological indicator.

Rocky outcrops: Small Natural Features to promote biodiversity in oak wood-pastures

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Abstract

Iberian oak wood-pastures are unique agroforestry systems that provide high levels of biodiversity and ecological services. Small rocky outcrops are prominent geological features in these areas and serve as biodiversity reservoirs, protecting sensitive species from grazing and farming activities. We assessed the relevance of including rocky outcrop conservation within wood-pastures to increase biodiversity. To achieve this goal, we studied the plant communities occurring within the outcrops and in the wood-pasture matrix to evaluate the impact of rocky outcrops on the overall plant taxonomic and functional diversities of these systems. We found that the presence of small rocky outcrops in evergreen oak wood-pastures greatly increases their gamma and functional diversities. Consequently, outcrop protection strongly impacts overall wood-pasture biodiversity and underlines the suitability of including outcrop conservation as a cost-effective solution capable of increasing biodiversity in these agroforestry systems. We propose the inclusion of outcrops and other Small Natural Features in the European Common Agricultural Policy as a measure to support biodiversity in agroecosystems.

Modelling structural fire risk and fire impacts in forest areas

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Abstract

Many parts of the world are facing both water scarcity and high fire activity. Droughts can impact fire occurrence since drier soils, vegetation and fuel are more likely to burn during a fire. Humans' actions can increase sediment erosion, from the uplands and connectivity to downstream receiving bodies. Fires can also impact water resources by enhancing the mobilization of fine sediments, ashes, and associated pollutants from burnt areas, contaminating streams and impacting aquatic ecosystems and water supplies. This is an example of the deep connection between fire, water and society. In these studies, we show that: (i) 83% of large fires occurred during and in the area affected by heatwaves, and all large fires occurred during drought; (ii) structural fire risk can be mapped using a deterministic approach based on the concept of fire risk, that comprises the combination of the fire hazard and the potential economic damage; this methodology is being used by Portuguese authorities; (iii) Post-fire erosion risk can be mapped using the semi-empirical Morgan–Morgan–Finney erosion model; this map identify the areas with higher post-fire erosion risk and its now part of JRC data centre; and, (iv) Sediment mobilization hotspots after wildfires can be mapped using the index of connectivity; this methodology helps forest and water managers take rapid mitigation decisions of fire impacts in water resources.

Past, present and future of technologies from Industry 4.0 and Industry 5.0 in the Water-Energy-Food-Ecosystems Nexus: a systematic review

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Abstract

This work presents a systematic literature review that aims to assess the benefits and harms of Industry 4.0 and Industry 5.0 technologies on the resources of the Water-Energy-Food-Ecosystems (WEFE) nexus. To achieve this goal, we selected a set of published papers that discuss WEFE nexus security and technologies from Industry 4.0 and Industry 5.0, based on predefined inclusion and exclusion criteria. Accordingly, we used an established systematic literature review protocol to identify the main findings and evaluate the potential effects of these technologies on the security of the nexus resources in terms of their availability, affordability, equity, preservation, accessibility, stability, and sustainability. Additionally, we identified technologies that address ecosystems' integrity and their capacity to deliver ecosystem services, as well as potential directions for the future application of these technologies to assure WEFE nexus security. The results of our systematic review provide valuable insights into the potential of Industry 4.0 and Industry 5.0 technologies in responding to the challenges of WEFE nexus security and sustainable development.

Contribution to a science-based design of public policies: The role of small scale farming landscapes in wild bee genetic biodiversity inside a climatic refugia

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Abstract

The susceptibility of species to agricultural landscapes is highly variable, with only a small number of species persisting in intensively managed landscapes. In contrast to these landscapes, heterogenous small-scale farming (SSF) landscapes may have less negative impact some bee species possibly presenting local adaptation to SSF landscapes. We tested such a hypothesis by exploring how three wild bee species (*Andrena flavipes*, *Bombus terrestris*, and *Lasioglossum malachurum*) responded to the selective pressures imposed by their local environment in one SSF landscape, the West region of Portugal (a climatic refugium), with using a contrast sampling design (small-scale farming landscapes vs. natural landscapes) and thousands of single nucleotide polymorphisms, generated by restriction-site-associated DNA sequencing. Overall, we found low levels of genetic differentiation between the SSF area and nearby natural landscapes, suggesting a weak effect of the two contrasting landscapes on gene flow. Moreover, we did not find any difference in neutral genetic variability between the populations of both landscape types. Notwithstanding, we identified several loci under selection suggesting that this type of landscape can promote an evolutionary response in vital insect pollinators, with some loci associated with land use variables that characterize those landscapes. This is particularly relevant to reinforce the importance of the west region of Portugal, a major national climate refugium, as part of the national strategy for biodiversity conservation.

Scaling-up nature positive outcomes to inform restoration policies

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Abstract

Despite all the agreements and commitments, the world has so far failed to halt biodiversity loss, as it continues to decay at unprecedented rates due to anthropogenic impacting activities. It is increasingly recognized that to halt biodiversity loss it is not enough to protect, we must also restore. Following UN's environmental agenda on the Decade for Ecosystem Restoration (2020-30), EU has recently proposed the Regulation on the Restoration of Nature. It calls on member states to act by creating incentives and regulatory mechanisms to help no-net-loss or net-positive outcomes, posing new demanding challenges as most are not prepared to comply with the ambitious agenda. Decisive action and transformational change are therefore needed to achieve the EU restoration goals for 2030 and beyond, namely: 1) restoration measures to cover 20% of EU land and sea, and 2) put in place measures for all ecosystems in need of restoration. In this presentation we will show how applied ecological research and demonstrative actions based on long-term monitoring, ecosystem service provision valuation, net-impact assessment, and implementation of nature-based solutions through adaptive management have been used to inform and deploy nature-positive outcomes in the restoration of degraded areas. Furthermore, these outcomes can and have been transposed to domestic and international policies and guidance leveraging large-scale effective strategies to entail massive ecological restoration activities, identifying the needs, opportunities, and solutions demanded to achieve 2030 restoration targets.

Designing sustainable production landscapes in Alentejo: optimizing local actions to co-maximize biodiversity, carbon retention, rational water use and economical gains

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Abstract

There is an increase in societal consciousness about the key role of a functioning nature to human welfare. In a world where the human footprint pervades, the space to be dedicated exclusively to natural functioning of ecosystems is scarce and expensive. Modern land use policies call for multi-functional landscapes where sustainable socio-economic activities cohabit with healthy ecosystems. This is the overarching goal of the EU Green Deal – a set of integrated, multidisciplinary and coherent sectorial policies which puts the EU in the path to a sustainable development. Under the Green Deal framework novel financial mechanisms to instigate land users in producing and protecting nature are emerging, thus opening opportunities for a paradigm shift in territorial management. The AgroSatAdapt project navigates this ground. The research uses spatial multi-objective optimization to pinpoint the land uses with potential to drive three testing areas in Alentejo to sustainability up to 2050. Particularly, the project will examine the land uses which maximize biodiversity adaptation to climate change, carbon retention and rational water usage without jeopardizing the legitimate economic aspirations of producers. Given the emergent nature of the financial mechanisms no benchmark still exist on the way payment for ecosystem services will be conducted. The project uses a portfolio of scenarios to test the design of the territory by varying: (1) the available budget to finance carbon retention and rational water use; (2) the models used to finance carbon and water; (3) the profile of producers to undergo in these novel payment regimes; (4) costs associated to land use conversion, among others. AgroSatAdapt offers a flexible support tool for policy makers and land owners to foster sustainable decisions on the use of land.

Linear Infrastructure Networks with Ecological Solutions – the legacy of the LIFE-LINES project

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Abstract

Recently, the Convention on Biological Diversity Conference of the Parties (COP 15) adopted the “post-2020 global biodiversity framework” where inverting biodiversity decline and restoring ecological connectivity are major flagships. The need for reversing the negative impacts of Linear Infrastructure Networks in the environment is increasingly acknowledged as a key to achieving those biodiversity commitments. LIFE-LINES project (LIFE14 NAT/PT/001081) employed and essayed a large and diverse number of interventions with the aim of reconciling biodiversity conservation and the presence of roads and powerlines. This was achieved through actions that enhanced ecological connectivity through the reduction of wildlife roadkill, promotion of autochthonous vegetation, and creation of refuges and corridors in habitats related to linear infrastructures. The project proved that fostering a European Green Infrastructure across Grey Infrastructure without jeopardizing their ecological and social roles is reachable. Beyond socio-ecological results, the flagship outcomes devised from the LIFE-LINES project spawn throughout a myriad of tools created to support stakeholders and decision-makers in making better choices concerning the sustainability of linear infrastructures at all levels, from the planning to the maintenance phases, namely: 1) solutions to mitigate mortality and barrier effects, 2) guidance to improve road verge management, and 3) creation of a National Roadkill Database to monitor and report large-scale mortality trends. Although a large part of the project was dedicated to the dissemination of the results, engaging stakeholders, policymakers, including recommendations for changing national and regional laws and plans, and overall society, continued efforts and funds are necessary to follow the aftermath of the project and ensure its legacy lives-on.

Understanding the responses of ecological networks to global changes through the lenses of evolutionary history

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Abstract

Understanding how evolutionary and ecological processes shape networks of interacting species remains as one of the main challenges in biodiversity science. Species traits modulate biological interactions in predictable ways, as well as the response of ecological communities to cascading effects, such as species loss. As species traits are largely a legacy of their evolutionary history, understanding how traits evolve along the phylogenetic history of a clade becomes crucial in order to grasp the outcomes of ecological disturbances. Using phylogenetically structured network simulations, I will demonstrate how eco-evolutionary dynamics can affect ecological network structure and stability in the face of global changes. More specifically, I will show: (i) The consequences of the loss of functional diversity to mutualistic networks; (ii) The role of trait redundancy in buffering extinction cascades, and, at last; (iii) How macroevolutionary processes determine ecological network persistence and reorganization in the face of climate change. Despite its simplicity, this *in silico* approach suggests that understanding the constraints imposed by species' evolutionary history is crucial to predict biodiversity responses to environmental changes.

Lichens as ecological indicators for the effects of environmental changes in urban areas: ongoing research and major challenges

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Abstract

Although cities are places for human fulfilment, urbanization causes environmental problems, such as atmospheric pollution and the urban heat-island effect. Although these can be directly quantified by sensors, measuring its effects on urban ecosystems biodiversity, functioning and provision of ecosystem services remains a challenge. To overcome this, the aim of this work is to present ongoing research and application of lichens as ecological indicators, including research challenges. Overall, we selected the lichen-based metrics more suited for the problem at hand: taxonomic-based or trait-based metrics (depending on the intensity of the environmental driver) and physical-chemical analysis of lichen thallus to understand pollutants deposition in ecosystems. Analysis of lichen metrics over space enhanced the application of lichens as indicators for factors working at different spatial scales. Still multi-city studies remain challenging, e.g. to disentangle the local effects from the large trends observed in a continental scale. Urban ecosystems are impacted by environmental changes, but also contribute to ameliorating its effects, by providing ecosystem services. We used lichens to quantify how green and blue infrastructure characteristics affect the provision of ecosystem services, e.g. how green areas characteristics (e.g. tree-density or habitat fragmentation) influence the amount of microclimate or air quality regulation. Still, measuring ecosystem services provision under the effects of multiple drivers remains a challenge. Addressing such challenges could allow us to improve even further the use of lichens as ecological indicators, contributing to the planning and management of cities green infrastructure and to adapt cities to future environmental changes.

Ecology and dynamics of flora and natural habitats: knowing to safeguard

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Abstract

The growing awareness for environmental problems, that we are facing at a global level, and the urgency to act have changed the paradigm of research in Ecology. We live in a time when decision makers require from us objective information to understand the mechanisms and processes, as well as monitoring methods, parameters and tools that can serve as a basis. Therefore, we must set up multidisciplinary teams that can integrate different aspects, including the capability of efficiently transmit knowledge. The R&D activities of the MED&CHANGE Botany Laboratory (CHANGE – Institute for Global Changes and Sustainability, coordinated by MED - Mediterranean Institute for Agriculture, Environment and Development from the University of Évora), address the general theme of ecology and dynamics of flora and plant communities. We develop work both in natural habitats of the European Directive, in semi-natural habitats such as the Montado and in the traditional agricultural systems of our region, namely vineyards and olive groves. When we face the challenge of using science to support policy making, we must always be aware of the complexity and uncertainty associated with all natural processes. This presentation will focus on different projects, external services, and consultancy already developed by the Botany Laboratory team or still ongoing, that somehow have contributed to changes in public policy.

Biodiversity management and conservation of Mesovoid shallow substratum (MSS) habitats in Portugal

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Abstract

In the last decade, subterranean habitats in Portugal went from a “biological desert” to one of the world’s subterranean biodiversity hotspots. Studies have focused mostly on deep subterranean communities, leaving the vast majority of shallow subterranean habitats virtually unstudied. This work focuses on the study of colluvial mesovoid shallow substratum (MSS), defined as air-filled subterranean spaces with high humidity between rocky fragments. MSS habitats are protected for their flora and geology, although their distribution is not yet mapped. Faunal communities are not included in the protection status, when in fact this habitat has a very important role as a climatic refuge for several animal species. This work will fill the knowledge gap for animal communities in the Portuguese MSS. We assessed the invertebrate and vertebrate communities in MSS of Estrela, Sicó, Estremenho and Arrábida mountain chains for one year, and developed a new mapping method for colluvial MSS, which proved efficient for habitat remote detection and extent estimation.

Preliminary data on arthropod fauna for spring and summer shows a total dominance of arthropods, more specifically insects: Diptera, Hymenoptera and Coleoptera. Small mammals have been found dwelling in this habitat, while the presence of herpetofauna remains scarce. The combined effects of anthropic destabilization, habitat destruction and lack of knowledge about habitat distribution and faunal composition place this ecologically important habitat under threat. This study will contribute to improve protection and conservation measures for MSS habitats and their biological communities in Portugal.



2

*Ensure Sustainable Food and
Biomass Systems*

Developing sustainable approaches for the control of plant-parasitic nematodes (NEMALAB MED)

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Abstract

Plant-parasitic nematodes (PPN) are a serious threat for economically important crops worldwide, severely affecting the sustainability of the agricultural and forestry systems. Some PPNs are listed as quarantine pests for which restrictive regulations are imposed by phytosanitary authorities. Preventive control management strategies can help in the early detection of these pathogens. At NemaLab (Laboratory of Nematology), we are interested in the biology of PPN and molecular interactions with the plant host in order to develop new sustainable and environment safe solutions for PPN control. Our research is focused on i) molecular systematics and genetic diversity of PPN; ii) molecular plant-nematode interactions and PPN parasitism strategies; and iii) biological control of PPN. We are working with three important pathogens in Portugal: the A2 quarantine pest, the pinewood nematode *Bursaphelenchus xylophilus*; the A1 and A2 quarantine pests, the grapevine virus-vector nematodes *Xiphinema* spp.; and regulated A2-non quarantine species, the root-lesion nematode *Pratylenchus penetrans*. NemaLab is also a certified laboratory for the detection and diagnosis of A1 and A2 quarantine pest, national and internationally, receiving samples from public and private companies of key sectors – tourism, vine, agriculture, and forestry.

How research about the biochemistry of oral medium can contribute to policies on Global Change and Sustainability?

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Abstract

Changing dietary habits is an important and complex challenge for achievement of sustainability and public and planetary health. But finding strategies for effective changes require a deep knowledge about the factors that motivate and determine choices. The multidisciplinary nature of eating behavior determinants makes necessary the interaction of different researchers, from different scientific areas.

In the Animal Applied Physiology (AAP) laboratory of MED we develop research focusing the role of food oral perception on food acceptance, preference and choices. Salivary proteomics is used to identify and understand the main mechanisms involved in oral sensory perception and how individuals differ in that perception. Moreover, how different types of factors (namely diet, external stimuli like olfaction, vision and audition) affect oral biochemistry, this relationship and further food acceptance are of our interest. We are greatly focused on Mediterranean Diet (MD) because besides this being the better example of sustainable and healthy diet, in our reality, the adherence is lower than desired and being a vegetable-based diet, it presents challenging sensory characteristics, including bitterness, sourness and astringency, which are aversive for most of individuals. Besides this more fundamental research, at oral food perception level, and linked to it, the AAP Lab, we are involved in national and international hubs, namely the National Higher School Institutions for MD promotion (RIESDM) and SYSTEMIC, an European knowledge hub on Nutrition, Food and Security, where information is being collected (and reviewed) about sustainable food systems in Europe, the current situation in terms of adherence to MD and the main factors that affect it. Altogether, our different results may further contribute to discuss/define policies concerning sustainable dietary habits promotion.

Food safety of plant-based foods (PBF): a legal void

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Abstract

The development of plant-based fermented foods (PBFF) at the onset of the European Green Deal is a key opportunity in terms of food sovereignty, food identity and autonomy but also public health for Europe.

The manufacturing of PBFF from local plant resources (pulses and cereals) promotes short-chain value chains and a circular economy, and further contributes to the Sustainable Development Goals (particularly SDG 3 and SDG 12) of United Nations 2030 Agenda.

The European Commission and all recent strategies and initiatives point towards the development of innovative, safe, tasty, and nutritious PBFF that provide us healthy and sustainable diets.

But are plant-based foods (PBF) safe or not? Studies have shown that food safety risks in animal protein and plant-based foods are similar, but PBF are subjected to less sanitary control. Why? Because scientific information is scarce. But, more important, because there is a legal void. The Commission Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs considers food safety criteria for different food categories which are somewhat unclear. Moreover, regarding process hygiene criteria, only five general food categories are considered, namely meat and products thereof, milk and dairy products, egg products, fishery products, and vegetables, fruits and products thereof. So, it is easy to see, why some PBF are not subjected to such a rigorous safety control as for instance meat products.

Therefore, it is important and urgent to assess the microbiological risks of PBFF, particularly after some problems that have arisen in Europe caused by *Listeria monocytogenes* in PBF.

Table olives: from production to consumption, a crossroad of issues

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Abstract

Climate change is a global emergency affecting agriculture in the Mediterranean with decreasing crop yields, biodiversity loss, and issues with the quality and safety of foods. Many Portuguese table olive (TO) cultivars are facing extinction, given their low oil content and declining consumption, despite being economically relevant elsewhere and a flagship of the Mediterranean Diet. TO fermentation is carried out by lactic acid bacteria and yeast frequently originating from the fruit and surroundings. Fruit maturity and composition (namely in secondary metabolites, such as phenols), depend on the frequency of rainfall, mean and extreme temperatures, radiation, minerals in soil, pollutants, and more. These factors also play a critical role in selecting the dominant microbial populations responsible for TO natural fermentation, which consequently affects the quality and safety of the fermented olives. We discuss herein how climate change indirectly impacts the quality and safety of table olives, from the crop level to the natural fermentation step. We show data that points to declining crop yields, changes in fruit composition, and maturity at harvest, among others. In addition, we also note challenges for the industry (mostly SME and local producers) because of the likelihood of transformations in the natural fermentation at higher environmental temperatures. Drifts in the quality of table olives, at microbial, nutritional, and sensorial levels may occur and should be anticipated. Finally, we found signs of emerging risks and discuss ways of addressing them, aiming at contributing to the design of mitigation measures and climate adaptation strategies.

GrowLIFE – Connecting actors of the food system to promote its sustainability

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Abstract

GrowLIFE, an EU project coordinated by FCUL, done in collaboration with Turismo de Portugal, was designed with the goal of contributing to the ecological, economic and social sustainability of the food system. Since, evidence suggests that the sustainability of the food system can be achieved more effectively if all actors involved in such systems are engaged, the whole project is rooted in the capacitation and connection of producers, consumers, decision makers and culinary professionals. The project is structured along four work packages, each targeting one of these audiences. First, we will promote visits to sustainable farms, with the aim to inform and empower farmers interested in investing in more sustainable practices. Second, we will carry out routes in which policy makers will visit municipalities that have implemented policies that promote short food supply chains, such that these initiatives can be replicated. Next, we will organise farmers open days, in collaboration with students from the Tourism schools, aiming at increasing the awareness of final consumers. Finally, we will create a new curriculum unit on sustainable food systems in the Tourism schools targeting future culinary professionals. All work packages will be implemented in the 12 municipalities hosting Tourism schools - Viana do Castelo, Porto, Lamego, Coimbra, Óbidos, Portalegre, Cascais, Lisboa, Setúbal, Portimão, Faro e Vila Real de Santo António. Together, these activities will strengthen the links between actors interested in increasing sustainability in the food system, such that effective and sustained change is accomplished.

Toward an eco-friendlier agricultural practice: ecosystem services provided by natural enemies

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Abstract

Integrated Pest Management is the best approach to control native and/or exotic pest populations, once it is in line with the objectives of European Common Agricultural Policy that recommend the use of agricultural sustainable practices. Organic production is a global management system for farms and food production that combines the best environmental practices, a high level of biodiversity and the preservation of natural resources. The adoption of biological methods in agriculture is enshrined in European Laws, after transposing Directive 2009/128 / CE of the European Parliament and of the Council, of 21 October, which established a framework for community action to achieve sustainable use of pesticides and full use of the potential of ecosystem services. In my talk I will present past and current projects in which eco-friendly agricultural practices, mainly the use of natural enemies, were developed, not only for agricultural system but for forestry systems, as well.

Does the exclusion of birds and bats affects rice yield? A field experiment in West Africa

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Abstract

Rice is a highly nutritious staple food cultivated globally. In West Africa, herbivore arthropods cause significant damage to this crop. Hence, urgent efforts are needed to increase rice productivity and diminish yield loss. To examine the top-down effects of insectivorous aerial predators, such as birds and bats, on rice productivity and plant damage due to insect herbivory, we conducted an enclosure experiment on lowland rice fields in Guinea-Bissau. We sampled 14 pairs of enclosure-control areas, measuring arthropod abundance during the rice growing cycle and assessed rice yield at harvest time. Results show that arthropod abundance is higher when predators were excluded and this higher abundance was positively related to defoliation in rice leaves. However, it was not sufficient to impact rice yield since no differences were observed between treatments. This study revealed that, while birds and bats can effectively suppress pests, their role in protecting yield was not apparent. Given the high human dependence on rice, urgent action is needed to protect and increase arthropod pest predators so that their pest suppression can reduce crop losses and increase yield. These ecosystem services offer a nature-based solution to control pests and reduce the use of chemical pesticide in rice fields. Implementing policies to conserve aerial vertebrate predators have the potential to increase rice pest suppression, enhancing food security and avoiding productivity loss.

Mycorrhizal inoculation affects wheat growth and gene expression under manganese stress

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Abstract

Arbuscular mycorrhizal fungi (AMF) are soil-inhabiting fungi that form symbiotic relationships with most terrestrial plants and can enhance plants' performance under various environmental stresses, including heavy metal stress. Manganese (Mn) is a micronutrient essential for plant growth and development, but once in excess it can have highly detrimental effects. This work aimed to study the effect of AMF inoculation on wheat (*Triticum aestivum* L., var. Ardila), in a context of Mn toxicity. Wheat plants were grown in a sterilized soil, inoculated or not with the AMF species *Rhizoglyphus irregularis*, under greenhouse conditions. Half of the pots were supplemented with 7.5 ppm of Mn. Fresh weight (FW) of the plants was measured after 7 weeks, and samples were taken for evaluation of root colonization, reactive oxygen species (ROS) determination and gene expression. Colonization rate was not altered by Mn addition. However, shoot FW was higher in inoculated plants. ROS production significantly decreased with AMF inoculation under Mn stress. The Mn-specific transporter MTP8.1 increased with AMF in the Mn treatment. For the genes related with oxidative stress, APx and GPx increased under Mn stress, catalase increased with Mn-addition only in non-inoculated plants, and thioredoxin increased with Mn addition in inoculated plants. This work showed that AMF inoculation seems to alleviate Mn-toxicity in wheat, and contributed for the elucidation of the molecular mechanisms controlling Mn tolerance. It further contributes for the development of sustainable crops management in a broader context of abiotic stress responses.

Molecular-assisted breeding for a more sustainable national rice production

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Abstract

Portugal is the 4th largest producer and the largest consumer of rice in the EU, with an equilibrated production/consumption rate. Carolino rice varieties are exclusive to Portugal just as Spain has rice specific for paella or Italy for risotto. Carolino has the special characteristic of retaining cooking flavors, being preferred for traditional dishes. However, Portugal mostly cultivates varieties selected abroad and not so well adapted to local edaphoclimatic conditions or consumer's taste. Additionally, the majority of national Carolino is exported, while imported rice for consumption increases, and with it, unnecessary carbon footprint. The National Rice Breeding Program has the main goal to produce new Portuguese rice varieties, especially Carolino, well adapted to the national (or even regional) climate and suited to all stakeholders: farmers, industry and consumers. The breeding process is extremely labor intensive and time consuming taking over 10 years to obtain a new variety. At present, we are using SSR molecular markers to assist the breeding process. The analysis of the available rice germplasm collection exposed five populations, one of which constitutes the current set of parents. Dendrogram analysis clearly reveal 3 major diversity groups. The PCA shows some degree of diversity with the current set of parents clustering together. Our goal is to identify marker genes to select for characteristics of interest, like disease susceptibility, grain quality and yield and by doing so, decrease the time to obtain new, better

adapted, varieties. Varieties tailored for local conditions and responsible consumers educated to choose homegrown products may be key for a more sustainable rice production.

Caravana Agroecológica

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Abstract

Evidence suggests that food systems sustainability can be achieved more effectively if all its actors are engaged. This premise led to the creation of the Agroecological Caravan (AC) in 2019. Since then, the AC has developed and implemented different initiatives rooted in the engagement, capacitation, and connection of all food system stakeholders. The Agroecological Routes involve visits to agroecological experiences across continental Portugal by farmers, policy makers, the media, and consumers. The Farmers Open Days bring together producers and consumers in one place where farmers with sustainable practices present and sell their products, a Chef prepares food with these products and an open conversation on agroecological topics is held. The Agroecological Vegetable Gardens promote the use of agroecological practices and experience-sharing in and between schools and other institutions. So far, the AC have organized 18 Agroecological Routes, 7 Farmers Open Days and collaborated with 34 schools/institutions. With these activities the AC have established a solid network of 125 sustainable farmers and partnered in projects with 27 municipalities. Also, with COVID19 Pandemic the AC have started the AC Radio online live program in which agroecology topics and experiences are presented and discussed with invited farmers, researchers, or policy makers. The AC have already done 95 radio programs. In sum, the Agroecological Caravan is creating opportunities to bridge the gap between consumers, producers, researchers, and policy makers. The joint and coordinated action of all these players will hopefully contribute to the ecological, economic, and social sustainability of the food system.



Sustainable management of contaminated soil – the challenges ahead

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Abstract

The European Green Deal and its cross-connected policies express the need to protect, conserve, and enhance the natural capital of the European Union, counteracting the risks and impacts of unsustainable practices. Although extensive legislation is in place to protect air and water (Directive 2008/50/EC and Water Framework Directive, respectively), the soil legislation is still in its infancy. This is one reason why soils are not adequately preserved despite their crucial ecological services (such as food production, water filtration, management, biodiversity hosting, nutrient cycling, climate change mitigation, etc.). To counteract this situation, one of the main goals of the upcoming Soil Health Law is to dramatically improve soil conditions by the year 2050 and give soils the same legal protections as air and water. Thus, there is a need to provide tools to support the upcoming Soil Health Law and the Mission "A Soil Deal for Europe", extend the framework for sustainable management of contaminated soils.

Implementing a new long-term network to monitor the effects of air pollution in terrestrial ecosystems in Portugal

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Abstract

Monitoring the effect of air pollution on terrestrial ecosystems in Europe, and related research, has been mostly focused on forests through the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests), launched in 1985 under the Air Convention (formerly named CLRTAP-Convention on Long-range Transboundary Air Pollution), following discussions on strategies and policies to reduce air pollution, at the time focused on sulfur compounds. Recently, the National Emissions reduction Commitments (NEC) Directive required that Member States establish ecosystem monitoring networks, with site selection following a risk-based and cost-benefit approach by defining a set of criteria to include spatial and ecosystem representativeness, and higher sensitivity of ecosystems to air pollution. In Portugal, representative ecosystems include (i) woodland and forests, (ii) grasslands, (iii) heathland and shrub, and (iv) croplands. In each monitoring site a set of parameters must be frequently measured, including air, soil, leaves, and soil pore water chemistry as well as biodiversity metrics, focusing on the effects of sulfur, nitrogen, and ozone. On the European scale, many countries will limit their network to well-established preexisting ICP Forest sites. However, some countries, such as Portugal, do not have active ICP Forest monitoring and need to create a network from scratch. This offers as much of a challenge as it does an opportunity. Here we describe the steps taken in the selection of 24 new monitoring plots, the factors that most limited the site selection, strengths, and weaknesses of the new Portuguese long-term monitoring network.

CitySelfy project - Assessing the self-sufficiency of natural resources at local scale as a driver for sustainability transition: the case of water-energy-food nexus

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Abstract

As more than half of the world's population now resides in urban areas, cities have become major contributors to the unsustainable use of Water-Energy-Food (WEF) resources. This in turn has create a negative multiplier effect throughout the WEF supply chain. Self-sufficiency has been adopted as a driver for sustainability as cities may have the ability to support the services and activity necessary while avoiding the resorting to external resources and satisfy its needs from its own endogenous resources. CitySelfy aims to focus on WEF resources used within the city boundaries, explicitly considering their interlinkages, to show how healthy food, safely managed water, and affordable, reliable, and modern energy services can be provided endogenously to its inhabitants without hampering the city's sustainability in the future. It will consumer profiles and possible paradigm modifications from centralized productive models to decentralized ones. CitySelfy will use a survey to collect information on citizens social preferences and economic profiles, including their willingness to accept and pay for new technologies and products. The results will inform WEF demand scenarios and local production potential, which will be fed into an WEF system optimization tool applied to the municipality of Cascais. Several levels of self-sufficiency and climate change impacts projected for the region will be tested, and their impact on city sustainability will be assessed, taking social, economic, and environmental indicators into account. The key outcomes of CitySelfy will include future optimal configurations for the WEF systems up to 2060/70, such as decentralized power, urban farming systems, and water harvesting solutions, corresponding to different levels of self- sufficiency and sustainability.

Soil Microbiology: an important ally for plant growth and resilience

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Abstract

The Soil Microbiology Laboratory-MED is dedicated to the study of soil microbes and their role in promoting plant growth, health and resilience. From applied research, which is often developed in close collaboration with farmers, to fundamental research focusing particular microbial genes, the main goal of our research is to promote the role of soil beneficial microbes, with special attention on key agroecosystems. We are especially interested in microorganisms able to establish mutualistic symbioses with plants, as is the case of arbuscular mycorrhiza fungi or rhizobia, as well as in the role of other plant-growth promoting bacteria. Soil microbial diversity and activity is closely related to soil health. The importance of soil microbes is gaining increasing attention and has been a major concern in the latest European Commission policies. In fact, the soil microbiota should be regarded as a resource to manage and an important player in the agronomic decision process. Our ongoing research lines include i) monitoring the soil microbial activity in several agroecosystems (Montado, vineyard, tomato, eucalyptus forest), in order to better understand the impact of different agronomic practices on the soil microbiota; ii) set up agronomic strategies that allow a better use of the soil microbiome; iii) studying the molecular mechanisms of beneficial plant-microbe interactions; iv) understanding the driving factors of belowground microbial communities assemblies; v) evaluating the ability of synthetic microbial communities (SynComs) to protect plants from (a)biotic stresses; vi) understanding how remote sensing can be used to monitor soil microbial activity, plant health and production quality.

Water scarcity under a changing climate: managing multipurpose reservoirs in the Mediterranean

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Abstract

Water scarcity is a reality in several parts of the world, and climate change scenarios foresee increasing pressure on water resources. This is very relevant in areas such as the Mediterranean, with significant impacts on future water availability for agriculture and human consumption. This work will present the results of climate change effects on future water availability, in two multipurpose reservoirs that are part of a system that provides water to several municipalities in the region of Évora, as well as to agriculture in an area of about 3000ha. This supply system currently receives water from the Alqueva reservoir and is dependent on this transfer to be able to provide the necessary reliability of these reservoirs. The results show that the proposed approach can ensure 100% of the urban water supply, improve the reliability of the irrigation supply from 75% to 86–91%, and provide 92–98% of the river ecological flow. The results obtained in this project have the potential to be replicated to other water supply systems with clear benefits to multiple purpose waterbodies management. Benefiting from this potential and associating the application of these models to climate change scenarios, the evaluation of the impacts to land use or the adoption of more sustainable farming practices is a determinant result to define management strategies, minimize risks and develop adaption strategies for an Integrated Water Resources Management (IWRM).

Greener methods for the analysis and remediation of pesticides in soil

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Abstract

Soil is a necessary support for life on land. It is well known that contamination from anthropogenic compounds is a significant driver in the reduction of soil quality and thus impairs ecosystem services. Our work has two drivers: firstly, the development of a novel methodology for quantifying currently used pesticides in soil (including the particularly difficult analyte glyphosate), which is more in line with green analytical chemistry principles than currently used methods; and secondly an electrokinetic remediation strategy which focuses on the most important pesticides contaminating EU soils, as well as the determination of their degradation products. By combining the two methodologies we hope to provide an integrated platform for assessment and remediation of pesticide soil contamination.

Contribution to the flood risk management policy - Vulnerability assessment

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Abstract

Over the last decade, flood disasters have affected millions of people and caused massive economic losses. At a time when the effects of climate change on the occurrence of natural disasters are becoming more and more evident, it is essential to develop research that will lead to an appropriate and technically based spatial planning policies, in order to reduce the vulnerability of populations living in flood-prone areas. We developed a multi-criteria analysis methodology for decision support to assess vulnerability to flood risk, which was used by the Portuguese Environment Agency in the areas of significant potential flood risk, constituting the Flood Risk Management Plan for the eight hydrographic regions of Portugal. The study was developed at the neighbourhood level, allowing for vulnerability analysis at inter civil parish, intra civil parish, and municipality scales. The geographic information system-based multicriteria decision analysis (GIS-MCDA) allows for an increased understanding and improved monitoring of vulnerability over space, identifying ‘hot spots’ that require adaptation policies. The index was recently updated by coupling Geographic Information System mapping capabilities with an Analytic Hierarchy Process Group Decision-Making. A survey was sent to 25 flood experts from government organisations, universities, research institutes, NGOs and the private sector (56% academics and 44% non-academics). The flood vulnerability index was calculated and the relevance of the proposed framework is demonstrated for flood-prone areas, in mainland Portugal. The results showed that in all hydrographic regions, flood-prone areas with very high vulnerability were found, corresponding to areas with a high probability of flooding.

Eco-hydrological solutions for ecosystem services under global change in Mediterranean watersheds

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Abstract

This paper aims to summarize the research conducted over the past three years in the field of eco-hydrology. The work carried out has contributed to quantifying the benefits of natural-based solutions (NbS) in mitigating water pollution, soil erosion, and water scarcity, using various Mediterranean watersheds as a case study. NbS have been evaluated in different contexts of global change, whether associated with climate change, changes in agricultural practices, or impacts resulting from rural fires. In this context, the assessment of natural-based solutions (NbS) involves the use of eco-hydrological models such as SWAT or OpenLISEM. These approaches were employed to analyze the benefits of implementing practices such as riparian vegetation [1,2,4], mulching [2,4], conservation tillage [2], water conservation practices [2,3], or land use changes [2,3]. The evaluation was conducted in some areas, including Almonda [1], Sorraia [2], Odiáxere [4] catchments, and the Algarve region [3]. However, the effectiveness of NbS is influenced by various soil and climatic factors, which is why a meta-analysis is currently being developed to obtain a better understanding of the benefits of these solutions in regions with a Mediterranean climate [5]. Through the integration of the various research studies presented, this paper seeks to summarize the impact of eco-hydrological processes on NbS in ecosystems that are particularly susceptible to global change, such as those in Mediterranean climates.

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Integrated valorisation of Agricultural Plastic Waste as a strategy to improve and restore soil properties

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Abstract

The agricultural sector generates a significant amount of plastic waste, which if not properly managed poses a threat to the environment. This paper introduces an overview on valorisation options of agricultural plastic waste which include recycling, energy recovery, pyrolysis, hydrothermal carbonization and hydrogen production.

The publication addresses the importance of the application of an holistic approach to tackle challenges related with agricultural plastic waste and soil recovery, combining sustainable waste management practices, implementation of robust collection schemes, plastic waste recovery and soil restoration strategies which all together, will ultimately lead to improved soil health and crop yields.

The research will enumerate possible approaches to integrate these strategies in various agricultural settings, including policy recommendations to support sustainable waste and soil management practices.

4

Promote a circular and carbon neutral economy



Exploring Energy Poverty and Buildings Energy Efficiency at Multiple Scales: Research, Policy Support, and On the Ground Action

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Abstract

The team studies energy poverty (EP), energy efficiency (EE), sustainable cities and buildings, and just and sustainable energy transitions. We are anchored on a robust transdisciplinary science-based approach leveraged by different expertise and a wide group of partners at a global scale. Our activities range from multiscale research projects and policy support to private and public consultancy projects. A strong outreach component is critical for global systems transformation, and thus we promote our activities through various channels. This presentation focuses on our research and projects, presenting the multilevel analyses conducted on EP mitigation and EE improvement to support different agents. EP and Buildings Energy performance indexes for regional mapping; and a public database of over 150 EE measures are relevant Tools and Materials we have developed. Regarding Public Policy Impact, we have been on the advisory team for the development of the National Energy Poverty Mitigation Strategy (2022-2050), key partners of the Carbon Neutrality Roadmap 2050, co-development of the EU Covenant of Mayors Guidelines for EP diagnosis, sector lead on Local and Regional Scale Climate Change Mitigation and Adaptation Plans, and part of the EU Energy Poverty Advisory HUB coordination team. We are a key partner of the Ministry of Environment and Climate Action, successfully leading the evaluation of four key RRP EE-related programs. We also have on the Ground Action flagship projects: Ponto de Transição, a physical one-stop-shop operating in a reused shipping container, and the Menu Renovação Verde digital EE platform, helping homeowners improve the sustainability and comfort of their homes while reducing energy bills. Overall, we are committed to informing society, national and local policymakers, and businesses for impactful and effective decision-making to tackle energy poverty and mitigate climate change.

Informing well-designed public policies and better decisions through co-creation processes

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Abstract

Complex environments and ongoing global changes call for strategies that accommodate multiple types of knowledge. Recognising the diversity of expertise required to address the challenges in socio-ecological systems and the pursuit of sustainability visions is an essential advantage. In this context participation is vital, especially within co-creation processes that combine mix-method approaches. A decision-maker often does not have all the resources needed to understand the fundamental aspects of a problem, which leads to the need to engage multiple perspectives. To address complex environmental problems, political agendas and business strategies should be aligned in integrating a systemic approach toward sustainability. Designing processes that integrate and interlink different participatory methods is essential for better decisions and well-designed policies that respond to different future scenarios. Recognising the importance of these collaborative processes, which should be framed and adapted to specific contexts, is aligned with contemporary scientific methods included in a transdisciplinary perspective and allows more inclusive approaches. The research that we have been conducting in CENSE, aims to understand how we can deepen the understanding of complex systems such as socio-ecological systems, low carbon neutrality, and circular economy, through the integration of participatory mix-method approaches and how these processes may be designed to better respond to current sustainability challenges. Which are the best suitable tools and methods, and in which format should they be combined? Who should be engaged, in what phases and how? Two concrete cases, where we had applied co-creation processes to support public policy development will be presented. The National Strategy on Green Public Procurement ECO360 (RCM, 2023¹) and the National Carbon Neutrality Roadmap 2050 (RCM, 2019²). Both policies aim to support circular economy and energy transition and benefited from the collective intelligence fostered by the co-creation processes.

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Stakeholder Perspectives of Portuguese carbon neutrality and energy poverty policies

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Abstract

Shifting to a circular and carbon-neutral economy has implications for contemporary production and consumption models of both goods and services. Citizens depend on energy services to support their daily needs, such as heating, cooling, and the use of domestic appliances. An inability to achieve a sufficient level of access to these services is known as energy poverty (EP). European policy makers seek to capitalize on the potential of energy transitions (ETs) to redress inequalities such as EP in tandem with addressing global climate change (CC). ETs offer the possibility to contribute to multiple policy goals simultaneously and to ideals of circularity by promoting renewable resources. However, trade-offs, such as the gentrification of areas due to domestic retrofit activities, can also occur. Portugal has rapidly progressed in its ET implementation; however, EP remains problematic, suggesting that an improved understanding of the inter-agenda interactions can inform improved policy outcomes. In 39 stakeholder interviews, we explored how these agenda interactions were perceived by stakeholders with diverse interests and at different operational scales. Given that the success of ETs and associated policies ultimately depends upon stakeholder acceptance, we find this participatory approach highly informative for highlighting policy synergies and trade-offs. Our findings reveal a general consensus among stakeholders that CC, ET, and EP agendas should be linked but unearth differences in opinion on how this transpires at the practical level. Understanding these different perceptions and their implications for policy design is ultimately informative for achieving maximum policy benefits and reducing trade-offs.

The role of infrastructural megaprojects in socio-metabolic transitions: long-term dynamics of ecosystem services resulting from land use transformation in the context of large-scale renewable energy projects

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Abstract

Infrastructural megaprojects (investment >1 billion US\$) are shaping the socioecological contexts and landscapes of entire regions, substantially altering long-term human-nature-interactions. They are generally justified in their capacity to foster economic growth and enhance access to natural resources or energy. Infrastructural megaprojects often have a key function regarding societal transition to a low carbon future, when these projects aim at producing renewable energy such as hydrological dams or solar- and wind parks. In arid and semi-arid regions, hydrological dams often fulfil multiple functions by not only providing electricity but also water for human use, irrigation and recreational purposes. Their significance for climate change adaptation and mitigation in combination with often severe regional environmental impacts thus sets their ambivalent role in sustainability transitions research. In my research I aim at combining Sociometabolic Research (SMR) and Ecosystem Services (ESS) conceptual frameworks to assess multiple aspects of land use transformation in the context of large-scale renewable energy projects. The identified research gaps point towards the lack of studies assessing 1) this ambivalent role of infrastructural megaprojects for sustainability transitions research and 2) quantification of synergies and trade-offs between ESS in transforming agroecosystems on a landscape scale. I thus aim at advancing and combining these two distinct lines of research and contribute to the development of a sociometabolic conceptual approach for the assessment of long-term impacts of infrastructural megaprojects. The proposed Sociometabolic Research (SMR) approach utilizes the Human Appropriation of Net Primary Production (HANPP) conceptual frameworks to quantify processes of rapid land use transformation in the vicinity of large-scale energy projects in Portugal. HANPP allows for the definition of indicators that link socioeconomic and ecological inputs with outputs of agroecosystems and is thus highly compatible with the ESS frameworks.

Participatory Methods in Stakeholders' Value Formations for Just Energy Transitions: A Systematic Literature Review

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Abstract

In this article, motivated by the quest to find ways for further incorporation of social ecological economics methodologies into transitions research, and for assessing in particular their impact on energy policy, we critically review the use of participatory methods in just energy transition literature. In this regard, our review targets four key groups of questions: (1) Which methodologies are employed to study indicators for just energy transitions? Which participatory methods are used in this area of study? (2) Who are the main stakeholder groups considered and how are they identified? What are the methods of engagement, and the role of just transition agencies on the stakeholders' values towards just energy transitions? (3) What are the themes and issue areas that have been covered in the literature (i.e., legal and political context, justice meaning, potentials and challenges of just energy transitions, data sources and generalizability of indicators)? (4) What is the added value of participatory methods in eliciting stakeholders' values, in promoting justice, and in contributing to energy policies? Our analysis is based on a systematic review of 42 articles from the years 2010-2023, based on relevant research strings through Scopus and Web of Science. Findings show that participatory methods are prevalently employed to analyze environmental justice and energy policy strategies at the local level, while transition to renewables is mainly studied as a just energy transition alternative. We conclude that participatory methods enable stakeholders and policymakers to widen the energy policy discussion to account for plural values of stakeholders involved in a more complex socio-ecological system.

Challenges and opportunities around effective and just wind energy in Portugal

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Abstract

The JustWind4All research project aims to accelerate the development of on- and offshore wind energy, including emerging technologies, through effective and fair governance. By integrating insights from various disciplines and societal perspectives, the project facilitates coordination and participation in wind energy actions. This abstract focuses on Work Package 3, led by the FCIências.ID team, which aims to comprehensively analyze effective and just wind energy governance. Specifically, it seeks to understand and promote energy citizenship in wind energy, fostering harmonious configurations between people, nature, and technologies, and enhancing local value creation. The objectives of this work package include creating a database of participatory practices, analyzing regional challenges and opportunities, understanding diverse perspectives on wind energy implementation, and organizing interdisciplinary dialogues for knowledge exchange. This presentation will focus on Task 3.2, which involves understanding regional challenges and opportunities in wind energy governance over the past 5-10 years and formulating recommendations for fostering energy citizenship. A mixed-method approach is employed, including document reviews, interviews with governance actors, and media and policy analysis. Comparative analysis across cases and regions allows for a better understanding of effective and fair wind energy governance. Our work focuses on the center-north region of Portugal, examining public participation and the history of wind energy. Preliminary results from document reviews and interviews will be shared, along with the expected future research direction of this task.

The role of green electricity and hydrogen in North Africa decarbonization: endogenous potentials, exports and challenges

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Abstract

The Maghreb countries (Tunisia, Morocco and Algeria) have committed to decarbonizing their electricity sectors in accordance with the Paris Agreement. However, the path towards achieving these goals is complex and challenging. This thesis presents an in-depth investigation of the power sector transition in the region, examining a wide range of technology options and system peculiarities using the TIMES model. The research seeks to answer key questions about the feasibility of meeting decarbonization targets, and the costs involved, as well as exploring the potential role of cross-border transmission lines and electricity trade in achieving these goals. To complement this analysis, the study employs SWOT (Strengths, Weakness, Opportunities and Threatens), analysis and semi-structured interviews to examine effective policy and regulatory frameworks for promoting the adoption of renewable energy technologies in The Maghreb countries. The research aims to identify approaches that can overcome economic, social, and environmental barriers, while also engaging and empowering local communities and consumers. The thesis also delves into the role of green hydrogen in power sector decarbonization in The Maghreb, exploring how it can establish mutually beneficial cooperation between North African and South European countries. The thesis's overarching goal offers a comprehensive and integrated approach to the power sector transition in The Maghreb countries. It provides valuable insights into effective policy and regulatory frameworks for promoting renewable energy adoption and explores the potential of cross-border cooperation and green hydrogen. The research findings can support policymakers, investors, and other stakeholders in making informed decisions towards achieving a sustainable and decarbonized energy system in The Maghreb.

Exploitation of the European TIMES model to focus on the role of green hydrogen trade in a carbon-neutral economy

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Abstract

Among the several carbon-neutral solutions identified to achieve a decarbonized energy system by 2050, hydrogen is gaining importance, recognized as a key player of the transition process, specifically if produced by water electrolysis enabled by renewable energy – the so called green hydrogen. Through the exploitation of the JRC-EU TIMES modelling, this work aims to assess opportunities and challenges of potential cross-border cooperation between North Africa and Europe in terms of green hydrogen production and trade. In order to discuss in which conditions it can be competitive, alternative scenarios are built through the exploitation of specific costs and amounts, modelled with respect to different assumptions related to the land suitability, local policies, financial and political risks. Specifically, the high availability of renewable energy sources in North Africa, the increasing European hydrogen demand in the next decades, the infrastructure availability, the technology readiness, the social acceptance, the geopolitical conditions and the environmental issues, are the different elements – often in conflict – that make an alternative competitive or not. Through the lens of the TIMES modelling, it is possible to account for the complexity of the whole energy system and to assess specific carbon-neutral pathways for Europe. Specifically, this study allows to support policymakers towards the definition and implementation of effective energy strategies, focusing on the crucial role that green hydrogen could have in the decarbonization process, if new competitive markets and cooperations are developed.

What is the role of circular economy towards carbon neutrality?

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Abstract

In the last decades, the concept of Circular Economy (CE) has gained notoriety as a solution to promote sustainable consumption and production practices, as well as the preservation and regeneration of natural resources. By improving resources efficiency and reducing resources and energy consumption, the CE has the potential to limit Greenhouse Gas (GHG) emissions, as currently approximately 50% of GHG emissions are caused by natural resource extraction and processing. Despite these benefits, there is still a lack of synergies between climate mitigation and CE in both policy and modelling research. Integrated assessment models (IAM) play a key role in informing policymakers about the cost-effectiveness of decarbonisation options and energy transition needs. However, they do not represent the impact or potential of CE strategies for climate change mitigation, as they do not depict material stocks and circular flows. As part of the EU CIRCUMOD project, this research aims to address this gap by developing an integrated modelling approach that combines mitigation and material flows modelling to assess the contribution of various CE strategies and policies towards EU carbon neutrality. The research will enhance the open source JRC-EU-TIMES model to provide environmental and socioeconomic sound answers to the future of the EU carbon neutrality. The results of this study will inform CE and climate policy, including the role of CE in the specification and benchmarking of nationally defined contributions (NDCs) of the Paris Agreement. These insights are crucial, as current climate mitigation policies still fail to achieve the rapid decarbonisation needed to limit the increase of the global average temperature to below 1.5°.

CHANGEMATs - Changing from Polymer Wastes to Adsorbent Materials

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Abstract

This Communication presents some of the results of research developed and ongoing in recent years, focusing on the use of polymeric wastes, mainly of natural origin. Some examples of synthetic wastes, in particular when combined with wastes of natural origin, will also be addressed. The use of these wastes, some of which are considered to be problematic wastes, is based on a strategy of transforming them into adsorbent materials, materials with a porous structure and a more developed surface chemistry, and thus into their valorisation. There are two ways in which this value creation can take place: firstly, by contributing to the reduction or elimination of waste that poses an environmental problem, and secondly, by transforming this waste into materials with added value, such as adsorbents. Examples of the use of these materials, from laboratory to field scale, will be presented in the form of scientific articles, projects and other initiatives. The knowledge generated is intended to contribute to the development of a set of results that, by being made available, will be accessible and can help, and perhaps influence, public and private sector decision making in the positive direction of a necessary global change.

5

Strengthen Territorial Cohesion to reduce disparities



Rethinking governance models in natural resource management - networking knowledge and people by systems thinking

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Abstract

Is academia the main driver of knowledge production? Are academics the care takers of sustainability? As knowledge production, communication and dissemination evolves, what does that mean for academia? As Research & Development spreads and integrates several societal sectors, how should we perceive science and policy interface? In this talk we will propose that academia is one of many contributors in a knowledge network that grows larger and more complex at fast pace. We will look in detail how dialogue platforms (e.g. multi-stakeholders' platforms, living labs, lighthouses) can play a key role in the future of academia by securing a safe space for knowledge exchange and co-production. We will discuss how procedures for the development and operationalization of these platforms need to be looked at from a scientific perspective. The benefits of monitoring the development of networks and of knowledge exchange is fundamental to secure that such platforms reach the intended goals. Our proposal is that the dialogue platforms can benefit from a social-ecological perspective, pragmatism, systems and critical thinking. If spaces for dialogue (between academics, the private sector, public administration and policy makers) are operationalized using these concepts and approaches, our hypothesis is that current social and social-ecological networks can induce important changes in societal and scientific practices.

Exploring degrowth policy proposals

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Abstract

Degrowth - the planned and democratic reduction of production and consumption as a solution to the social-ecological crises - is slowly making its way to the sphere of policy-making. But there is a problem: proposals are scattered through a voluminous literature, making it difficult for decision-makers to pinpoint the concrete changes associated with the idea of degrowth. To address this issue, we conducted a systematic mapping of the degrowth literature from 2005 to 2020 using the RepOrting standards for Systematic Evidence Syntheses (ROSES) methodology. Out of a total of 1166 texts (articles, books, book chapters, and student theses) referring to degrowth, we identified 446 that include specific policy proposals. This systematic counting of policies led to a grand total of 530 proposals (50 goals, 100 objectives, 380 instruments), which makes it the most exhaustive degrowth policy agenda ever presented. To render this toolbox more accessible, we divided it into 13 policy themes – food, culture and education, energy and environment, governance and geopolitics, indicators, inequality, finance, production and consumption, science and technology, tourism, trade, urban planning, and work – systematically making the difference between goals, objectives, and instruments. Following this, we assess the precision, frequency, quality, and diversity of this agenda, reflecting on how the degrowth policy toolbox has been evolving until today.

The contribute of administrative decentralisation to environmental management and protection: The case of Portuguese coastal municipalities

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Abstract

The process of administrative decentralisation (AD) is a crucial in governance; it is based on the transfer of responsibilities or competences from central government to lower levels. This hierarchical and complex process, however, can be further challenging when there are large disparities in the territory and competences are transference homogeneously where administrative boundaries do not coincide with territorial and ecosystem boundaries. Furthermore, those who receive the transference may not always have the capacities and/or interest to assume them. As such, our research aims to elucidate how an administrative process of transferring competencies from the central to municipal level can contribute to environmental management and protection (EMP). To achieve this goal, we conducted interviews with scholars and experts to identify clear and measurable competences that enable the contribution of AD to EMP. We also conducted an online survey to Portuguese coastal municipalities to gain a better understanding of what coastal municipalities want and can take on. Our findings suggest that AD can contribute to EMP if municipalities, considering their differences, share an integrated vision of their municipality and territory. This integrated vision is based on three fundamental pillars or enablers which are: Financial and political autonomy; Political, human and resource capacity; Multi-level participation and collaboration. These pillars identified by the experts are essential for municipalities to have an advantage within the territory and thus influence local and national policy in order to improve the lives of their citizens, always within the limits of ecosystems and maintaining the central administrative level. For further studies, it is important to explore multi-level participation and collaboration, specifically the types of Participatory Processes used at the local level and their transdisciplinary applications in the pillar of "Multi-level participation and collaboration" on environment and sustainability topics.

Landscape Approaches in Mediterranean Portugal; why?, how?, when? where?...and so what?

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Abstract

Introduction (why?, and what?)

Landscape approaches (LAs) aim to foster multi-functional and sustainable land-use governance. LAs have been implemented to reconcile landscape protection, climate change adaptation and mitigation, food security, and biodiversity conservation. They are especially well suited for the coordination and cooperation amongst multiple actors and institutions. However, few examples of LAs are yet found across the Mediterranean, a hotspot for biodiversity conservation, food production and climate change.

In this paper we examine the potential and limitations of LA for implementation in the Mediterranean bio-climatic region of Portugal. To do this, we will examine the alignment between 3 land-use pressures relevant in this context and the 10 LA principles, to then discuss more broadly the conditions, benefits, limitations, and opportunities to implement these principles via specific action plans that are tailored to local social-ecological conditions. The 3 pressures examined are: A) Water Over-Exploitation, B) Agricultural Soil Erosion, and C) Landscape Homogenization.

Methods (how?, when?, and where?)

An exploratory review of the scientific literature was combined with results and lessons learnt across the 10 plus research projects examining agricultural land-use and sustainability on which the author has been directly involved over the past 7 years. Finally, the results obtained throughout these exercises were paired with the 10 LA principles to disentangle any mutual overlaps in the form of opportunities and limitations.

Results and discussion (...and so what?)

Results point out to various degrees of severity in the presence of opportunities (in green) and limitations (in red) for tackling each of the 3 pressures addressed via implementation of a LA:

PSVA Findings	A) Water Over-Exploitation	B) Agricultural Soil Erosion	C) Landscape Homogenization
1: Continual learning and adaptive management.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
2: Common concern entry point.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
3: Multiple scales.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
4: Multifunctionality.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
5: Multiple stakeholders.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
6: Negotiated and transparent change logic.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
7: Clarification of rights and responsibilities.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
8: Participatory and user-friendly monitoring.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
9: Resilience.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓
10: Strengthened stakeholder capacity.	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓	↓ ↓ ↓ ↓ ↓ ↓

Results obtained so far indicate a clear overlap, and although preliminary, we can conclude the following:

Clear opportunities are in place for the consolidation of a LA in Mediterranean Portugal, although those opportunities are generally stronger for those pressures (e.g., water over-exploitation) where institutions are already in place, and where a clear economic logic drives these institutions.

Nonetheless, limitations are also detectable across all 3 challenges, being in this case stronger where stakes are less clear and governance is more fragmented (e.g., landscape homogenization).

Regenerative governance: the (trans)local coproduction of a systemic and integral approach to transformation in tipping point times

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Abstract

Communities are asked to transform deeply and fast to face the unfolding global polycrisis. This transdisciplinary research wants to explore how communities can use innovative governance approaches to support the development of (trans)local transitions. We adopted critical participatory action research and focused on developing spaces where renewal can be nurtured in the context of reorganization. This approach is expected to lead to new agreements and actions. Still, it is primarily designed to facilitate multi-stakeholder learning processes and open the floor for the emergence of new shared meanings. The research process was based on two initiatives nested in the Transition movement, namely Municipalities in Transition and Dive Deep & Dream Big. The Transition movement is one of the most significant examples of local communities leading the way to a post-carbon society. The movement is spread worldwide and demonstrates a distinctive openness for collaborations, providing, therefore, an experimental space with transformational ambition. In this communication, we want to share the outputs and outcomes of these two bridging exercises. We present a structured and replicable governance approach capable of catalysing and supporting inclusive change at the local scale. This approach involves connecting the support of change-makers, the welcoming of trauma, and the exercise of creativity, together with the acceleration of systemic collaboration. This regenerative governance approach is expected to support disruptive public policies and leverage change. Additionally, we want to present the ongoing process of creating a Local Climate Action Centre in Póvoa do Varzim, in a partnership between Academia and Local Government.

Result based agri-environmental to support the resilience of Montados: a pilot of science-policy-practice interface

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Abstract

The Montado is increasingly threatened, and its total extension decaying each year. Agricultural intensification and specialization are increasingly driven by external financial interests and global market forces, and consequently the patterns of farm ownership, employment and production are changing at an unprecedented scale. In face of these pressures, finding new pathways for the farming strategies and practices is highly challenging. The Common Agriculture Policy (CAP) has opened up for performance based payments in the agri-environmental schemes. In different policy areas, the Commission is turning into payments by results, instead of payments by activities. In the agro-environmental programme, this turn foresees tailor made solutions focused on environmental outcomes, not processes, benefiting farmers who go beyond the minimum required, in terms of environmental performance. More conventional agri-environmental instruments based on the payment of selected practices, are to be partially replaced by payments for measurable results in terms of biodiversity, soil degradation neutrality, climate change mitigation, and landscape quality. And while farmers are delivering environmental outcomes, they are also working for the regeneration and long term resilience of their Montado. The result based payment for the Montado is a pilot, applied in the present CAP in Portugal, in two areas. Its application is coordinated by MED. We will present the programme and its construction, and we will assess the drawbacks and successes of the science-policy-practice interface required for its implementation.

A Contribute of Science for the co-creation of local policies: the case of Ferreira do Alentejo's Programme for the Valorisation of Commerce and Local Products

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Abstract

MED-CEBAL develops scientific and technological knowledge in biotechnology field applied to agriculture-related areas and combines it with a strong strategy based on knowledge and technology transfer, providing tailored made solutions for farmers and agro-food industries, as well as for municipalities and other public and non-public stakeholders. MED-CEBAL advanced in a new approach for management and development of knowledge and technology transfer and innovation in Alentejo, narrowing liaisons between regional actors and providing more focused, adapt and collaborative activities, fostering technological and rural development processes. The Municipality of Ferreira do Alentejo embraced this model and integrated it in its governance strategy, and in October 2018 it established a cooperation protocol with CEBAL for the creation of a decentralized Technology Transfer unit. The challenges of Ferreira's territory in what concerns to agriculture and agri-food sectors were exploited between both partners. Ensuring social cohesion, the diversification of local economy, the protection of the environment and the promote of local Identity, were the four key drivers identified. But there was a particular focus on local identity, as the municipality intended to augment its commitment to the promotions of endogenous products; to affirm material and immaterial heritage and to promote community involvement.

For that, a close connection to small producers was promoted, and producers' auscultations were also performed to obtain their opinions and needs in relation to the municipality support. In addition, a close analysis to the short food supply chains in the county, was also performed. As a result, the Municipality created a local policy called "Programme for the Valorisation of Commerce and Local Products", which includes a set of incentives, such as: 1) the provision of physical or virtual Infrastructures; 2) financial support for investment; 3) promotion and marketing support; 4) exemptions of municipal licensing fees and 5) technical

and scientific support. The Programme regulations is available at the Municipality webpage at <https://bit.ly/3Mkx4QH>. The development of this policy matched with the pandemic period, in the year 2020. Through these measures, the intention was to provide a set of material and immaterial tools that responded to the identified needs from producers' community, but at the same time, that may be a contribution to adaptation to local and global challenges, such as a pandemic or the climate change.

A results-based scheme for the pine forest of the Algarve (Sotavento)

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Abstract

Traditional agri-environmental measures offer payments made on management practices that are expected to lead to a particular environmental objective. However, there is no guarantee that this relationship between a management practice and the intended environmental outcome will become effective, so the overall result has been a disappointing environmental return on the expenditure of public funds. To overcome this situation, results-based measures have been implemented in many European countries. These measures offer payment for delivering a specific environmental result, allowing producers to decide how best to achieve that result. Within the scope of the MED, a project of Agri-Environmental Measures based on results has been developed, which culminated in the inclusion in PEPAC of a measure of Results-based Management of Montado. In the Algarve, the Sotavento pine forest seems especially suited to develop a new results-based measures' project. This forest, mostly planted under the regulation to support the afforestation of agricultural land (Reg. EEC 2080/92), has already completed the 20-year period in which it received maintenance aid, but it is not productive, nor will it be in the short term, therefore it is not possible to guarantee its maintenance. However, it has a recognized environmental function, as it contributes to fixing the soil and preventing upwelling and supporting some biodiversity – precisely the type of objectives that are envisaged for PEPAC. This project proposes to study the possible results and the indicators that can support a results-based scheme for this forest to integrate Portuguese agricultural policy, which is in line with the European biodiversity strategy, that aims to contribute to European society's resilience to the impacts of forest fires, and with the focus on performance and results aimed by CAP 2023-2027.

Abstracts (Poster Session)

Innovative reforestation - The R3forest Project

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Abstract

The R3forest project implemented and evaluated technical solutions that can contribute to reforestation, natural regeneration, and the mitigation of erosion processes. The ultimate objective was to achieve healthy and functional soil in post-fire or highly degraded areas, while promoting sustainable management of invasive species biomass. Local biomass was harvested and chipped, either from invasive species to produce green waste compost (GWC), or from tree species such as eucalyptus and pine to produce wood chips (WC). Subsequently, ditches and contour bunds (CB) were created and filled with this biomass and various forest species were planted. The working hypothesis was that while CBs help to decrease erosion and might benefit plant growth, this effect should be improved by WC application due to improved microclimatic conditions, such as water retention, and further amplified with GWC addition due to increased nutrient availability. The data obtained demonstrate a high survival rate of the planted species in experimental plots with these interventions compared to the control (only vegetation removal), however, the various plant species showed different

responses to the treatment applications. This scientific poster presents the successful implementation of the R3forest project, its experimental setup and preliminary data of plant survival in the first two years after treatment application. The poster aims to disseminate the project's findings and encourage the adoption of sustainable practices for erosion control and biomass management in fire-affected and degraded areas, as well as foster new collaborations with other members of the Change associated laboratories.

The positive effect of Nature-based Solutions for achieving the Sustainable Development Goals in Mediterranean agrosystems: a meta-analysis

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Abstract

The Mediterranean region is currently facing environmental and socio-economic challenges. Due to reduced rainfall and warmer conditions, droughts and wildfires are becoming more common. Additionally, changes in agriculture practices are increasing the risk of land degradation. In this context, Nature-based Solutions (NbS) emerge as a sustainable strategy to address climate change adaptation and mitigation. Extensive literature focuses on the analysis of NbS to address this problem, although no analysis discriminates against the individual and combined effect of NbS in agroecosystems. In this work, we capitalise on state-of-the-art results and present a random-effects meta-analysis of NbS. Our analysis focuses on a cohort of 79 NbS for agricultural land management. We used response ratios as effect sizes to determine the most suitable NbS for improving soil health and water quality. We built a database with field-scale data from 69 published case studies comparing NbS and conventional agricultural management practices in agroecosystems in 11 countries in Mediterranean climate-type regions. Our analysis results from a literature selection of 988 scientific articles published from 2019 to 2022. We have analysed the effect that NbS have on soil's ability to retain water, organic matter and carbon, reduce soil loss and improve water quality. To further understand the influence of abiotic factors, we also analysed the impact of precipitation, soil texture, and irrigation systems on the effects of NbS. These results shall contribute to leveraging climate change adaptation in Mediterranean agroecosystems, addressing land and water-related Sustainable Development Goals (SDGs).

Carbon balance in olive groves of Alentejo under different land management practices

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Abstract

Rural landscapes in Alentejo (Portugal) have changed greatly during the last 15 years, largely due to the expansion and technological intensification of olive groves. The application of agrochemicals (fertilizers and herbicides) along with crop intensification (increasing tree density) likely affect the C balance of these groves. Hereby we assess the C contents of different farming system components and flows affecting the farm, tree and soil C balances during one hydrologic year. Seven olive groves were selected with different soil management practices and production models, including organic vs integrated, as well as contrasting tree densities, 100, 300 and more than 1000 trees per hectare. The annual C inflows comprise the C which accumulates annually in the trees, olive leaves/flowers, tree pruning, olive fruits and cover crop biomass, and also the inflow due to organic fertilizer applications, whereas annual C outflows comprise harvested olive fruits plus olive leaves, soil erosion and soil CO₂ emissions. Preliminary results show that C balances are mostly positive mainly due to the accumulation of C in the tree permanent structure. Some of the farms showed negative farm C balances, indicating that more C was lost than entered. This was the case mainly in the farms which applied herbicide and, consequently, exhibited both lower annual CO₂ entries in the biomass of cover crops, and higher annual C erosion losses. Results indicate that: i) olive cropping contributes to climate change mitigation, and ii) there is a great potential to enlarge

this contribution by, for instance, reducing herbicide application to allow positive C balances in the olive grove.

Advances in genetic and propagation tools to assist the climate change challenges in the Mediterranean region

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Abstract

The environmental and economic sustainability of high-value cultures can face in the near future, some challenges in the Mediterranean region. Different biotechnological approaches can help to mitigate some of those challenges and redefine new public strategies to overcome biotic and abiotic stresses. The selection assisted by molecular markers and propagation of resilient genotypes to climate changes with increasing yields in agriculture and forest systems are some of the strategies studied by our team. In this context, a subset of transcriptomic studies has been performed to identify previously differentially expressed genes (DEGs) associated with some economic/phenotypic traits of interest in endogenous species. Genetic studies associated with productivity and quality traits will be presented in cardoon and cork oak.

Moreover, introducing certified almond trees free of pathogens is essential for the sustainability of the orchard and even for agricultural production in an entire region. Thus, the insurance of healthy and resilient plants, adapted to biotic and abiotic stresses, is also one of our goals. Different molecular and propagation strategies are being studied to identify and screen for potential plant diseases and, clonal propagate disease-free plants. A case study of almond trees disease-free production using micropropagation and micrografting tools will also be presented.

Systematic analysis of microbial alternatives for lignocellulosic biomass hydrolysates detoxification: A review

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Abstract

The Mediterranean area produces up to 98% of the olive by-products, where Extracted Olive Pomace (EOP) constitutes 35% of its full production. To access these non-seized sugars contained in the lignocellulosic biomass (LCB), a pre-treatment is always in need. Its production, unfortunately, carries important fermentation inhibitors (furaldehydes, phenolic compounds, organic acids) that depletes the fermentation rate due to its toxic effect on fermentative metabolism. Due to complications to eliminate them by physicochemical means, other strategies are put in practice. Using microorganisms as a way; not only to harvest the available sugars and other compounds contained in LCB, but also as a manner to eliminate the inhibitors from biomass hydrolysates has been showed as one of the most prolific paths to overcome the problem. The different strategies based on microbial adaptation to surpass toxicity of the main inhibitors found in EOP hydrolysates reported within the last 15 years are analysed in the present work.

Effects of groundwater changes on coastal dune ecosystems

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Abstract

Groundwater can greatly influence the physiological performance of plant species, the composition of vegetation, and ultimately ecosystem functioning. Groundwater depletion is particularly relevant in seasonally dry coastal dune forests of the Iberian Peninsula, where human pressure is currently high, exacerbating climatic trends of groundwater scarcity. To have a full idea of the impacts of water-table lowering, both physiological and community structure knowledge are needed. We assessed the water-use strategies and species' cover estimates in the community and the sensitivity of the dominant plant species to the reduction of groundwater resources along a water table gradient in the dune ecosystem of Reserva Biológica de Doñana. We explored their integrated trait syndromes, multi-trait functional diversity and community weighted means. We found similar patterns in the ordination of physiology and cover of the woody community. Water table depth influenced not only the physiological performance of the woody species but also their abundance. Interestingly, physiological responses only signal further impacts of groundwater scarcity on species cover in groundwater-dependent species and mesophytes. Xerophytic species (even with different water-sources-use, such as *J. phoenicea* and *R. officinalis*), although physiologically affected by water-table depletion, showed an increasing cover with water-table lowering, probably due to the decrease of interspecific competition. Importantly, dominant traits on shallow groundwater sites pointed to a community with a higher photosynthetic capacity and better water status. A decrease in functional richness and functional evenness with groundwater lowering reinforced the functional impacts at ecosystem level. This study shows the importance of combining multitrait physiological approaches with community structure assessments to better trace shifts in the community due to groundwater depletion and define the vulnerability of woody species to the decline in water resources.

Grapevine Portuguese genotypes – mechanisms of plant resilience to climate changes while maintaining wine quality

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Abstract

The grapevine (*Vitis vinifera* L.) is a plant species well-adapted to the Mediterranean climate, in which plants are often exposed to long periods of drought. The vineyard irrigation was only allowed in the southern region of Portugal since the middle of the last century. Its use allowed to maintain consistency in the yield and quality of the grape production through the years, something that did not happen until then. The predicted scenarios for climate change suggest a significant increase in the frequency and severity of drought events, a situation that may condition the continuity of irrigation of some crops, including the vineyard. Anticipating this eventuality, it is essential to develop research directed to understand the mechanisms of high plasticity over environmental stresses presented by existing vine genotypes. The research plan here presented is integrated in the project Vine&Wine - BioGrapeSustain and aims to contribute for the improvement of Portuguese grapevine cultivars increasing drought stress tolerance. Six grapevine cultivars used for red wine production and behaving differently upon drought stress were selected from the ampelographic field of Esporão vineyards to investigate the mechanisms involved in plant acclimatization. An integrative multiomics approach will be followed using leaves and fruits collected from plants growing under field conditions. For each cultivar, transcriptome, proteome and metabolome will be analysed.

Additionally, a metagenomic analysis will be performed to identify bacterial and fungi communities associated with differences on drought tolerance that could be also linked to wine quality.

Calorespirometry as a new phenotyping tool for selection of genotypes with high plasticity upon environmental stresses

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Abstract

In times of global climatic changes, one of the main goals of the agricultural industry and breeding companies is the development of high resilient cultivars able to produce seeds that more efficiently overcome environmental constraints and consequently lead to greater germination rates. The development of phenotyping tools that could assist breeding programs for selection of more resilient seeds and selection of high-quality crop seeds is very welcome. Within the scope of the LIVESEED project (H2020-SFS-2016-2017/H2020-SFS- 2016-2), a team of researchers from the University of Évora implemented a methodology based on the evaluation of calorespirometric parameters using pea seeds. Calorespirometry, a technique that measures respiratory parameters from the heat emitted by a tissue, is a promising approach to predict seed viability without the need of establishing time-consuming germination tests. As proof-of-concept seeds of four *Pisum sativum* L. (pea) cultivars were considered for experimental design. Pea seeds taken from different breeding lines were

imbibed in sterile tap water for 16h and metabolic parameters measured by calorimetry (heat and CO₂ emission rates) in a Multi-Cell Differential Scanning Calorimeter. The results demonstrate a correlation between the germination rate and calorimetric parameters, in which cultivars characterized by a low germination rate exhibited the lowest metabolic heat and CO₂ emission rate. In the future, our goal is to establish this technique to other important agronomical species and make calorimetry an available tool to seed breeders, allowing the selection of more resilient genotypes and to outline strategies for adapting crops in times of undesirable climatic change.

Supporting adaptation decision-making under overshoot scenarios in the Lisbon Metropolitan Area

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Abstract

Overshooting the 1,5 °C limit of global warming set by the Paris Agreement is plausible scenario with severe social-economic and ecological repercussions. The Lisbon Metropolitan Area (AML) is particularly vulnerable to climate hazards, such as extreme temperatures, droughts, couple with projections of increasing frequency and intensity of heatwaves in Lisbon. However, knowledge of overshoot scenarios and their impacts has yet to gain broad consideration by local adaptation practitioners. The possibility of overshooting ir/reversible impacts and critical limits and thresholds for adaptation must be considered in local adaptation policies and plans, allowing an effective management of climate risk for populations and ecosystems. To address this knowledge gap, our research group is working to supply AML stakeholders and adaptation practitioners with innovative tools that can improve adaptation planning, under the H2020 PROVIDE project (<https://www.provide-h2020.eu/>). Stakeholder engagement meetings have been held to assess their understanding of the novel concepts of overshoot and ir/reversible impacts and apply a novel self-assessment tool - the Overshoot Proofing Methodology. This tool was designed to guide policy-makers in including overshoot in their plans and policies. Simultaneously, we are developing modelling activities using a probabilistic damage model – CLIMADA. This modelling approach aims to support practitioners in decision-making on climate change adaptation measures. Interviews are being conducted to gather perspectives from healthcare professionals, professors and outdoor workers on the societal impacts of urban heat.

Harnessing Satellite Technology to Improve the Sustainability of Walnut Orchards

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Abstract

'Persian walnut' (*Juglans regia* L.) is one of the most consumed nut species in the world, and N, K, and Ca fertilization are critical for its growth and quality. In addition to nutritional problems, improper management of N fertilization in fruit production leads to a large amount of nitrate leaching and consequently to ground water contamination. In fruit crops, mineral nutrition management over large areas is a challenging task. To overcome this challenge, we propose, in this study, the use of remote sensing data in addition to NIR spectroscopy, a rapid analytical method, to develop predictive models to quantify N, Ca, and K in the trees. These predictive models were developed based on remote sensing data from the Sentinel-2 satellite using 9 different spectral bands and 2 vegetation indices (NDVI and NDWI) through a multiple linear regression approach. The predictive models for N, Ca and K were satisfactory, with R² values of 0.72, 0.61 and 0.79, respectively. Therefore, the results obtained indicate that remote sensing is a potential technology to assess the nutrient status in crops in a faster and more reliable way than traditional plant leaf analysis procedures. New agricultural practices that promote soil health, minimize water use, and lower pollution levels, are crucial to change the way all societies produce toward a more sustainable producing system. In this context,

the use of remote sensing data (RS) to reach quantitative assessments, in large areas of crop parameters, such as nutrient level, is becoming an increasingly important tool.

Role of different “omics” as powerful tools to face climate change and enhance breeding programs

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Abstract

Climate change is the main cause of biotic and abiotic stresses affecting agriculture in different ways such as increasing temperatures, variations in rainfall, as either floods or droughts, or increasing disease incidence. In fact, it poses a major threat to species and ecosystems in Portugal and world-wide having harsh impacts on plant and animal growth, development, health and productivity. With the advent of next generation sequencing technologies, the number of sequenced genomes has increased significantly in the last decade opening new horizons in the field of genomics and transcriptomics, among other “omics”. Hence, different “omics” offer new and exciting opportunities for the development of powerful strategies that can enhance the resilience of these species to climate variability accelerating their genetic characterization, a key requirement for their preservation, improvement and valorization. Understanding genetic diversity is crucial in order to identify candidate genes and genetic markers associated to agronomic traits of interest such as improved production and biotic and abiotic stress resistance. Here we present some examples, using plant and animal endogenous species, of how different “omics” approaches help to understand the molecular basis of the differences in phenotypic traits.

A multi-species approach for minimizing road impacts on wildlife

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Abstract

Road networks are continuously expanding globally, especially in tropical and subtropical regions, in which new roads are expected to be built in the upcoming decades. Reconciling the development of these infrastructures and the maintenance and recovery of biodiversity is an important scientific challenge of our time. Although protected and indigenous areas or habitat cover are usually considered in multi-criteria analysis when planning the design of new roads, a thorough evaluation of the direct potential impacts on wildlife are usually lacking. Incorporating spatialized and quantified biodiversity information that represents the most notable road impacts on wildlife during the planning phase of new roads has the potential to prevent their impacts, and to guide optimized spatial implementation for other mitigation measures. Combining fine grain species distribution data and predictive modelling, we propose a multi-species framework to account for the main potential road impacts on wildlife in road planning, namely direct mortality, connectivity changes and habitat change and loss. We exemplify our approach with a study case from Brazil. We expect that incorporating impact predictions based on wildlife data on road planning will increase impact avoidance and optimize mitigation, which is an urgent need for road expansion worldwide.

Natural Remnant Habitats – promoting biodiversity and policy changes in Montado agroecosystems

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Abstract

The Portuguese Montado is a traditional High Nature Value production system based on practices that promote high levels of biodiversity. However, Montado is under threat by land-use changes resulting in habitat loss and fragmentation. In this context, Natural Remnant Habitat (NRH) patches and corridors become more vital for maintaining the structural and functional diversity of the Montado landscape, and for the preservation of biodiversity through landscape heterogeneity and connectivity. This PhD thesis aims to identify and quantify the ecological value of the NRH (small forest/ shrub patches, rocky outcrops, ponds, and riparian gallery) through the establishment of a biodiversity assessment system based on biological importance, habitat suitability and habitat connectivity. This will be achieved through: identification of different NRH in the field; identification of specificities and conservation status based on typical vegetation assemblage; analysis of relationships with management-related variables; analysis of selected fauna species preferences for NRH with different specifications; identification of minimal optimal density and compositional diversity of NRH through connectivity analysis. Study areas include estates in Central Alentejo (southern Portugal) in Montado areas under different management regimes. The results will be translated into biological indicators, management strategies and recommendations for the preservation, restoration and re-creation of natural remnant habitats in the Montado agroecosystem. These results can be used in new “results-based models” for agri-environment schemes implemented under the Common Agricultural Policy.

Claiming sustainable development outcomes in decentralised

renewable energy: results from a systematic review

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Abstract

A fast energy transition requires new technologies such as soaring renewable energy solutions. It is commonly considered that decentralisation increases benefits at the local level, but the argument is under-researched. This research assessed conditions, factors, and criteria in decentralised renewable generation, indicating which ones contribute to claiming local-level sustainable development benefits. Based on a comprehensive systematic literature review, reveals that, as an emerging research agenda, little attention was dedicated to local-level outcomes. It compares literature from the Global South and Global North and concludes that the energy justice approach largely addresses these concerns and guides future academic and policy actions.

Sea level rise induced impacts on coastal areas of Bangladesh and local-led community-based adaptation

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Abstract

Bangladesh is as a low-lying country, susceptible to various Sea Level Rise (SLR) induced impacts. Previous studies have separately explored SLR effects on Bangladesh's coastal ecosystems and livelihoods, across multiple spatial and temporal scales. However, empirical studies acknowledging local population's perceptions on the SLR induced physiographic impacts, their effects on lives and livelihoods of local communities have not addressed the causal-linkage relationship between these impacts and their potential effects. Our study explores how SLR has already impacted the lives and livelihoods of coastal communities in Bangladesh and how these have been responded by adopting different adaptive measures. We applied a qualitative community-based multistage sampling procedure, using two Participatory Rural Appraisal (PRA) tools, namely Focus Group Discussions (FGDs) and Community Meetings (CM), to collect empirical data about SLR effects on livelihoods and implemented adaptation responses. Our study found that both man-made and natural causes are responsible for different physiographic impacts of SLR, and which seem to vary between place and context. Five major SLR induced impacts were identified by coastal communities, namely: salinity increase, rising water levels, land erosion, waterlogging and the emergence of char land. Salinity increase and land erosion are the two most severe impacts of SLR resulting in the largest economic losses to agriculture. Our results highlight how coastal communities in Bangladesh perceive the impacts of SLR and the benefits of different adaptation processes set in motion to protect them, via development projects and other local interventions.

LTsER Montado Platform: an opportunity for long-term collaborative socio-ecological research

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Abstract

The Long-Term Ecological Research (LTER) network aims to study long-term ecological processes (e.g., the effect of climate change) and the impact of rare events (e.g., fires), which are impossible to detect in the short term. This network stores relevant data in ecology, establishes links between institutions and researchers and transfers knowledge to society. There are LTER sites all over the world, including in Portugal, where the Portuguese network integrates 4 LTsER platforms (Estuaries, Sabor, Ria de Aveiro and Montado). These platforms represent regions from a cultural, ecological and historical point of view and assume the involvement of the scientific community, stakeholders, and all beneficiaries of the knowledge produced. The montado, due to its economic, ecological and social importance for Portugal, was selected to be one of the 4 Portuguese LTsER platforms. The variability found in the montado led to the choice of 5 research and monitoring stations that represent the gradient of climate and land uses.

In recent decades, several projects have been developed at LTsER Montado platform, resulting in more than 80 scientific publications, more than 85 master's and doctoral theses, 10 conferences and workshops, hundreds of students in field classes and around 5200 participants in activities of dissemination and citizen science carried out by cE3c. LTsER Montado and the European eLTER network provide an opportunity to boost the collaboration among CHANGE research units, with a envisioning long-term interdisciplinary research in Alentejo, to inform science-based public policies in the promotion of sustainability.

qPCR as a sensitive tool for detecting Fusarium spp. in tomato plants.

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Abstract

The need to increase food production together with the demand to reduce the application of synthetic chemicals that have consequences on increasing the carbon footprint and negative impacts on the environment and human health, led to the search for alternative methods to protect plants against pathogens. The use of the highly sensitive real-time quantitative PCR (qPCR) arises as an extremely useful tool for studying various agents of infection in plants, such as fungi, viruses, or bacteria leading to a better control of diseases and limiting the use of chemical defence strategies. Given the high incidence of diseases in tomato plants caused by *Fusarium* spp., their consequent negative economic impacts, and the fact that most phytosanitary treatments are based on the application of synthetic fungicides, the establishment of a molecular-based tool that enables their early and accurate detection is of great interest. Furthermore, it will provide an additional tool for the screening of resistant plants. In the presented study, a TaqMan[®]-based qPCR method targeting the *Fusarium* spp.-specific internal transcribed spacer (ITS) region was developed for the simultaneous detection and quantification of a panoply of *Fusarium* species that affect tomato. As a proof of principle, the new qPCR assay was used to assess *Fusarium* spp. contamination of tomato field plants and of plants grown under controlled conditions. qPCR combined with the chemistry of TaqMan[®] MGB probes represents a highly specific and sensitive detection system, even when low amounts of target DNA are present, as in the case of early plant–fungi interactions.

CRISPR/Cas13 system: A technology to the successful control of plant viruses

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Abstract

Viruses are among the most important causal agents of infectious diseases, having relatively small genomes that comprise RNA or DNA. They have the ability to rapidly replicate and spread throughout a crop, being very difficult to monitor and causing devastating diseases in many agricultural systems. These can lead to significant losses in crop quality and yield, resulting in extreme economic impacts worldwide and threatening the provision of adequate nourishment for a continuous growing population. There are no efficient chemical products that can eliminate an infecting plant virus without perturbing host cells. Therefore, preventive sanitary measures, such as the use of viral resistant or tolerant plants, are usually the only options. Conventionally, these resistant/tolerant plants were generated through a very time-consuming classical breeding process. However, nowadays, molecular plant breeding plays a key role to prevent and control plant viruses. Clustered regularly interspaced short palindromic repeats (CRISPR) and CRISPR-associated (Cas) proteins systems allowed the development of a new technology that paves the way towards a new horizon for crop improvement. The first CRISPR/Cas systems studied were very useful for DNA-targeting, however, more recently identified types, such as CRISPR/Cas13, can specifically cleave single-stranded RNA in eukaryotic cells. Therefore, CRISPR/Cas13 is a promising tool for engineering plant immunity against a broad range of RNA viruses, which are the most abundant class of viruses in plants. The present work aims to bring together the most up-to-date information on CRISPR/Cas13 system to control plant viruses, discussing the limitations and future challenges for its application to produce virus resistant plants towards a more sustainable agriculture.

