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La Ecología y los Retos Sociales

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ECOLOGY AND THE SOCIAL CHALLENGES:

Under the motto of "Ecology and the social challenges," the Fourth Iberian congress of ecology to be held in Coimbra (Portugal) in 16-19 June 2015 welcomes all scientists, professors and students of ecology interested in learning and contributing to this overarching goal. In other words, ecological science meeting social needs. The way ecology can serve this purpose is various, and, consequently, the congress will encompass a range disciplines and topics. The congress has attracted the attention of evolutionary ecologists, ecophysiologists, population and community biologists, and marine and global change ecologists just to mention a few. The general framework of the congress has been inspired by the societal needs included in the Horizon 2020, with special emphasis on global change and anthropogenic pressures and threats on goods and services provided by ecosystems.

The international flavor of this scientific gathering will reinforce this vision of ecology as a synthesis of different approaches and perspectives. The two main scientific associations for ecology in the Iberian Peninsula, the Portuguese SPECO and the Spanish AEET, have joined forces to bring together the best experts and to make the best possible meeting in the charming city of Coimbra. This Fourth Iberian congress of ecology is also the 15th Encontro Nacional de Ecologia of SPECO and the XII Congreso Nacional de la Asociación Española de Ecología (AEET). The organizers of this congress have done their very best to facilitate information exchange in a pleasant atmosphere, sparing no expense or effort. We are very grateful to all of them, and it is with pleasure that we welcome all of you to this congress, wishing success in facing the timing challenge that inspired its motto.

SPECO and AEET

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1. Biodiversidade e Conservação / Biodiversidad y Conservación

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Coordenador: *Miguel Ángel Rodríguez-Gironés*, [rgirones@eeza.csic.es] Estación Experimental de Zonas Áridas, EEZA, CSIC

Conferências plenárias / Ponencias plenarias

Plenary talk

Marine ecology: scientific challenges and societal needs

Cabral, H.[1]

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Marine ecology scientific research have been evolving towards more complex and holistic frameworks, addressing cutting edge topics, common to all environmental sciences. Although a large volume of literature have been published in recent years, several key research topics have been recognized as requiring further research, namely biodiversity and ecosystem functioning, relationships between human pressures and marine ecosystems, impacts of climate changes, assessment of the ecological quality of marine habitats, ecosystem services, habitat rehabilitation, ecosystem management and modelling of marine systems. These cutting-edge research topics not always correspond to what is important for human society, being often evident, for certain domains, a mismatch between current research challenges and societal needs. In this work we present some of the most important contributions to marine ecology science and we highlight the major needs for society, namely those related to food production and fisheries management, marine hazards, ecosystem health, recreation and cultural heritage.

Plenary talk

Implications of oak decline for the structure and functioning of Iberian forests

Gómez-Aparicio, L.[1]

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In the last decades widespread tree dieback has been documented in forests all over the world. In the Iberian Peninsula in particular, evergreen oaks *Quercus ilex* and *Quercus suber* are among the tree species most severely impaired by problems of defoliation and mortality. To date, the emphasis has been on analyzing the patterns and causes of this decline. However, much less is known about the consequences of oak mortality for the structure and functioning of declining forests. In this talk I will provide an overview of our current knowledge about the impacts of oak decline on plant and soil communities and the ecosystem processes that they control, using examples from recent work conducted in *Q. suber* forests of southwestern Spain.

The evidence thus far suggests that ongoing alterations in health and cover of canopy oaks do translate into changes in understory plants and microbial communities, and that such changes occur more consistently in terms of abundance and functionality than of taxonomic diversity. For example, the decline of *Q. suber* has been shown to reduce the abundance of seedlings and saplings of tree species, particularly late-successional oaks, but not of other functional groups such as shrubs or lianas. These differential responses among woody species could affect successional trajectories, potentially leading to vegetation shifts. Belowground, the decline of *Q. suber* has been linked to lower soil respiration rates but higher heterotrophic respiration and microbial biomass, altered probabilities of establishing mycorrhizal interactions, higher pathogen loads, lower nematode abundance, and an increasing role of bacterial-feeder nematodes in soil food webs. Overall, the process of oak decline seem to translate into functionally altered above- and below-ground biotic communities that could threaten the quantity and quality of the goods and services provided by these valuable forest systems.

Plenary talk

Interaction modules: disentangling the complexity of biological communities

Heleno, R.[1]

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In recent decades, the use of network analysis has grown popular as a framework to explore ecological processes and the relationships between community structure and its functioning. The field has rapidly developed and contributed with several important descriptors of biological communities, such as connectance, nestedness or network specialization. By evaluating emergent properties of biological community and their constituent nodes (e.g. species, individuals), networks provide a dynamic viewpoint from which ecologists can simultaneously "see the forest and the trees". Modularity analysis", is a recent and highly promising descriptor of ecological networks which allows us to detect nuclei of strongly interacting species within large interaction networks. These nuclei, or modules, are delimited by the interaction patterns of the species and not by arbitrary decisions of the researchers and thus can provide a very special insight into the organization of biological communities or the very "architecture of biodiversity". In this talk I will present data on insect- and bird-pollination, frugivory and seed-dispersal, plant-mycorrhiza associations and bat-roost networks, from broad geographic contexts such as the Galápagos and the Canary Islands, the Gorongosa National Park in Mozambique and Europe to highlight the potential of modularity analysis to ecology. Specific questions will be addressed on the fields of biogeography, community organization, inter-habitat connectivity and applied conservation planning.

Plenary talk

How is diversity maintained during host and parasite adaptation?

Magalhães, S.[1]

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The maintenance of diversity is a classical, yet unresolved issue in both Ecology and Evolution. One tempting hypothesis is that organisms cannot simultaneously adapt to all available habitats: there is a trade-off between traits allowing adaptation to each environments. I will present data aiming at testing this hypothesis in two host-parasite systems: one composed of parasitic spider mites (*Tetranychus urticae*) and their plant hosts and another of *Drosophila melanogaster* hosts infected with either bacteria or viruses. The data will show (i) which traits have evolved in response to a biotic challenge and (ii) what are the consequences of such adaptation for host/parasite niche breadth. Finally, with the *Drosophila* system, the genomic changes associated to adaptation to viral pathogens revealed a simple genetic basis of resistance. Overall, adaptation entailed an expansion of niche breadth, with low specificity. This generalist response was also patent in the properties of the genomic changes associated to adaptation. Therefore, diversity in these systems is not maintained by genetic trade-offs, but may rely on competition among colonizing and resident populations.

Plenary talk

How can large flightless beetles disperse by flight? The role of the omnivorous gulls on an oceanic island

Nogales, M.[1], López, H. [1]., Emerson, B.[1]

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The enigma of how large insects can colonize oceanic islands has not being satisfactory explained and often has been attributed to stochastic processes linked to oceanic rafts or other undocumented means of dispersals. Once on an island, these insects often undergo processes of evolutionary radiation, as in the case of the 13 taxa of *Pimelia* (Coleoptera: Tenebrionidae) within the Canary archipelago. Field observations carried out in 1986 (El Hierro island), revealed that omnivorous gulls (*Larus michahellis*) can regurgitate large intact *Pimelia laevigata* (≈ 16 gr), some of which survived digestion by this large bird. In response to this observation we developed a research project funded by the Canary Island Government (2010-2013). We recorded this process in at least 15 times in the field, and also under experimental conditions. Furthermore, the frequent and high consumption of *Pimelia* by seagulls takes place during spring and the beginning of summer, coinciding with the optimum maturation of the female eggs. Therefore, post-regurgitation colonization success of this beetle is presumably favorable. A parallel study on mitochondrial DNA has been developed, whose preliminary data indicate a lack of population genetic structure within *Pimelia* of El Hierro, which, at least in part, could be attributable to this singular phenomenon. Although at the moment we are unable to extrapolate biogeographical implications of this particular process in a context of oceanic islands, this is the first time that is documented how a bird can successfully disperse an invertebrate.

Plenary talk

Gypsum plants: living on the edge

Palacio, S.[1]

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The occurrence of special substrates such as saline, serpentine, dolomite or gypsum soils, with a distinct flora associated to them, has puzzled naturalists for centuries. Some of these substrates, and the adaptations displayed by plants to cope with them, are quite well understood. Such is, for example, the case of saline and serpentine soils, where distinct traits have been identified as characteristic of plants adapted to them. However, other substrates like gypsum soils are still poorly understood, and the mechanisms displayed by plants to survive on them pose intriguing questions to ecologists.

Gypsum ($CaSO_4 \cdot 2H_2O$) is a rock-forming mineral that also occurs in soils. Gypsum outcrops are widespread throughout the Earth, being present in the five continents. They are particularly prevalent in arid and semi-arid regions of Africa, Western and Central Asia, where they account for ca. 40%, 75% and 25% of the total surface, respectively. Gypsum is also a key water-holding mineral of Mars, and a targeted substrate in the search of extra-planetary life. Due to its particular physical and chemical properties and the aridity typical of the areas where gypsum soils develop, this type of soil poses very restrictive conditions to plant life, yet it hosts a highly diversified flora, rich in endemic and rare species.

This talk is an invitation to discover the most recent advances on the ecology of gypsum plants. We will take a closer look at the diversity of gypsum plant communities, examine the different limitations that restrict plant growth on gypsum soils, explore the various mechanisms displayed by plants to cope with them and analyze the dangers that threaten the conservation of these unique environments.

Sessão 1. Biodiversidade e Conservação / Sesión 1. Biodiversidad y Conservación

S1. Poster

Evaluation of the conservation status of two prioritised forest species in Quijos river sub-basin, Ecuador

Aulló Maestro, I.[1], Moreno Amat, E.[2], García-Amorena, I.[2], Ramos, R.[3]

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The aim of this study is to analyse the climate change and land-use change effect on two forest species of the cloud forest. The innovation of this research lies in the application of a Participatory Rural Approach (PRA) for the prioritisation of the target species, which result was: Cedrela montana Moritz ex. Turcz and Erythrina edulis Triana ex. Micheli. Moreover, this study contributes to the improvement of flora and fauna conservation status analysis as it use replicable and access-free methods, making it utterly useful for future researchers. As a result of the study both species were categorised as Critically Endangered (CR). This conclusion was reach by evaluating diverse Species Distribution Models (SDM) combined with UICN Red List Categories and Criteria. Furthermore the analysis of the data sampled in primary and intervened forest revealed that the impact of land use change is markedly negative in Cedrela montana as it disappears in the intervened forests and, if it subsists at all, presents severely reduction of diameter average, presumably due to its excellent wood quality. On the contrary, Erythrina edulis, as it is edible, seems to maintain or even increase its abundance and its diameter average in intervened forests.

S1. Poster

Complex interplay between fruit removal by carnivorous mammals, rodent seed predation and fruit depulpation by rabbits determine lower seed dispersal rates of *Ziziphus lotus* across gradients of habitat alteration in southeastern Spain.

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Anthropogenic habitat alteration and fragmentation is a major threat to conservation of plant populations and biodiversity. We evaluate the impact of alteration and fragmentation on pivotal stages of plant regeneration in Ziziphus lotus, a keystone scrub inhabiting semiarid habitats in southeastern Spain. Along fall 2014 we determined, both observational and experimentally, fruit and seed-fall patterns across seven populations differing in habitat alteration and fragmentation. We also estimated rodent abundance (main seed consumers) during the diaspore-release period and conducted post-dispersal seed removal experiments. Observational data show that the initial amount of fruits available on the ground for mammal dispersal was highest in well-preserved populations, intermediate at severely-altered populations and lowest in moderately-altered populations. However, fruit removal did not vary among them. Experimental fruit offerings showed that fruit removal rates by mammals was higher and faster at altered than at well-preserved populations. However, the number of seeds remaining undispersed was significantly higher at altered than at well-preserved populations because many fruits suffer in situ fruit depulpation by rabbits. Rodent abundance was highest at well-preserved populations, however, their abundance and seed predation were unrelated. In conclusion, complex relationships between fruit abundance, fruit removal, seed predation and fruit depulpation occur along the gradient of habitat fragmentation. Although results point to higher seed dispersal limitation in well-preserved habitats, the number of seeds remaining undispersed was finally higher under severe fragmentation because depulpation of fruits by rabbits in fragmented habitats prevented additional seed dispersal there, while seed predation was generally low and unrelated to habitat fragmentation.

S1. Poster

Density and population size of *Alouatta guariba clamitans* (Primates, Atelidae) after an outbreak of Yellow Fever in Southern Brazil

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The effects of yellow fever outbreaks on the conservation of non-human primates may be significant but not well understood. The aim of this study was to estimate the density and the population size of the Brown howler monkey (*Alouatta guariba clamitans*) at Campo de Instrução de Santa Maria (29043'-29044'S, 53042'-53044'W), south Brazil, after a recent yellow fever outbreak (2008-2009) and compare with the pre-outbreak period. Between 2012 and 2013 we collected data using the line-transect method for the largest fragment (Sarandi 977.3 ha) and the extensive sampling for the remaining fragments. The fragment-occupancy rate was 40% and 61 individuals (13 groups) were found in 6 fragments. Population densities ranged from 0.01 to 1.7 individuals/ha and the average group size was 4.6±2 individuals. The density estimated by the software Distance 6.0 for the fragment Sarandi was 17.8±5.2 individuals/km² and the average group size was 4.1±3.6 individuals. Statistical analyses showed significant differences between the current population densities and those previously registered ($Z=3.5$ $p=0.0004$ $N=17$). The lowest number of adult females ($Z=3.5$ $p=0.0004$ $N=17$) and infants ($Z=3.3$ $p=0.0010$ $N=17$) may indicate a reduction of these sex-age classes in the current group composition. Our data clearly suggest high decline and mortality in the metapopulation. The record of low densities, low occupancy rates and small group sizes supports our conclusions. Although this has been a short-term study, it provides important data for evaluating and monitoring future changes which may affect the metapopulation throughout the next years.

S1. Poster

History, Ecology and regional co-occurrence patterns of European *Carabus*.

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Biogeographic regions constitute an essential tool for conservation planning and large scale ecological and evolutionary investigations. Although their delineations have received much attention, the processes underlying regional species pools are seldom evaluated. Using a community detection approach borrowed from network theory, here we aimed at exploring the role of history (throughout the effects of dispersal limitations) and ecology (as idiosyncratic linage environmental responses) in determining regional species composition of European *Carabus* ground beetles. We found that *Carabus* biota can be divided in six distinctive chorotypes and their correspondent regions. Preliminary results show that the transition zones between regions were either associated to dispersal barriers (such as the Pyrenees or the Bosphorus strait) or with the southern limits of the ice-sheets at the Last Glacial Maximum. Besides, species range sizes and levels of phylogenetic clustering vary between chorotypes pointing to a plausible legacy of the Pleistocene glaciations in the configuration of geographical *Carabus* species pools.

S1. Poster

Characterization of forest with *Taxus baccata* L. in Catalonia (NE Spain) and water stress in relation to canopy cover

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In the framework of the LIFE Taxus project, the goal of this study is to typify *Taxus baccata* L. populations in Catalonia and obtain guidelines about how different intensities of selective cuttings to improve the yew habitat conservation may affect the vigor of yew trees. In the Mediterranean region, yew trees (*Taxus baccata* L.) are usually find living with other tree species in mixed forests.The largest extension of yew populations is in the Alta Garrotxa mountain ranges in the north and in the Llaberia, Cardó and Prades ranges in the south. Six types of forest with presence of yews have been identified in Catalonia from the main forest with yew. Water stress of yew trees, and its growth, may depend on the net balance between the competition for soil water with neighbors and the cover of the same neighbors, which may reduce the evaporative demand. This study aims to understand these processes using the natural abundance of carbon isotopes (d13C) in yew leaves. d13C may be considered as a proxy for the water use efficiency of a plant. The results suggest that yew water stress positively relates to the total basal area of neighbors and, negatively, with the canopy cover. Yew trees growing in the Mediterranean area are more stressed than those from the Submediterranean region are. Selective cuttings should be addressed to reduce basal area of neighbors surrounding the target tree but avoiding affect the canopy cover.

S1. Oral

Individual species effects on plant trait structure

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Evaluating community assembly through the use of functional traits is a very efficient tool for testing predictions arising from Niche and Coexistence theories. Although interactions among neighboring species and their inter-specific differences are known drivers of coexistence with a strong spatial component, assessing the role of individual species on the functional structure of the community at different spatial scales remains a challenge. Here we ask whether individual species exert a measurable effect on the spatial organization of different functional traits in local assemblages. We first propose and compute two functions that describe different aspects of functional trait organization around individual species at multiple scales: Individual Weighted Mean Area Relationship (IWMAR) and Individual Functional Diversity Area Relationship (IFDAR). Secondly, we develop a conceptual model on the relationship and simultaneous variation of these two metrics, providing five alternative scenarios in response to the ability of some target species to modify its neighbor environment. Our results show that some species exert their effect on the spatial structure of specific functional traits by affecting the two metrics employed, and that their effects were largely idiosyncratic (it depends on the target species identity) but always restricted to fine spatial scales. These effects point to two main mechanisms driving functional structure of the community at the fine scale, strong environmental filtering meditated by some individual species and/or niche complementarities forced by a highly competitive environment around certain target species.

S1. Poster

Allelopathy of *Cistus ladanifer* on the regeneration of *Quercus suber*

Chaves Lobón, N.[1], Sosa Díaz, T.[1], Carretero Gutiérrez, A.[1], Alías Gallego, J.C.[1]

(1) Universidad de Extremadura.

Mediterranean forests are currently dominated by evergreen oak species as: *Quercus ilex* and *Quercus suber*. The long-term persistence of these ecosystems critically depends on the regeneration of the tree layer. Different authors suggest a facilitative effect of shrubs on seedling survival due to nurse effects associated with shade and protection from herbivores. Nonetheless, some shrubs species provide clear evidence of allelopathic effect. Allelochemicals derived from living, dead and decomposed tissues of the shrubs can interfere with tree regeneration directly by affecting seed germination and seedling growth. The objective of our study are to determine if *Cistus ladanifer* affects *Quecus suber* regeneration (inhibition or facilitation). Seed germination and growth of *Quecus suber* were studied. 300 acorns were sown in plastic pots that have been filled with vermiculite. 100 acorns were placed at 1-2 cm depth (control); then 100 acords were covered with litter of *Cistus ladanifer* (treatment A) and 100 were covered with washed litter (the exudate having been previously extracted with metanol) of *Cistus ladanifer* (treatment B). More than 90% of the acorns germinated during the experiment in the control and significant differences were found among treatments, treatments A: 55% germinated and treatment B: 71%. Seedlings in vermiculite with litter of *Cistus ladanifer* grew considerably less than those growing in the control. We can conclude that *C. ladanifer* played a strong role in inhibiting establishment and growth of *Quercus suber* and allelopathy is an interaction which could partially explain the difficulties in natural regeneration of *Quercus suber*.

S1. Poster

Using niche modelling of indicator species to predict the distribution of xerophitic shrub dune communities in South-Western Portugal

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Inland sand dune systems are amongst the most threatened habitat types of Europe. Affected by severe conditions, these habitats present distinct community compositions, which makes them excellent for studying possible interactions among their integrating species and the environment. We focus on understanding the distribution and co-occurrence of the species from dune plant assemblages as a key step for the adequate protection of these habitats. Using data from an extensive survey we identified the shrub species that could be considered indicators of the different xerophytic scrub dune communities in South West Portugal. Then, we modelled the responses of these species to the environmental conditions using Ecological Niche Factor Analysis. We present some preliminary results elucidating whether using species distribution models of indicator species at a regional scale is a valid approach to predict the distribution of the different types of communities inhabiting these endangered habitats.

S1. Poster

Payment for Water Ecosystem Services in the Brazilian Rural Context

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This work aims to enhance the visibility of what the ecological/environmental services have to offer and to emphasize the importance of its valorisation for the Brazilian society, particularly concerning water used by farmers. Payment for environmental services can be considered as a challenge, can produce new possibilities of income generation in rural areas, in a diversified and sustainable way. Takes into account agroclimatic aspects, areas covered by native vegetation (including riparian forests), the appropriate place for pastures, correct use of the soil according with its suitability, proper management, uniting technique and environmental awareness of farmers, the problem of scarcity and pollution of water, conservation of springs and "eyes of water" and biodiversity. It was observed that, on a small-scale in the places implemented in Brazil, this new model has proved to be feasible and efficient compared to the old environmental policies that were framed by command, punishment and control instruments and did not take into account the logic of the economical instruments of incentive and encouragement of environmentally sustainable practices, as well as the conception of ecosystem services as positive externalities. Thereby, it accomplishes the integrated management of land, water and living resources, as well as its harmonization with human needs, making use of good agricultural practices, eliminating unsustainable patterns, aiming the maintenance, protection, preservation and recovery of water-producing areas, as a guarantee of physical, mental well-being and social inclusion of the rural population as social justice and contribution for poverty reduction.

S1. Oral

Impact of wild boar (*Sus scrofa*) rooting in the structure and community composition of sub-alpine grasslands

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Land use changes and global warming are two main drivers of the current changes in the distribution areas of many animal and plant species worldwide. In Europe, the dramatic expansion of wild boar during the XX century has also been observed in mountain areas (alpine and sub-alpine environments) where it used to be seldom present in the past. Whether the activity of wild boar (e.g. rooting) may threat the structure and diversity of the communities in alpine and sub-alpine grasslands is a challenging question. In this study we analyzed the impact of wild boar rooting in the structure and floristic composition of sub-alpine grasslands in the National Park of Aigüestortes i Estany de Sant Maurici (PNASM) in the Catalan Pyrenees (NE Spain) comparing a sampling conducted in 2005 (MINUARTIA, 2005) and a second one in 2013. The results obtained revealed that rooting activity was highly heterogeneous among years (from ca. 25% of the grassland surface rooted in 2005 to less than 8% in 2013). Rooting decreased plant vertical structure, species richness, diversity, the presence of rare species and the number of boreo-alpine species. Conversely, the number of pluri-regional species increased, probably owing to their higher resistance to disturbance. These results highlight the negative consequences that wild boar expansion may have in plant communities in mountain areas.

S1. Oral

Phenological responses of dung beetles along an altitudinal gradient of the Sierra de Guadarrama, Spain

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Phenology studies the relationship between periodical environmental variations and life cycles of plants and animals. In mountainous regions, many species' populations show pronounced gradients of phenological change over short geographic distances. This allows evaluating these factors and their relation with climatic conditions. We discriminate the main types of phenological responses of dung beetles species along an elevational gradient, taking into an account variation in abundance both to altitude and temperature. We conducted standardized surveys during 2012-2013 along an altitudinal gradient from 775 to 1900 masl in Sierra de Guadarrama. We registered a total of 70 species of the three Palearctic dung beetle families: 39 Scarabaeidae, 26 Aphodiidae and 5 Geotrupidae. We observed synchronic variation between families throughout the year. There were four types of species' response to the altitudinal and thermal gradients. Eleven species seem to be generalists for these two factors; these species would not be vulnerable to current environmental changes. We also recorded three species that were generalists for altitude but thermal specialists; although they show thermal constraints, their phenological plasticity allows local adaptation to climate changes. 16 species can be classified as specialists for altitude but generalist for temperature, due to either low dispersal ability or high habitat specificity –which would make them sensible to land use changes and fragmentation. Finally, we registered 31 species that are specialist for both factors, hence they may require strict conditions to develop and reproduce. These latter species would be the most vulnerable to climate change.

S1. Poster

Impact of wildfire on singular species *Gentiana lutea* L. in the Cantabrian Mountains (NW Spain)

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Gentiana lutea L. is one of the protected species in several European countries due to exploitation concerns related to its use, mainly in pharmaceutical and beverage industries. In the Cantabrian Mountains another threat to this species is the wildfire, which could affect its regeneration. The main objective of this work is to identify wildfire effects at short and medium term on *Gentiana lutea* populations. Likewise we try to study the use of prescribed burning and cutting as management tools to conserve this species. We selected sites that were burned one year (short term) and six years ago (medium term), and sites subjected to cutting two years (short term) and eight years previously (medium term). In each site a total of 9 transects of 10 sampling units (1m2) were carried out. In each sampling unit we measured the following variables: density of vegetative shoots, density of generative shoots and cover percent. We analysed the same variables in control areas. Fieldwork was supplemented by laboratory assays to investigate the germination behaviour of seeds from three *Gentiana lutea* populations after heat-shock treatments and heat-shock combined with dormancy break treatments. Fieldwork results showed that wildfire effects were negative at short term, but populations were recovered six years after fire. We identified cutting as an appropriate management strategy, because shoot formation was stimulated and competition with woody species was eliminated for several years. Laboratory assays found that heat-shock do not enhance seed germination and a gibberellic acid pre-treatment is required for seeds to germinate.

S1. Oral

Richness and diversity of arthropods in forest of the Mediterranean region and their interactions with the lichen *Lobaria Pulmonaria*

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Forest biodiversity is partially dependent on habitat heterogeneity at several spatial scales. A source of this heterogeneity for forest invertebrates is provided by epiphytic species, including lichens. Lichens are potentially important refuge and food for many arthropods. However, little is known about how lichens influence invertebrates richness and diversity. The aim of this study is to assess how the richness and diversity of invertebrates in oak and beech forests in the centre of the Iberian Peninsula was influenced by *Lobaria pulmonaria*, a threatened lichen species. Two different phorophytes of *L. pulmonaria, Q. pyrenaica* and *F. sylvatica*, were studied. A total of 80 bark traps at two heights (base and 1.5 m) were placed in 40 trees. In addition, 20 L. pulmonaria thalli per tree species, were randomly collected. Four sampling periods, one per season, were carried out along a year, and all arthropods found were identified at order or family level. A total of 24 groups of arthropods were found. The assemblage of arthropods differed between *Lobaria* thalli and the bark traps on each tree species. Differences between heights were less clear. A clear seasonal shift was detected in the arthropod assemblages, with a higher presence of arthropods on *Lobaria* in autumn and winter.

S1. Poster

A preliminary analysis of the relationship between landscape heterogeneity and bird species richness in the Cantabrian Mountains (NW of Spain)

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During the last decades, landscape fragmentation associated to land-use change has been identified as a main factor of biodiversity loss. Thus, it is necessary to develop appropriated methodologies to predict species richness in complex and changing landscapes through indicators of spatial variability. These approaches are particularly relevant in the context of the European Landscape Convention, which implementation is limited by a lack of basic ecological information for decision makers and end-users. This study aims to explore the relationship between landscape heterogeneity and bird species richness in the Cantabrian Mountains (NW Spain). Landscape heterogeneity was estimated by applying both Shannon diversity and Whitaker indices on landscape maps elaborated by integrating topographic, human variables and land cover data (NDVI and CORINE). Bird richness was calculated as the number of species present in the Spanish Inventory Database of the Terrestrial Species. Calculations were made at two different levels: water basins and regular grids of different cell size that were subsequently aggregated (20x20km, 50x50km and 100x100km) to test the importance of using units with ecological meaning against arbitrary units. Results showed a significant relationship between landscape heterogeneity and bird richness at the level of water basin, but not at the level of regular grids. This finding confirms the relevance of choosing land units with an ecological/geographic meaning, against arbitrary units, to identify emerging relationships between spatial patterns and biodiversity at landscape scale.

S1. Poster

Flow regulation of vegetation successional processes in an ephemeral stream.

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Mediterranean climates favor ephemeral streams with short flow pulses and long flow absence. Terrestrial vegetation of El Partido stream (Doñana Parks) has been recorded along 3810m in 10x15m plots on either side of the channel. In each plot channel morphology changes and flow/flooding were recorded monthly for 2 y. Plant abundance was measured as numbers (trees), cover (shrub) and frequency (herbs). Sampling was repeated in two years. Factor analysis separated scrub and herb layer units. Mobile split window analysis of vegetation along stream identified frontiers at different window sizes. Vegetation units occur along the stream separated by neat boundaries matching geomorphological features (pools, bars, steps). For each stream segment plant composition of riverbed is closer to bank vegetation, highlighting the role of floodplain vegetation as source of seeds for the channel. Ordination of all samples on the Ist axis of factor analysis matches plot location along river, revealing the role of water flow in sustaining connectivity. During flow episodes channels, banks and pools are rebuilt, herb layer disappears and perennials are partially eroded away. The stream exhibits an ecological mosaique with a repeated pattern of natural elements. Favourable biotopes are shifted to new places where species dispersal will rich them, starting a new succession. A network of vegetation succession caused by flow in temporary streams is proposed.

S1. Poster

Early establishment of *Quercus insignis*: an oak species with the biggest acorn of the world

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Germination, emergence and seedling growth of *Quercus insignis*, a critically endangered cloud forest oak species, were analized under two different light conditions in a secondary forest fragment in southern Mexico. Light conditions were: 1. Canopy Gap (CGA); available Photosynthetically Active Radiation (PAR)= 97.61 ± 0.48% and 2. Closed Canopy (CCA), PAR= 19.70 ± 1.29%). Germination and emergence counts were made during 60 days (n=150 acorns each light condition) and growth during 1.3 years (n=60 seedlings each condition). Growth measurements were: height, basal diameter, leaf number and leaf area, represented by relative growth rate (RGR). Height/basal diameter relation were represented by Slenderness. At the end of the experiment, specific leaf area (SLA) was obtained. Data were analized by generalized linear models (glm). Germination (P=0.46; CGA= 68.66 ± 4.14%, CCA=64.66 ± 4.03%) and emergence (P=0.81, CGA= 44.66 ± 4.03%, CCA=43.33 ± 4.29%) were similar between conditions. However, light had a significant effect on growth. RGRheight, RGRbasal diameter, Slenderness, RGRleaf and RGRleaf area were higher under CGA than in CCA (P<0.000), except SLA, higher under CCA (P<0.000). Survival growth was not affected by light (P=0.09). Results indicate germination and emergence processes are not affected by light (with these PAR values). Nevertheless, seedling growth were higher under CGA although survival were similar in contrasting sites. This study reflects *Q. insignis* can be successfully propagated and introduced in secondary forest fragments derived from cloud forests in the surroundings, but it is still necessary to study another factors than can affect its early establishment.

S1. Oral

Geographic patterns of biodiversity suggest an out-of-Gibraltar origin for a northward expansion of Mediterranean heathlands

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Mediterranean heathlands occupy acid, nutrient-poor soils of the western half of the Iberian Peninsula and northernmost tip of Africa. They are dominated by low, Ericaceous shrubs, being Erica australis one of their most representative species. This habitat is associated with mild temperate, Mediterranean-type climate, and it is certainly more abundant in the northwestern section of Iberian Peninsula. Owing to the comparatively high plant diversity, this region has been suggested as the glacial refugium for European heathlands. The biogeographical role of Mediterranean heathlands from further South in the Iberian Peninsula and northwestern tip of Africa has been systematically overlooked or underestimated. Here we explore geographic patterns of biodiversity of Mediterranean heathlands throughout its entire range at both species (woody plants) and genetic (*Erica australis*) levels in order to infer its biogeographical history. At the species level, our results showed highest woody species richness and, particularly, highest endemism in heathland samples from the Strait of Gibraltar region, and a northward decrease in endemism. At the genetic level, haplotype diversity of *E. australis* was also highest in the Strait of Gibraltar and decreased towards the North. These parallel patterns highlight the high diversity values of Mediterranean heathlands from the Strait of Gibraltar and support the role of this region as the biogeographic origin or glacial refugium for Mediterranean heathlands.

S1. Poster

Thinning intensity influences deadwood in mixed Scots pine forest in the western Pyrenees

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Deadwood plays a variety of roles in woodland systems through its influence on nutrient cycling, carbon storage, hydrological processes and on biodiversity. The aim of this study was to estimate the amount of woody debris that remains in a mixed Scots pine-beech forest under different thinning intensities. The study forest is located in the western Pyrenees (Navarre, NE Spain). Nine experimental plots were set up and thinned at three intensities: 0%, 20% and 30% of basal area removed. Deadwood components studied were logs, divided into coarse woody debris (CWD, diameter >7cm) and fine woody debris (FWD, diameter 2-7cm), stumps and snags. Logs and stumps were sampled by line intersect methodology, whereas snags were inventoried for whole plots. Decay condition was assessed by qualitative classification based on the physical appearance. Mean deadwood volume and biomass in unthinned plots were 80.7m3ha-1 and 35.1Mgha-1, respectively, and 27.5m3ha-1 and 10.8Mgha-1 in thinned plots. These results fell within the range identified by other studies carried out in boreal and temperate pine woodlands, and are over those found in managed Mediterranean forests. Significant differences were found between control and thinned plots. This difference remained when considering snags and FWD, showing that mortality and self-prunning processes have greater importance in unthinned stands. Snags were the main deadwood component in unthinned plots but they became less important with increasing thinning intensity, which may endanger cavity-nesting birds. Although deadwood in this Pyrenean forest complies with recommendations for associated biodiversity conservation, deadwood harvesting after future thinnings should be carefully planned.

S1. Poster

Pollinator assemblages of *Ziziphus lotus* (Rhamnaceae) change according to land use and habitat fragmentation in semiarid southeastern Spain

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(1) Universidad de Jaén.

Since the 60s native populations of *Ziziphus lotus* of Iberian Peninsula (arborescent scrubs with Ziziphus, habitat 5520 Habitats Directive) have suffered a severe decline as a consequence of expansion of greenhouse agriculture and urbanization, and such phenomena may disturb plant-pollinator associations in these habitats. This study seeks to clarify to what extent the degree of habitat alteration is influencing pollinator-plant associations, with special attention to pollinator taxonomic and functional diversity. We chose nine populations of *Ziziphus lotus* in Almeria province according to land use type: highly-fragmented habitat by intensive agriculture (2 sites), partially-fragmented habitat (2), 'rambla' habitat (2), and residual habitat of native vegetation (3). In each population we selected 25 individuals randomly to which 5-minutes pollinator visitation censuses were performed (three visits during May-July flowering period, two censuses in each visit, one in the morning and another in the evening). We recorded number and species of floral visitors, number of flower visited/visit and duration of each visit). According to the observed taxonomic groups, all habitats showed a dominance of Hymenoptera with the exception of ramblas where the predominant group was Diptera. However, according to behavioral functional groups, "transient large flies" and "partially-diving large ants" were the dominant groups in all disturbed habitats, while in most natural habitats the dominance was clearly shown by the "transient large bees". Both taxonomic and functional pollinator diversity seem to shift as a consequence of habitat fragmentation and land use.

S1. Poster

Pollinator visitation rates and fruit production vary according to land use and habitat fragmentation in *Ziziphus lotus* (Rhamnaceae)

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(1) Universidad de Jaén.

Intensive agricultural practices, mainly greenhouse agriculture, are seriously threatening native populations of *Ziziphus lotus* (arborescent scrubs with *Ziziphus*, habitat 5520 Habitats Directive) in southeastern Iberian Peninsula. This study seeks to clarify how land-use and fragmentation of this habitat are affecting pollinator visitation rates and fruit production of *Z. lotus* populations. We chose nine populations in Almería province according to its degree of landuse and habitat alteration. In each population 25 individuals were selected and during May-July pollinator visitation, flowering and fruiting were monitored in censuses conducted in three visits to each population (two 5-minutes censuses per visit). Fruiting success was positively related across populations to flower and pollinator visitation rates, which tends to be affected positively by fragmentation, with severe and moderate fragmentation rendering higher pollination and flower visitation rates than low fragmentation and Ramblas. Landuse affected less clearly pollination visitation rates, although populations surrounded by green-houses achieve the highest values; however flower visitation rates reached its maximum at natural habitats and minimum at partially-abandoned croplands. Populations with higher number of floral visits and higher number of ripe fruits had "transient large bees" as dominant floral visitors while the population with a lower number of floral visits and lower production of fruits had the lowest number of visits by this group. We conclude that pollination and fruiting success are being affected positively by fragmentation and greenhouse agriculture because they are favoring large bee abundance in the landscape, probably associated to the greenhouse practices.

S1. Oral

Towards a unified framework for community ecology

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The organization of species in ecological communities has been one of the central debates in ecology for more than a century now. One key aspect –that dates back to the Clements vs. Gleason debate in the early XXth Century– is the role of species interaction in determining which species hold populations in a locality; opinions range from the extreme position that communities as mere assemblages of non- or weakly-interacting species that coexist in a locality due to adequate conditions, to the thought that the establishment of species in a community is entirely driven by the interaction with those that are already present. Another key issue –that has been the subject of hot debate during the last twenty-five years– is whether species' niches are determinant for species persistence in an assemblage, or rather this is the outcome of neutral, dispersal-driven, processes. Assuming that all these radical positions are extremes of the natural variability in community dynamics, I propose a conceptual framework for understanding the differences in the processes operating in different ecological communities. This framework allows unifying apparently contradictory bodies of theory. It is also particularly useful for conservation biology, since it provides important information about how different communities and landscapes shall be managed.

S1. Poster

Soil multifunctionality independently of altitude increases plant richness and diversity in High Mediterranean climate type Andes

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The high-mountain ecosystems are considered among the most vulnerable to global change especially in the case of Mediterranean type ones where not only coldness but drought afffect plant life. To know how different environmental factors affect to plant communities of alpine habitats plants is a breakthrough for conservation. We evaluated the effect of different environmental factors on richness, cover and diversity of a community of alpine plants in the Chilean Andes. Plant composition of 20 plots were sampled at two scale: 20 x 20 m and 2,4 x 2,4 m. Altitude was recorded, litter percentage was measured and, sunshine and soil multifunctionality index were estimated. Soil multifunctionality index and not altitude showed a direct and positive effect on species richness and diversity at both spatial scales . This functional index represents not only the stock of nutrients available in the soil but also the nutrient dynamics and microbial activity. It suggests that soil quality and not altitude increases plant richness and diversity. This could be related with the fact that conditions at edge conditions (up and low limits) are very stressful by two opposing drivers, freezing and dryness, so limiting the plant primary productivity.

S1. Oral

Plant domestication through an ecological lens

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Archeology and genetics have produced most of our understanding of domestication processes. Here we advocate that the use of current ecological theory and tools provides novel insight into the causes and limitations of evolution under cultivation, as well as on the wider ecological impacts of crops. Generally, domestication research has focused on artificial selection while not stressing enough the roles that natural selection in the cultivation environment and that correlated evolution have played during the emergence of crops. Ecological theory makes testable predictions about the environmental selection pressures occurring under cultivation, the constraints limiting crop evolution, and the feedbacks that newly evolved domesticated phenotypes exert on ecosystem processes and on co-occurring biological communities. We will discuss the consequences of domestication in the light of ecological theory at three biological scales – individual traits, the integrated phenotype, and the extended phenotype. The benefits of studying domestication through an explicit ecological lens are multiple. First, domestication provides an excellent study system for basic ecological research, such as testing ecological strategies theories, hypotheses on evolution of mutualisms, or plant defense theories. Additionally, plant breeders can benefit from systematic knowledge on the functioning of wild plants, taken to a crop-centered focus, particularly at a time when wild gene pools are at the heart of breeding efforts. Further, the ecological lens would add conservation value to crop wild relatives, but also to unrelated wild species with previously unsuspected agronomic value. This will join to and strengthen current efforts on agrobiodiversity conservation.

S1. Poster

Distribution and habitat preferences of the small rodent community in the National Park of Aigüestortes i Estany de Sant Maurici

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Small rodents are adapted to a variety of environments worldwide, being the most diverse group of mammals. Their distribution mainly depends on vegetation type, climatic conditions, predation and human habitat management, and their populations can typically experience rapid changes in time. Collapse of rodent populations may lead to important impacts in ecosystem functioning, particularly for rodent-dependent predators and rodent-dispersed plants, so that continuous research is needed to understand and protect the small rodent communities. The National Park of Aigüestortes i Estany de Sant Maurici is a protected area located at the Pyrenean Mountains that hosts a variety of emblematic habitats and species. We surveyed the small rodent community of the Park in three different habitat types (pine wood, grasslands and fir wood) across an altitudinal range from 1600 to 1900 m.a.s.l. in years 2012, 2013 and 2014. We recorded species of mice, dormice and voles, being this community highly structured by the habitat types. Mice species (*Apodemus* sp.) were the most common, occurring in all habitats. However, dormice (*Elyomis quercinus*) were found almost exclusively in fir woods, whereas voles (*Myodes glareolus*) were just present in fir woods and grasslands. We also found some inter-annual changes in the distribution patterns and the relative abundance of each rodent species, as well as different patterns of space use at microhabitat scale. We highlight the need of long-term monitorings of small rodent communities in view of current evidences suggesting that climate change is one of the main drivers of change for European rodent populations.

S1. Oral

Response of Reptile Assemblages to Fire – A Global Meta-Analysis

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Wildfires are considered among the disturbances with a major impact on community structure and ecosystem functioning in many areas of the world. This disturbance has major effects on narrow-ranging species, such as reptiles. Indeed, this is a good model group to track population shifts as they are ectothermic, sensible to modifications in habitat attributes such as vegetation structure and canopy, have low mobility and dispersal rates, and experience high rates of population declines and extinction. For that, need special attention in terms of conservation and monitoring. In this study we perform the first quantitative synthesis describing the effects of fire on reptile communities worldwide, using meta-analytic methods. With this we hope to access some gaps on the reptile research, by providing an insight of reptile response to fire in different locations and at different time since fire. Specifically we expect: 1) to quantify the effect of fire on the reptile communities worldwide; 2) determine if there is an influence on the effects of fire by factors such as fire type and habitat location. Reptiles' abundance is positively influenced by fire in the early successional stages, between 1 and 10 years after the disturbance. These results may emphasize the need for open spaces for thermoregulation. Different species often peak in abundance at different seral stages following fire, due to changes in the availability of resources as time-since-fire progresses, and due to changes in the landscape as fire promotes the occurrence of new open areas and facilitates the recolonization of open-space species.

S1. Poster

Effects of Fire on Reptile Communities

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There is an increasing recognition that fire is an important component of many ecosystems in the world, essential to the ecology and diversity of communities. Fire impacts fauna directly, through mortality, or indirectly by changing habitat structure and resources availability. Despite the impression of destruction, following fire, impacts on fauna are not necessarily negative and will be some winners and some losers, which may change along the succession. Reptiles are a good model group to track population shifts along a post-fire succession as they are ectothermic, sensible to modifications in habitat attributes such as vegetation structure and canopy closure, have low mobility and dispersal rates, and experience high rates of population declines and extinction. The main goal of this study was to examine how reptile assemblages are affected by fire. Particularly, how reptile communities (composition, species richness and abundance) change with time-since-fire. For this, we compiled published experiments carried out worldwide examining reptile composition and abundance between unburnt and burnt areas (with different times-since-fire). We investigated differences in reptile diversity and abundance along post-fire succession in relation to unburnt areas.

For lizards, diversity (richness), but not abundance, decreases after fire (<1y) but recovers quickly to pre-fire levels with increased abundance. Regarding snakes, diversity is not significantly affected by time-since-fire but abundance decreases in the latter stages of post-fire succession.

Our results suggest that immediately after fire there is a decrease in species richness (particularly for lizards) but communities recover quickly and reptile abundance increases in early stages of post-fire succession.

S1. Poster

Habitat Suitability Modelling of *Asphodelus bento-rainhae* P. Silva using the Analytic Hierarchy Process (AHP)

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(1) ESA-IPCB.

Asphodelus bento-rainhae P. Silva is a plant species belonging to the order of Liliales. This endemic plant occurs in central Portugal in an area of only 700 hectare of the Serra da Gardunha (Fundão, Portugal). It is mainly present in north to northeast facing slopes and found in deep soils and open areas. It occurs along the edges of oak and chestnut forests. Sometimes, it survives in pine forests, mixed woods and slopes or roadsides. The tree plantations, as well as urban sprawl, have decreased the extent and quality of its habitat. The mapping of the *A. bento-rainhae* habitat suitability index results on the integration of a set of biophysical criteria using the ArcGIS 10.3 software, based on literature concerning the species ecology. The data used included bioclimatic, soil and topographic variables, based on a digital terrain model (DTM). All the geographic themes were classified into three suitability levels: unfavorable, less favorable and favorable. Based on the reclassified themes, the habitat suitability index (HSI) for *A. bento-rainhae* P. Silva was calculated using the Analytic Hierarchy Process (AHP). The fundamental concept of AHP lies in proceeding from a pairwise comparison of criteria to evaluate the weights that assign relative importance to these criteria. In the end, a map algebra was performed. The results regarding the actual species distribution, obtained in the aim of fied work performed in the LIFE-Nature project "*Asphodelus bento-rainhae* - Measures to manage and preserve it" show a high correlation with the values of HSI.

S1. Poster

Co-existence of calopterygid damselfly species: neutrality or negative frequency dependence?

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Closely related species often share the same local environment and use similar resources. Local diversity could then be maintained through some frequency-dependent species maintenance mechanism, fulfilling the invasibility criterion. Alternatively, and according to the neutral theory of biodiversity, different species should randomly go extinct over time. Here, I studied two closely related and congeneric damselfly species (*Calopteryx splendens* and *Calopteryx virgo*) to investigate if, how and why species with similar ecology could coexist. Through an experimental investigation ,I investigated if there was any evidence for either species neutrality or coexistence via negative frequency dependent survival advantages of rare species. I quantified the longevity of both species under several different density and frequency treatments, where the number and species composition was manipulated in a fully factorial experimental design. My results suggest that longevity of these two species was similar over a large range of densities and frequency treatments, except when total male density was low and the frequency of *C. splendens* males was high. In this situation, *C. virgo* males showed evidence of a negative frequency-dependent survival advantage. I also discuss how territorial plasticity might contribute to coexistence between the two species. I found that *C. virgo* was significantly more likely to be territorial in two out of six treatments than was *C. splendens*. Overall, my results are consistent with species neutrality across most density and frequency environments, although there is also evidence for negative frequency dependent fitness advantage of *C. virgo* at low density and when *C. splendens* was common.

S1. Oral

Evolutionary determinants of species distributions: a case study with North American conifers

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Understanding why species are not distributed randomly across space is a central goal of ecology and biogeography. One way to pursue this goal is to focus on the relationship between current climate and historical patterns of climate change. In their response to past changes in climate species had to adjust their phenotypes to cope with multiple stressors or migrate into new areas tracking suitable habitat. Identifying the evolutionary shifts of the traits that allowed past species adaptations may facilitate understanding not only of current distributions but also how species may respond to future climate change. Using North American conifers as a case study we apply comparative phylogenetic analysis and ancestral reconstructions to infer how Cenozoic climate change shaped the morphological and physiological trait differences between modern species. Observed adaptive trait shifts from ~50 Ma onwards are consistent with an expansion into increasingly cooler and drier Cenozoic habitats that followed the early Eocene climatic optimum. This matches to the major climatic drivers acting upon current geographical patterns of conifer traits: temperature and precipitation. Mapped phylogenies combined with phylogenetic correlations also indicated correlated evolutionary processes of several traits. One of the strongest was the negative correlation between shade and drought tolerance. Contrary to expectation, fire resistance and tolerance did not show a clear evolutionary history, suggesting species-specific adaptations to contemporary fire regimes. We conclude that the modern biogeography of North American conifers was shaped in large part by their capacity to adapt to drought and shade conditions.

S1. Oral

Regional connectivity of remnant *Ziziphus lotus* populations mediated by Red fox (*Vulpes vulpes*) endozoochorus seed dispersal in the semiarid southeastern of Iberian Peninsula.

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Natural habitats of semiarid southeastern Spain are in an accelerated process of loss, fragmentation and degradation due to urbanization and expansion of greenhouse agriculture since last 60 years. In particular, *Ziziphus lotus*-dominated scrublands are habitats with priority interest for European conservation directives because they have been displaced to <5% of their original extension. We characterize connectivity of remnant populations of this species through its distribution range in Almería province. We surveyed and geo-localized specimens through all region, complementing our data with GBIF, and characterized resistance to movement of Red fox as mobile vehicle for long distance dispersal of the species using land-use information. Considering the maximum dispersal distance of endozoochorus plants by Red fox, we modeled connectivity of remnant patches of *Z. lotus* through the region, as well as resistance maps and minimum resistance pathways for seed dispersal. We used CONEFOR, LINKAGEMAPPER and CIRCUITESCAPE for modeling. Despite red fox provides considerably long distance dispersal (2400m), we obtained a reduced connectivity for *Z. lotus* through the region (PC=0.31), meaning that only 31% of the area remain connected for the species. Provided its value for seed flux among patches and its stepping-stone role between East and West side of the coastline, the area of Amoladeras-Retamar-Toyo-Alquián, which is in part protected, was identified as the most critical patch for connectivity. Other non-protected patches play fundamental role for connectivity being merit of further management efforts. Minimum resistance pathways and maps inform about how optimizing future efforts to improve management and conservation of this habitat.

S1. Poster

Differential functional responses to water stress and fungic infection by *Fusarium graminearum* in the *Brachypodium distachyon* grass complex species

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The *Brachypodium distachyon* (Poaceae) complex is constituted by three close-related species, the diploids *B. distachyon* (2n=2x=10) and *B. stacei* (2n=2x=20), and its derived allotetraploid *B. hybridum* (2n=4x=30). These three species are ecologically differentiated. *B. distachyon* grows in higher, cooler and wetter sites, B. stacei in lower, warmer and drier places, and B. hybridum in places with intermediate climates but closer to that of *B. stacei*. Fungi infestation also varies between populations differing in humidity, being higher at wet populations. To test whether such ecological differentiation has an adaptive basis we performed two experiments in which we evaluated functional responses of species to abiotic (drought) and biotic (pathogenic infection) stress. First, 120 genotypes from these species were subjected to well-watered conditions vs. dry-down soil conditions and recorded physiological measurements related to drought-tolarence. In a second experiment, these genotypes were infected with a common fungus pathogen of cereals, Fusarium graminearum, and recorded leaf damage across time. In dry conditions, *B. distachyon* showed higher water content, lower electrolite damage and proline concentration than *B. stacei* and *B. hybridum*, concordant with a drought-tolerant response. Contrastingly, B. stacei and *B. hybridum* genotypes showed low drought-tolerance, rather acting as drought-escapers. Relative leaf damage was highest in *B. distachyon*, intermediate in *B. hybridum* and lowest in *B. stacei*. Our results support that ecological differentiation may be based on a different adaptive response of species to drought. The fact that *B. distachyon* growing in wet habitats shows stronger susceptibility to fungi infection suggests potential maladptation to these environments.

S1. Poster

Afforestation of open farmland affects nest predation of ground nesting birds

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Afforestation of open farmland in Mediterranean traditional agricultural systems is recognised to increase nest predation risk of ground nesting bird species. Nonetheless, how the predation risk and the type of nest predators vary with the distance to the edge are still unknown. We used artificial nests baited with two quail eggs in 26 agricultural parcels with fallows or pastures adjacent to forested areas (pinewood, eucalyptus, and holm and cork oaks stands) in spring of 2014 in the Mediterranean plains of southern Portugal. In each sampling plot, nests were placed at each 100-m across transects perpendicular to the forest-grassland edge and located until 300 m in grassland and a maximum distance of 300 m in the interior of forested area. Each nest (n=144) was surveyed by a camera trap during seven days to identify predators and estimate predation rates. Two controlling nests without camera were placed at 25-m from each nest with camera (n=90), one to control the camera effect and another to control the herbaceous removal. We identified the predators of 73% of the predated artificial nests with camera, which belong to a total of 12 species. The predators of the remaining 27% were unknown. Corvus corone was the main nest predator (49% of the identified predators). A GLM (binomial response variable) suggested that edges, but not forest type, might indeed play an important role in shaping nest predation risk because predation rate increased with the distance to the edge, while vegetation removal (nest surface) may also affect the results.

S1. Oral

Generalized Diversity-Interaction models are a powerful tool to reveal diversity effects on multifunctionality in model agroecosystems

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Experiments testing biodiversity-ecosystem function interactions have been established since the late 90s'. The problem is how to model responses, and disentangle identity from diversity effects; that is, how to separate positive effects associated to increasing probability of having a good performing species when increasing the species pool, from true diversity effects derived from species interactions. Furthermore, discrimination between species richness and evenness effects has often been neglected in most experiments. In 2003, the Agrodiversity experiment was established following the simplex design, where sown proportions of n species can be treated as particular vectors in the n-dimensional space. The development of the Generalized Diversity-Interactions models in the framework of this experiment is a powerful tool to discriminate among species identity, richness and evenness effects. The Agrodiversity experiment included mixtures of productive forage species, locally adapted to the conditions of the over 30 sites in the experiment, distributed at continental scale. This and later experiments following the same methodology have confirmed the positive effects of biodiversity on several ecosystem functions and have revealed the important effects of biodiversity on previously untested functions: increased productivity; increased stability of productivity; substitution of fertilization by diversity; reduction of weeds and pests; decreased N2O emissions; preservation of forage quality.

S1. Oral

Contribution for *Plantago* spp. conservation

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The ecology of *Plantago almogravensis* (Plantaginaceae), a rare endemic critically endangered and Al-hyperaccumulator species, was investigated to recognize limiting factors contributing for the species' rarity. This knowledge can then be used to contribute for conservation purposes. We focused on: (i) determining major ecological niche factors; (ii) diagnose crucial phases in the species' life cycle through studying the dynamics of its population; (iii) comparing and integrating, sister species knowledge to better understand its phylogenetically based response and its evolutionary position among the closest members of the genus. We aim to contribute to the theoretical study of rarity and the ecological role of rare species in the ecosystem, while suggesting also directions towards conservation.

S1. Poster

Inhibitory effects of litter from treeline dominant species on the germination and early establishment of *Pinus uncinata*

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The effect of different plant species on the seedling emergence of *Pinus uncinata* at treeline is poorly known, although this is acknowledged to be a strong driver in the dynamics of this ecotone at local scale. In potential safe sites for pine germination, litter accumulation may act as a limiting factor due to structural effects or to chemical effects (allelopathy). We used litter of eight species that may be locally dominant at treeline to perform three experiments under controlled conditions. In the first one we put litter directly on sown seeds, and in the other two we watered the sown seeds with litter lixiviates at different concentrations. The litter of all the species studied limited the germination of Pinus uncinata through different effects and intensities. Contrastingly, any litter type significantly reduced initial seedling growth. These species may be classified into three groups according to the limitation exerted. Only one species (the grass *Festuca gautieri*) had solely a physical effect, due to its thick, dense litter layer that inhibited germination. Two conifers (*Pinus uncinata, Juniperus communis*) formed thin litter layers only inhibiting germination by allelopathy. And five dicots (*Arctostaphylos uva-ursi, Betula pendula, Dryas octopetala, Vaccinium myrtillus, Rhododendron ferrugineum*) reduced germination through both structural and chemical effects of their thick, dense litter layers. These contrasting results suggest differential limitation for the expansion of *Pinus uncinata* populations into distinct landscape units. These constrictions, combined with other modulating factors such as seed rain or terrain parameters, drive the Pyrenean treeline encroachment and advance.

S1. Oral

Demographic compensation across environmental gradients and species' distribution ranges

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Intraspecific variation is an often neglected aspect of biodiversity. Species are exposed to environmental gradients across distribution ranges, although vital rates (survival, growth, reproduction, and recruitment) need not respond in the same ways to these environmental differences. Opposing vital rate trends across environmental gradients, a phenomenon called "demographic compensation", might allow species to occupy larger geographical ranges and be buffered against shifting local conditions, and have thus important implications in ecology and conservation. Yet the term has never been precisely defined, nor has its existence or strength been tested for multiple species. Here we provide a rigorous definition, and use it to develop a test for demographic compensation. By applying the test to data from 26 published, multi-population plant studies, we show that demographic compensation commonly occurs, although the scarcity of information at large spatial and temporal scales limits our ability to detect it. We also investigate the mechanisms by which demographic compensation arises by assessing the types of demographic processes and life stages that are most often involved, and we quantify its effect on the variation in population growth rates across environmental gradients, a potentially important determinant of the size of a species' geographical range. Finally, we discuss the implications of demographic compensation for the responses of populations to temporal environmental variation and to ongoing environmental trends, e.g. due to climate change.

Sessão 2. Monitorização Ambiental e Restauração Ecológica / Sesión 2. Monitorización ambiental y Ecología de la restauración

S2. Oral

Aquatic macroinvertebrate species traits and urban stream disturbance

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Urbanization has deep impacts in streams affecting all aspects of the ecosystem. The distinctive impacts of urbanization include the increase in impervious surfaces which in turn alters the hydrology and geomorphology of streams. Thus, urbanization affects not only water quality but also habitat characteristics. Biological indicators may reveal spatial-temporal effects of stressors and their cumulative effects on stream biota but the multiple, co-occurring and interacting stressors of urban streams, namely habitat alterations, may be better revealed by macroinvertebrate traits - the species adaptations to environmental conditions. The aim of this study was to evaluate urban stream health using aquatic macroinvertebrate species traits. We expected a decrease in environmental quality and a concomitant response of the macroinvertebrate community along the longitudinal gradient. The results obtained during four sampling occasions at four sampling sites of Ribeira dos Covões, a small peri-urban stream in Coimbra show that macroinvertebrate biological, physiological and ecological traits respond to environmental alteration suggesting that species traits can be used to assess the urban stream environmental stress. However, in this particular case, seasonality rather than site was the major cause of environmental alteration and the response of macroinvertebrate species traits identified this seasonal pattern rather than a longitudinal one.

S2. Oral

The role as species reservoir of areas affected by road construction

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Transport infrastructures are generally perceived as a generator of negative impacts on ecosystems. However, compared to these adverse effects, some researchers suggest that areas affected by road and railway construction can increase landscape heterogeneity, providing refuge for certain species, especially in intensive agricultural landscapes. In order to test this hypothesis is necessary to ascertain whether the road verges are able to maintain species or communities of interest from the point of view of conservation and generation of ecosystem services. This knowledge will allow improvements in restoration and maintenance measures of the road verges. This study was carried out on a stretch of 12 km of highway A3 (Madrid-Valencia, Spain, between provinces of Madrid and Cuenca), which runs along a fragmented agricultural territory over gypsum soils. We measured the coverage of all species of perennial plants in 92 plots of about 400 m2. The plots include road verges (mostly roadslopes) and fragments of natural vegetation. The results point that road verges are able to be home to very rich and diverse communities, including species of conservation concern. Moreover, the road verges maintain both the regional pool of species as other species not found in the natural vegetation plots. These results point to the need for ecological restoration techniques to manage road verges, due to its potential as a refuge for species and biological corridors.

S2. Poster

Using equilibrium temperature to assess thermal disturbances in rivers

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We examine the sensitivity of an empirical approach, the Temperature Equilibrium Concept (TEC), to detect both the effects of hydraulic infrastructures on stream temperature and the recovery of thermal equilibrium with the atmosphere. Analysis was undertaken in a Pyrenean river affected by a series of hydropower dams and related water diversions. Equilibrium temperature (Te) is defined as the water temperature (Tw) at which the sum of all heat fluxes is zero. Based on the assumption of a linear relationship between Te and Tw, we identified the thermal alteration in river flow, and assessed its magnitude by examining the regression slope and its statistical significance. Variations in the regression parameters were used as indicators of the influence of factors other than atmospheric conditions on water temperature. Observed Tw showed a linear relationship with Te at all river stations. However, the slopes of the Te-Tw relationship appeared to be lower in the reaches downstream from hydraulic infrastructures, particularly below large reservoirs. Although thermal characteristics did not strongly depend on atmospheric conditions downstream of hydraulic infrastructures, the river recovered to pre-alteration conditions with distance downstream, indicating the natural tendency of water to attain thermal equilibrium with the atmosphere. Accepting associated uncertainties, mostly due to the quality of the data and the lack of consideration of other factors influencing the thermal regime, TEC appears to be a simple and effective method to identify thermal alterations in regulated rivers.

S2. Oral

Tree nutritional responses to atmospheric N deposition are dependent on the species leaf longevity: N use strategy and stoichiometric shifts

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Chronic atmospheric N deposition has modified relative N availability, altering biogeochemical cycles of forests and stoichiometry of nutrients in trees, inducing P limitation, and modifying N:P ratios of plant biomass. On the other hand, inter-specific variability in leaf longevity is known to be related to N use and elemental stoichiometry in plant species. However, studies on tree nutritional imbalances resulting from N deposition have not yet considered leaf longevity as a potential factor explaining divergent responses among species. We examined shifts in needle stoichiometry and aminoacid profiles along a geographic N deposition gradient, and in response to compensatory P fertilization applied to N-saturated forests near the pollutant source. Two coexisting species differing in leaf-longevity were compared (Abies pinsapo, up to 15 year-old leaves; Pinus pinaster, needle life-span < 5-yr). We also applied 15N-labeling to young- or old-leaves in separated branches within trees to track if N allocation across needle ages was dependent on the species identity and N saturation status. Normal foliar stoichiometry (specially N/P) was found in <4 yr-old needles of Abies pinsapo along the whole pollution gradient. In the N-saturated stands, abnormal N accumulation and decreasing N/P patterns arose toward older leaves, concurrently with altered aminoacid profiles (arginine accumulation); these were corrected by P fertilization. The 15N experiment further supported allocation of excess N to older leaves in the species with long-lived needles, allowing it to maintain nutritional balance and functionality of younger leaves. Species leaf-longevity should be considered when assessing N deposition effects on forest vitality.

S2. Poster

Coupling a water balance model with forest inventory data to evaluate plant drought stress at the regional level

De Cáceres Ansa, M.[1], Martínez Vilalta, J.[2], Coll, L.[1], Llorens, P.[3], Casals, P.[1], Poyatos, R.[2], Pausas, J.[4], Brotons, Ll.[1]

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Predicting current and future levels of plant drought stress is important at the landscape to regional scales, because these are the management scales at which adaptation and mitigation strategies are implemented. To obtain reliable predictions of soil moisture and plant drought stress over large extents, water balance models need to be complemented with information about the spatial variation of vegetation and soil attributes. We designed, calibrated and validated a water balance model that produces annual estimates of drought intensity and duration for all plant cohorts in a forest stand. Taking Catalonia (NE Spain) as a case study, we coupled this model with plot records from two Spanish forest inventories. We determined recent trends (1980-2010) in drought stress for the main tree species in Catalonia; where forest growth and densification occurs in many areas as a result of rural abandonment and decrease of forest management. Regional increases in drought stress were detected for most tree species, although we found high variation in stress changes among individual forest plots. Moreover, the predicted trends in tree drought stress were mainly due to changes in leaf area occurred between the two forest inventories rather than to climatic trends. We conclude that forest structure needs to be explicitly considered in assessments of plant drought stress patterns and trends over large geographic areas, and that forest inventories are sources of convenient data at these spatial scales, provided that reasonably good estimates of soil attributes and root distribution are available.

S2. Oral

Towards a biodiversity monitoring program for Portuguese forests: operationalizing the use of soil macrofauna as an indicator tool

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Forest' biodiversity is influenced by many drivers whose effects should be identified, evaluated and monitored. Extensive soil biodiversity monitoring schemes should be implemented and rely on good, cost-effective indicators and the possibility of modelling species richness using surrogates. Estimating the relation between sampling effort and percentage of species richness attained is also important, especially when considering trade-offs between costs and data robustness. To make operational the use of epigeal soil macrofauna in a monitoring programme of forest biodiversity and assess the feasibility of using surrogates as indicators, 16 areas were defined considering dominant tree species in Portuguese forests. Sampling occurred during Spring 2007, using 15 pitfall traps/area. Of the 11551 individuals collected and identified to species level (when not possible, morphospecies was used), most were Formicidae, Coleoptera or Araneae. Species richness varied among areas, reflecting differences due to main tree species, location, management practices or interactions between these factors. GLM techniques modelling total species richness and Coleoptera and Araneae species richness, delivered two significant models: one indicates Araneae and Coleoptera species richness can act as surrogates for total species richness; the other showed total family richness can be a surrogate for total species richness. Rarefaction models revealed 8 samples/site suffice to attain 70% of maximum species richness. Our results suggest surrogates can be used in Portuguese forested areas to determine soil macrofauna richness. Furthermore, a range of baseline values for soil macrofauna richness for these areas can be obtained the first step towards implementing a monitoring program using these organisms.

S2. Poster

How does the colonizing substrate affect diatom assemblages? - a microcosm experiment.

Elias, C.[1], Rocha, R.J.M.[2], Feio, M.J.[3], Figueira, E.[2], Almeida, S.[1]

(1) GeoBioTec – GeoBioSciences, GeoTechnologies and GeoEngineering Research Centre, (2) CESAM - Centre for Environmental And Marine Studies, (3) MARE-Marine and Environmental Sciences Centre.

The diatom assemblages grown on sand and ceramic tiles were investigated in an indoor controlled experiment. A composed inoculum of periphyton collected from four Portuguese streams was introduced in 12 running water artificial channels (6 sand-S and 6 tile-T) and left to colonize for 35 days. Periphyton chlorophyll a (chla) and c (chlc) concentrations, diversity (Shannon-Wiener), density (cells/cm2) and composition of epilithic and epipsammic diatoms were determined twice during the experiment (days 14 (d14) and 35 (d35)). There were no differences in chla concentration over time or between substrates (Pseudo-F=3.10, p(perm)=0.06). In both sampling moments the epipsammic diatoms presented higher concentration of chlc (Td14-Sd14 t=2.80, p(MC)=0.02; Td35-Sd35 t=2.80, p(MC)=0.03) and diatom density (Td14-Sd14 t=2.59, p(perm)=0.02; Td35-Sd35 t=2.39, p(perm)=0.03) compared to the epilithic assemblages; however, these variables were not different in both substrates along time (p(perm)>0.05). The diatom taxonomic composition was different between substrates (Td14-Sd14 t=1.36, p(perm)<0.01; Td35-Sd35 t=1.31, p(perm)=0.04) and along time (Td14-Td35 t=1.73, p(perm)<0.01; Sd14-Sd35 t=1.65, p(perm)<0.01). The diversity was similar between substrates in both sampling periods (p(perm)>0.05) but not over time (Td14-Td35 t=4.50, p(perm)<0.01; Sd14-Sd35 t=4.41, p(perm))<0.01) being higher at day 14. The present results suggest that both substrates reach an almost maximum productivity (density and chlc concentration) after two weeks of substrate colonization although diversity and community composition continue to vary. The type of colonizing substratum does influences diatom communities (productivity, density and composition). This was reflected mostly in the diatom cell number, which was higher in sand.

S2. Poster

Are "new forests" in Spain relevant for C accumulation and storage?

Espelta Morral, J.M.[1], Vila, A.[1], Vayreda, J.[1], Basnou, C.[1], Pino, J.[1]

(1) CREAF.

Land-use changes are one of the major drivers of global environmental change. In spite of a clear overall world trend of deforestation, in many developed countries socioeconomic changes have induced a widespread expansion of forests during the last centuries, with still seldom explored implications for ecosystem function. Here, we aim at assessing the contribution of these “new forests” on forest C accumulation and storage under the imprint of land-use history in the Iberian Peninsula. We used data from 6,422 plots of the Spanish National Forest Inventory (1986 ? 2007) and the land-cover map of 1956 to distinguish among pre-existing and new forests (made up after 1956). Almost a quarter of current forests were identified as new forests and they represented the 22% of the total C pool. New forests maintained similar C stocks than pre-existing ones (~ 45 Mg ha-1), but they accumulate C at rates 25% higher. The extrapolation of the accumulation of C by new forests to the whole Spanish forested territory would offset around the 9% of the rate of total C emitted in recent decades. The effects of land-use history on C dynamics varied with environmental conditions, bringing support to the idea that agricultural legacies may prevail in the long-term. In a time when the rapid increase in C emissions has turned to be one of the main ecological and societal challenges, and the first signs of carbon sink saturation in Europe have been reported our study endows an unprecedented ecological value to new forests.

S2. Poster

Using lichen diversity to evaluate the alleviation of Urban Heat Island Effect provided by green spaces

Figueiredo Vieira, J.[1], Pinho, P.[1], Duocastella, J.[1], Santos-Reis, M.[1], Branquinho, C.[1]

(1) Centre for Ecology, Evolution and Environmental Changes.

Urban areas are associated with higher temperatures than their surroundings, which is known as Urban Heat Island (UHI) effect. The UHI effect enhances the impact of heat waves, which is particularly relevant considering that most of world population lives in urban areas. It is known that increasing the amount of green spaces in a city, decreases the magnitude of the UHI effect. Using ecological indicators that evaluate the impact of microclimate changes is a way of unavailing the real importance of green spaces to microclimate changes in urban areas. Lichens communities are sensitive to environmental changes that occur in the ecosystems since they are poikilohydric. In particular lichen response functional groups, i.e. groups of species with a common response to an environmental factor, have been shown to give an integrated response to the microclimatic variations occurring in urban areas. Our aim was to use epiphytic lichens diversity to understand the effect that different types of green spaces (e.g. with different sizes, tree densities, density of the surrounding urban areas) have on alleviating the UHI effect. We found that lichen functional groups based on water and nutrient availability significantly responded to the quality of green spaces. Using this results we were able to support the decision makers of Lisbon urban area about what type of urban green spaces are able to alleviate the UHI effect, thus optimizing the urban green infrastructure.

S2. Poster

Using lichen diversity to evaluate the impact of green spaces in the mitigation of Urban Heat Island Effect

Figueiredo Vieira, J.[1], Matos, P.[1], Duocastella, J.[1], Santos-Reis, M.[1], Branquinho, C.[1], Lopes, P.[1]

(1) Centre for Ecology, Evolution and Environmental Changes.

Urban areas are associated with higher temperatures than their surroundings, which is known as Urban Heat Island (UHI) effect. The UHI effect enhances the impact of heat waves, which is particularly relevant considering that most of world population lives in urban areas. It is known that increasing the amount of green spaces in a city, decreases the magnitude of the UHI effect. But what is the importance of each garden and of its characteristics (such as tree density), is not easy to quantify. Using ecological indicators that evaluate the impact of microclimate changes is a way of revealing the real importance of green spaces to microclimate changes in urban areas. Lichens communities are sensitive to environmental changes since they are poikilohydric. In particular lichen response functional groups, i.e. groups of species with a common response to an environmental factor, have been shown to give an integrated response to the microclimatic variations occurring in urban areas. Our aim was to use epiphytic lichens diversity to understand the effect that different types of green spaces (e.g. with different sizes, tree densities, density of the surrounding urban areas) have on alleviating the UHI effect in Lisbon. We found that lichen functional groups significantly responded to the quality and quantity of green spaces. Using this results we were able to support the decision makers of Lisbon urban area about what type of urban green spaces are able to alleviate the UHI effect, thus optimizing the urban green infrastructure.

S2. Oral

A comparison of object-oriented and pixel-based classification approaches for mapping ice plant invasion using Unmanned Aerial Vehicles (UAVs)

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Two species of the genus Carpobrotus of a South African origin (C. acinaciformis and C. edulis, commonly known as ice plant), were introduced in many parts of the world as an ornamental plant and for erosion control. However, due to their exceptional adaptability to extreme environmental conditions and their reproductive strategies, this led to their extensive dispersal into regions with Mediterranean climate worldwide, where it is considered one of the most severe threats to numerous terrestrial plant communities. In this context, protecting native species against alien invasive species has become a major challenge for biodiversity conservation. Several techniques, such as remote sensing, can be used for improving the management of invasive plants through mapping actual invader distribution based on their spectral characteristics. With this aim, we used an UAV to collect very-high resolution RGB and NIR imagery (3cm GSD) and to produce a Digital Surface Model (7cm GSD) of a coastal landscape invaded by the ice plant in northern Portugal. From this data, we compared two UAV-based classification approaches: pixel-based vs objected-oriented to assess the most suitable UAV-remote-sensing methodology for mapping the distribution patterns of the ice plant. Overall, both UAV-approaches showed high mapping accuracies for identifying presence or absence of the ice plant. Based on our results we provide a discussion regarding which approach performs better under different contexts and situations. In addition, we argue that UAV technology and imagery currently provides highly detailed data in terms of spatial resolution useful for monitoring ice plant invasion over native communities.

S2. Poster

Flora monitoring in the control of invasive species. National forest of Bussaco.

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(1) Universidade de Aveiro.

The National Forest of Bussaco (MNB) is located in the central region of Portugal continental and has 105ha extension, with 17ha formed by species of natural vegetation climax, representative of the ancient forest of the region, which is call for Forest Relic (FR). Being the proliferation of invasive flora species, the main threat to biodiversity reduction in FR, at the end of 2011 has begun the implementation of a BRIGHT project financed by the Life+ programme with the objective of promoting the control of invasive species and preserves the high conservation value associated with the Relic Forest. The monitoring component of the invasive control actions, have been carried out since 2012 in order to assess the results of the implementation of the BRIGHT project. Based on monitoring results collected to date, in the 33 plots of wandering Jew (Tradescancia fluminensis) intervened, there was an increase in the diversity of native species and even germination of a seed bank of bredbladig stenlind (Phillyrea latifolia), mainly in the FRT1 plot next to the doors of Coimbra. For invasive in forest community, despite the relatively recent interventions in 20 plots, statistical analysis allowed detect for now, some significant differences at the level of vegetative cover post-BRIGHT, particularly in squares where the dominant invasive monitoring is the Australian blackwood (*Acacia melanoxylon*).

S2. Oral

A statistical spatial model of recent tree loss and tree gain areas in Mediterranean wooded rangelands as spatial reference to perform afforestation measures

Herguido Sevillano, E.[1], Lavado Contador, J.F.[1], Gómez Gutiérrez, Á.[1], Schnabel, S.[1]

(1) Universidad de Extremadura.

Iberian dehesas and montados are highly determined by their history of land use and management which, in turn, are conditioned by the physical context, particularly by the topographic features. Tree aging and lack of tree recruitment are threads to its long-term conservation, while shrub encroachment in marginal areas facilitates tree recruitment. We hypothesized that the spatio-temporal dynamic of trees, observed as tree loss and tree recruitment, could be satisfactorily explained by the topographic context where it happens. These processes should be considered when designing afforestation measures and policies. Based on historical photographs from 1956 and 2009, we analyzed the temporal tree dynamics in five dehesas of Extremadura (Spain), with a total area of 3,377 ha. Using topographical variables and Multivariate Adaptive Regression Splines (MARS), we built a spatial model that explains historical tree dynamics. Model AUC was 0.704. Correctly predictions accounted to 73.79% of lost and 72.57% of recruited trees. The model so constructed was applied to the whole area of dehesas in the province of Cáceres, using 400 circular plots of 100m radius to assess for model performance. This whole-area model showed an AUC of 0.723, correctly predicting 61.53% and 88.01% of lost and recruited trees respectively. Using 395 records of afforestation measures in the province, results showed that 56.36% (4666.72 ha) of these areas were predicted by the model as prone to tree loss, while 43.64% (3613.28 ha) were predicted as prone to tree recruitment.

S2. Poster

Ecological niche modelling for three Mediterranean pine species in the south of Spain: an implement for afforestation/reforestation programs in the 21st century

López Tirado, J.[1], Hidalgo, P.J.[1]

(1) Universidad de Huelva.

An increase in the mean temperature and a decrease in the annual rainfall in the context of global change could be a reality for the next decades. The Mediterranean basin could suffer more stressful shifts than other areas in the world. This work analyses the trends of distribution on three Mediterranean pine species: *P. pinea* L. (stone pine), *P. halepensis* Mill. (Aleppo pine) and *P. pinaster* Aiton (cluster pine). The study has been carried out by means of Ecological Niche Models (ENMs), using Multinomial Logistic Regression (MLR). The studied area extents about 8.7 million ha in the south of Spain (Andalusia region), in which 11 explanatory variables have been performed. Four time periods have been studied: reference period (1961-2000), early 21st century (2011-2040), middle 21st century (2041-2070) and late 21st century (2071-2100). Moreover, each period of the 21st century has been analysed according to three different scenarios: B1, A1b and A2; which belong to the CNCM3 General Circulation Model (GCM). Results reveal more potential distribution in the reference period respect to the current presence data. Along the 21st century, stone pine could undergo an increase of the potential area, spreading towards the east. In contrast, Aleppo pine and cluster pine could suffer a decrease, especially evident in the last one, being sheltered at higher elevations. This study has been carried out with a high degree of resolution (200 m). The accuracy of the validation model leads to final maps which are a powerful tool for afforestation/reforestation management programs.

S2. Oral

Quarry slopes restoration: the use of native species in hydroseeding mixtures

Mendes Mexia, T.[1], Oliveira, G.[1], Nunes, A.[1], Clemente, A.[2], Correia, O.[1]

(1) Centre for Ecology, Evolution and Environmental Changes - FCUL, (2) Botanical Garden, National Museum of Natural History and Science.

Open quarries are one of the most disturbed and difficult sites to restore. In SECIL quarry (Arrábida, Portugal), hydroseeding has been used since 2005 to revegetate slopes. This is a broadly used technique aimed at stabilizing the substrate and reducing erosion. Commercial seed mixtures used for this purpose include species from very few functional groups but with presumed high germination rates and fast growth. Although important for short-term results, those are usually generalist species of wide geographic distribution, probably unsuitable to promote a plant community resembling the native one. In fact, some generalists can prevent the establishment of less competitive native species which are often the goal of restoration, because they are adapted to local environmental and represent a more sustainable option in the long-term. In this study, we tested a hydroseeding mixture mainly composed by native species (18 out of 20 species) in quarry slopes. Two years after seeding, vegetation cover and maximum height increased, and consequently bare soil decreased. Vegetation cover was over 90% and largely represented by seeded species (over 80%). Although native species dominated (>60%), their cover decreased over time. The generalist legume Medicago sativa and the native grass Piptatherum miliaceum became the dominant species. Although a good vegetation cover and erosion control were obtained with the tested seed mixture, the establishment of several sown species was unsuccessful and further changes in the hydroseeding procedure must be tested.

S2. Poster

Reduna – Restoring Almada coastal dune ecosystems

Mendes Mexia, T.[1], Silva, P.[2], Lopes, N.[2], Freitas, C.[2,3], Bastos, A.[3], Andrade, C.[3], Branquinho, C.[1], Santos-Reis, M.[1], Correia, O.[1]

(1) Centre for Ecology, Evolution and Environmental Changes - FCUL, (2) Câmara Municipal de Almada, (3) Instituto Dom Luis - FCUL.

Restoration actions monitoring is essential for the proper assessment of its performance and can be decisive for ecosystem-based management. São João da Caparica coastal dunes, located near Almada (Portugal), are being restored under the "ReDuna program – Recovery and ecological restoration of the S. João da Caparica sand dune system" managed by Almada Municipality. The long-term shore retreat of the coastline, together with extreme weather conditions, led to dune erosion and vegetation degradation, aggravated by human pressure. In 2014, responding to a major storm and overwash, the dune was artificially restructured, the beach was sand nourished and the project began, including willow sand fences, plantation of dune species, and the mitigation of human pressure with fences, pathways and strong communication. Monitoring of dunes morphological evolution will be made through land systematic surveys using GNSS equipment operated in RTK mode. With these data, cross sections and three-dimensional representations will be obtained, allowing the assessment of planimetric and volumetric changes of the dune system. Beach profiles will help understand the beach-dune sediment dynamics. Plant communities will be monitored using diversity indexes, cover, survival and natural regeneration assessment. Several plant introduction methodologies will be monitored (sowing, nursery plants, near plant transplants) to understand vegetation establishment and long-term sand stabilization, as well as the cost-benefits in each choice. Key faunal groups will be used as indicators of habitat ecological functions renewal. This multidisciplinary approach will be essential to evaluate restoration progress, including the success of the different used techniques, and to define future interventions.

S2. Oral

Monitoring schema to assess the effects of a restoration activity in a channel irrigation in Sierra Nevada.

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A network of ancient irrigation channels crosses Sierra Nevada National Park (South Spain). This system was built by the Muslims in the IX century in order to improve the water use for irrigation and recharge of aquifers. This network can be considered as an artificial hydrological system able to distribute water across the landscape. Some of these irrigation channels flow through vulnerable ecosystems such as Quercus pyrenaica forests and provide water to overcome the Mediterranean drought. This traditional irrigation system is threatened by the global change: land use changes (abandonment of traditional uses, irrigation modernization) and climate change (changes in the flow, etc.). In this context we propose that irrigation channels could be useful infrastructures to buffer the impact of global change in Mediterranean mountains. The restoration of abandoned irrigation channels is a first step to test this hypothesis. MEMOLA FP7-project (Mediterranean Mountainous Landscapes.) managed to restore an abandoned irrigation channel in Barjas (Alpujarra basin) during the first months of 2014. The main aim of this activity was the recovery of the traditional land uses associated with the irrigation channel. In this work we aimed: (i) assess the results of the metioned restoration project, (ii) test the hypothesis of irrigation channels as buffers to face up global change. We designed a monitoring schema focused on the following variables: species diversity and richness, oak recruitment, vegetative and reproductive vigour, productivity, etc. Our schema includes several methodologies: field sampling (transects, fixed points, etc.) and remote sensing (satellite and field cameras).

S2. Oral

Multi-taxa ecological indicators for the effects of urbanization: fragmentation and urban heat island effect

Pinho, P.[1,2], Munzi, S.[1], Santos-Reis, M.[1], Vieira, J.[1], Matos, P.[1], Branquinho, C.[1]

(1) cE3c – Centre for Centre for Ecology, Evolution and Environmental Changes, FCUL, (2) Cerena (IST-UL).

Urban sprawling associated land-use changes and forest fragmentation has various effects on urban ecosystems. We tested if forest size alone was the key driver of urban forests biodiversity. Using a multitaxa approach, the diversity of lichens, butterflies and other arthropods, birds and mammals was evaluated in Mediterranean urban forests in south-west Europe (Almada, Portugal). Birds and lichen communities presented urban-tolerant and urban-sensitive species, which shaped functional groups, and could then be used as ecological indicators of the urbanization effects. For lichens and birds, the effect of forest's surroundings characteristics (such as the density of urbanization) was more important than forest quantity size alone. Using these biological groups, it was also possible to determine the most valuable forest fragments to be connected when aiming for a decrease of forest fragmentation in term of conservation and possible reforestation of this area. Afterwards, using lichen functional groups, we tested if microclimate could be the underlying driver of changes associated to urban sprawling. In fact, we confirmed that a shift from hygrophytic to xerophytic functional groups was associated to an increase of urbanization in the surrounding urban areas, suggesting a prevailing influence of the urban-heat island effect. This microclimate effect, and the way green infrastructures can mitigate it, could then be characterized and mapped within urban areas.

S2. Oral

New Iberian forests: community assembly rules and ecosystem functions

Pino Vilalta, J.[1], Espelta Morral, J.M.[1], Basnou, C.[1], Bonal Andrés, R.[2], Muñoz Muñoz, A.[3], Ruiz Carbayo, H.[1], Vayreda, J.[1], Vilà-Cabrera, A.[1]

(1) CREAF, (2) Universidad de Extremadura, (3) Universidad Complutense de Madrid.

Socioeconomic changes have induced a widespread expansion of Iberian forests during the last century, with still seldom explored implications for landscape, community assembly and ecosystem function. We provide the main results of the NOVFORESTS project, aimed at exploring the spatial distribution and environmental correlates of these new forests, their community assembly rules for woody plants and insects, and their contribution on forest C accumulation and storage. The distribution and correlates of new forests have been studied from combining historical and current land cover maps in especially well known regions (Andalusia, Catalonia). Lepidopteran community assembly was studied from specific sampling in Central Spanish Holm Oak dehesas, whereas woody community assembly and C uptake were studied using the IFN2 and IFN3 plots in Andalusia and Catalonia. In the studied regions, 25% of current forests are new, which are more associated to lowland, hot dry landscapes than pre-existing forests. No immigration credit of woody plants was observed in new forests except for vertebrate-dispersed species, probably due to niche constraints of plants and their dispersers. Niche differences determine strong changes in woody species composition between pre-existing and new forests. As for lepidopteran in dehesas, there is a major effect of tree age on total abundance, species richness and diversity, while species composition is mostly attributable to lottery rather than niche effects. Concerning the ecosystem functions, new forests provide 22% of total C pool, while maintaining C stocks similar to those of pre-existing ones but accumulating C at rates 25% higher in the last decades.

S2. Poster

Soil quality indicators and pasture production in SW Iberian rangelands

Pulido Fernández, M.[1], Schnabel, S.[1], Lavado Contador, J.F.[1], Herguido Sevillano, E.[1], González, F.[2]

(1) Universidad de Extremadura, (2) Centro de Investigación La Orden-Valdesequera.

Iberian rangelands such as dehesas or montados occupy a surface area of more than 40,000 km2. They are considered as a farming system of high natural value and a habitat of common interest by the European Union due to their great productivity and diversity species. However, it is a fragile landscape system where farmers' decisions such as the increasing of the number of animals can lead their soils, natural pastures or trees to a state of serious deterioration. Soil properties, land degradation processes, pasture production, rainfall and land management variables such as animal stocking rate and tree density were analyzed in order to better understand how soil quality indicators and pasture production as influenced on land management are related. The study was carried out in 22 fenced areas belonging to 10 privately-owned farms distributed throughout the Spanish region of Extremadura. Firstly, the process of selection of indicators was conducted. Cation exchange capacity, available potassium, soil organic carbon, water holding capacity, soil depth and the thickness of the Ah-horizon were selected as soil quality indicators. The percentage of bare ground surface and bulk density from 5 to 10 cm in depth were also chosen as soil degradation indicators. Finally, these indicators and their relationships to pasture production were also investigated. Results showed that an increasing of bulk density from 5 to 10 cm in depth reduces considerably the pasture production. Moreover, the influence of soil nutrients and depth, particularly in the dry years, on pasture production has been also studied.

S2. Poster

Effects of thermal pollution on benthic macroinvertebrate communities of a large Mediterranean river

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(1) IRTA.

The influence of a thermal discharge caused by the cooling system of a Nuclear Power Station on benthic macroinvertebrate communities was assessed at the lower Ebro River (in Spain). Surveys conducted at sites before and after the effluent and collected from natural and artificial substrata were analyzed and, Non-metrical Multidimensional Scaling (NMDS), Similarity Percentage Analysis (SIMPER) and 1-way Analysis of Similarities (ANOSIM) were performed to assess changes in community structure. The relationship between macroinvertebrate assemblages and environmental variables was assessed with a multivariate distance-based linear regression model (DISTLM) and the model was visualized through a redundancy analysis (dbRDA). Macroinvertebrates assemblages showed sensitivity to thermal changes both in natural and artificial substrata, even though warming did not exceed 3 oC. Factors that seemed to influence benthic macroinvertebrate assemblages the most were the thermal increase caused by the Nuclear Power Station and seasonal variation in nutrients and conductivity. Given that warming conditions in the study area have been permanent during the last 30 years, results could be useful to assess the impacts of global warming on large Mediterranean rivers.

S2. Poster

Monitorization the macrofungi community in one ecological reconversion zone of Pines inside of Mata Nacional do Buçaco

Vaz Lemos Pires Batista, E.[1], Lopes, L.[1], Matos, N.[2], Pinho, R.[1]

(1) Universidade de Aveiro, (2) Fundação Mata do Buçaco, Mata Nacional do Buçaco.

Macro fungi are sexual structures from the phyla Basidomycota and Ascomycota which can establish several relations with the vegetal community present in one habitat. This relation might be beneficial such as mycorrizal associations or harmful such as parasitism or pathogenic relations. The characterization is a fundamental process for the development of conservation and forest management measures. Our aim with this study was to monitoring the macro fungi community in one reconversion zone of Pines with high level abundance of invasive species in Mata Nacional do Buçaco. The experimental part of this poster took place between October and February with the main goal the collection of all macro fungi species present in three different spots with 800 meters square of area. The periodicity of the field work was three field trips each month. We select two areas with old Pinus pinea and one area with spontaneous Pinus pinaster entitled by PM1, PM2 and PM3 respectively. In all areas was performed a flora inventarium where was verified differences in the abundance and density of invasive species. The macro fungi specimens collected were preserved in herbarium and identified in order to analyse the density and diversity of the studied areas. After the data processing was verified that exist a higher diversity and abundance inside the macro fungi community in Pine zone with lower density of invasive species. With this study we can prove that the macro fungi community tends to decrease with the increment of vascular invasive plants.

S2. Oral

Reforestation with resprouter species to increase diversity and resilience in Aleppo pine forests: a comparison between SE France and SE Spain

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Developing silvicultural methods to adapt pine forests to climate change has become a priority. Recommended management include stand thinning to reduce competition for water and re-introduction of resprouting hardwood species to promote diversity and resilience. In this study, we examined the effect of Aleppo pine thinning on early establishment of a set of introduced hardwood seedlings with different shade and drought tolerance, in relation to environmental factors under different canopy covers. Stands were selected in 2 sites -South-East France and South-East Spain, corresponding to wetter and dryer conditions, respectively- and thinned at three levels (control, moderate or heavy thinning). Thinning increased light transmittance and accentuated the daily extremes of temperature and vpd. Thinning effect on soil water content was different between the two sites. Hardwood species performances were higher under thinned treatments in France, whereas in Spain thinning was detrimental for the survival and height growth of most species. Best performing species were shade-tolerant in France and drought-tolerant in Spain. Surprisingly, species survival was lower in the thinned treatments in Spain in spite of higher soil water content. This suggests that reduction of stressful conditions may be more critical than soil water content for survival in Spain whereas in France light availability was the most crucial parameter. Pine thinning can be a tool for accelerating the transition towards mixed stands but with contrasted impacts according to site conditions.

S2. Poster

Biochar: the soil amendment to mitigate Climate Change and increase crop productivity

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Biochar is a carbonaceous material produced from thermal decomposition of organic waste materials under a limited supply of oxygen (pyrolysis) and at relatively low temperatures (<700ºC). Due to its highly aromatic structure it is chemically and biologically more stable compared with the organic matter from which it was made. Therefore, the carbon contained in biochar does not degrade to CO2 to the same extent as untreated organic materials; being biochar considered as a C sink. Also, research is now confirming benefits of biochar application to soil and plant growth and productivity. We summarized the results of different experiments of biochar application under field and controlled conditions. In general, we found that biochar addition decreased soil compaction and increased the soil water retention capacity and nutrient content. These changes in soil environment induces changes in the morphology of roots (experiment with wheat), increasing its proliferation and specific root lenght. The application of biochar had positive effects on wheat growth and yield. Also, experiments with wheat under field conditions showed similar results. Moreover, in a growth-chamber experiment we found that biochar addition increased the growth and yield of ten of the eleven agronomic species studied. In general, our results showed that biochar addition to soil favored soil conditions and resources, inducing a better crop development and productivity. Therefore, these beneficial effects, together with the fact of being a C sink, show us that biochar could be an interesting option to mitigate the Climate Change and to improve of crop productivity.

Sessão 3. Ecologia Evolutiva / Sesión 3. Ecología Evolutiva

S3. Poster

Altitudinal variation in the prevalence of ectoparasites and intraerythrocytic parasites of the lizard *Psammodromus algirus* in Sierra Nevada.

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Parasites are important in population dynamics. Since parasites compete with their host for resources, causing damage to many aspects of the host, parasitism interacts with many selective forces driving host's evolution. In a scenario of global change, there are many organisms shifting their distributions (i.e. parasites and their hosts); frequently towards higher latitudes and altitudes. Running studies in altitudinal gradient framework can help us to understand the adaptations of species to different environments (i.e. environmental conditions, species interactions). In this context, our aim was to determine patterns of variation in lizards' parasite (the ectoparasite *Ophyonissus* spp. and the intraerythrocitic parasite *Hepatozoon* spp) prevalence along altitude. For this aim we studied the Mediterranean lizard *Psammodromus algirus* (Linnaeus, 1758) in six localities along a 2200m altitudinal gradient. Under the hypothesis that warmer thermal conditions at lowlands predict better conditions for parasites development, we predict that lowlands populations will show higher parasites prevalence. According to our hypothesis, we found higher prevalence of ectoparasites in lowlands lizards, being inexistent over 2000 m asl. In contrast, intraerythrocitic parasites prevalence increased in altitude. The known transmitter of *Hepatozoon* found in lizards is mites of the genus *Ophyonissus*. Therefore, since we failed to find mites at highlands, our results suggest that might be another transmitter. More humid conditions at highlands suggest that mosquitos might be the transmitters. In addition, there were sexual differences in prevalence. Following the handicap principle, higher levels of testosterone may be the reason of higher prevalence in males, independently of the altitude.

S3. Oral

The maintenance of flower color polymorphism in *Lysimachia arvensis* (Myrsinaceae): biotic, abiotic and reproductive factors

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Color polymorphism has ecological and evolutionary interest and can be due to a variety of evolutionary processes, from direct or indirect selection mediated by biotic or abiotic environmental factors, to random genetic drift. Recent research on color polymorphism focuses on two key areas: maintenance of genetic variability and speciation. We studied the factors maintaining color polymorphism at two spatial scales in *Lysimachia arvensis*, an annual herb with red and blue morphs. Dimorphism showed a geographical pattern with a negative association between blue frequencies and latitude. The proportion of blue plants increased with temperature and sunshine, but decreased with precipitation. Blue plants showed higher fitness in xeric environments, while red plants performed better in wet places, which correlates with the higher frequencies of blue plants in Mediterranean areas, and red ones in Atlantic zones. These results suggest the exitence of divergent selection driven by abiotic factors. In Mediterranean areas, pollinators markedly preferred blue flowers, which were more visited than expected from their proportion, and transitions between morphs were less frequent than expected. Pollinators caused strong directional phenotypic selection for blue flowers through male function in blue-biased populations. Therefore, in Mediterranean areas, not only is the blue morph favoured by climatic factors, but it is also selected by pollinators. However, red plants persist at low frequencies in these areas, probably due to a delayed selfing mechanism confering reproductive assurance when pollinators are scarce. Our results suggest a limited gene flow between morphs and open the possibility of speciation in *Lysimachia arvensis*.

S3. Poster

Effect of different non-prey foods on the longevity of the cursorial spider *Haplodrassus severus* (C. L. Koch, 1839) (Araneae: Gnaphosidae)

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Spiders are generalist predators although they can feed on different supplementary food sources as well as hunting prey. Within the olive grove agroecosystem, these sources can be provided by flowers and/or insect honeydews. The objective of this work was to assess the effect on spider's longevity of different sugars and non-prey foods. *Haplodrassus severus* (C. L. Koch, 1839) was selected as target spider because is commonly found in the olive grove and easy to rear in laboratory. Subadult individuals of both sexes were captured in the olive grove and maintained in laboratory in order to obtain spiderlings. Between 47 and 55 spiderlings per treatment were placed individually in wells of 24-well plates. Three sugars (glucose, fructose & sucrose) at different concentrations (0.25, 0.5 & 1 M) and three non-prey foods (pollen 10%, honey 10% and Saissetia oleae Olivier, 1791 honeydew) were offered on a weekly basis to the spiderlings. Longevity mean and standard error was calculated for each treatment. Treatment overall effect was assessed through survival curves. Differences between treatments were also evaluated. Glucose 0.5 M was the treatment that showed the best results among sugars (51.02 ± 2.41 days) whereas fructose 0.5 M registered the lowest longevity (34.77 ± 1.42 days). Spiderlings fed with sugars probably obtained energy but lacked proteins while the opposite could happen with pollen (37.92 ± 2.25 days). On the contrary, honey (59.22 ± 2.42 days) and honeydew (72.20 ± 2.62 days) probably provided both sugars and essential amino-acids giving longer longevity to *H. severus*.

S3. Oral

Transgenerational plasticity to salinity on the invasive estuarine shrub *Baccharis halimifolia*

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Abiotic constraints act as strong selection filters for plant invasion. Threshold levels of stress may prevent the invasion but, at moderate stress, individual differences in tolerance can determine population persistence. The exotic shrub *Baccharis halimifolia* is replacing estuarine communities in Europe. In these habitats plasticity is expected to play a major role in salinity tolerance rather than local adaptation because the spatial scale of edaphic heterogeneity is smaller than that of gene flow. We hypothesize that parental environment salinity may affect plant performance and we investigate the effect of within- and trans-generational plasticity on salt tolerance of *B. halimifolia*. We collected plant material through an estuarine population in the Urdaibai Biosphere Reserve and we used leaf sodium content in sampled individuals as a proxy of the parental salinity. We grew seed- and cutting-derived offspring through a salinity gradient in the greenhouse and we analysed the effect of the salinity treatment and the parental salinity on fitness and physiological traits. We found that both plasticity and parental salinity significantly affect different ecologically relevant traits. At intermediate salinity levels, aboveground biomass was positively correlated with maternal leaf sodium content. Moreover, increased parental salinity triggered early flowering at moderate salinity levels. Sustained shoot growth and earlier flowering may provide a selective advantage when the risk of mortality by unpredictable increased soil salinity is high. Our results suggest that adaptive transgenerational plasticity can contribute increasing the invasion success through stressful heterogeneous habitats.

S3. Oral

How does pre-dispersal predation drive seed packaging strategies and seed viability of a multi-seeded fruit species?

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Pre-dispersal predators might influence the evolution of seed packaging in fruits (i.e. seed size/number strategies) favouring fruits with a large number of seeds under higher predator pressure. Multi-seeded fruits are a better strategy than single-seeded fruits to ensure that some seeds survive predation. However, undamaged seeds within preyed fruits might lose viability due to a reduction in the resources allocated by the plant to preyed fruits. These hypotheses were assessed using the conifer *Juniperus thurifera* in which cones show a large variation on seed size/number strategies. We explored cone predation incidence and predation effect on the size and viability of undamaged seeds within preyed cones in single-large-seeded cones (North African populations) and multi-small-seeded cones (Southern Europe). Single-large-seeded cones (African populations) suffered from lower cone predation incidence compared to multi-small-seeded cones (European populations). In the latter populations, we found a higher percentage of seeds contained no embryo, and also that seeds from non-preyed cones were larger and had a higher germination success than those from preyed cones. Our results show that the selective pressure exerted by pre-dispersal seed predators might drive intraspecific variation in seed packaging. Multi-small-seeded cones and empty seeds might be maintained as a strategy to save some seeds from predation in European populations with high cone predation rates. However, surviving seeds within preyed cones suffered from a reduction in size in response to predation. Conversely, pre-dispersal predation might not have a strong effect in African populations, which displayed single-large-seeded cones with higher seed germination rates than European populations.

S3. Oral

Geographic body size patterns in new world anurans

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The investigation of spatial broad-scale gradients in species traits allow us a better understanding of evolutionary processes that shape observed ecological patterns. One widely studied trait gradient is Bergmann's rule, which states that species with larger body sizes are more prone to be found in high latitudes. However, a consensus about the generality of Bergmann's rule has been slow to emerge. In the present study, we test for latitudinal gradients in body size of New World anurans. We use an assemblage-based approach to correlate variation in body size to environmental variables, taking into account spatial autocorrelation in our data. We analyzed 1229 New World anuran species and calculated six environmental variables to correlate observed patterns in body size and environmental gradients. For each hypothesis, we used least squares regression modeling and model selection approaches to evaluate the observed patterns. We chose to repeat the analyses in two separated ecoregions: Nearctic and Neotropical. In the New World region, the geographic variation in body size has a consistent association with water availability, with larger species being found in more arid regions, as west coasts of South and North America. When looking at Nearctic and Neotropical regions in separate, both regions have different patterns. In the Nearctic region, the body size gradient is correlated with water availability, the same pattern found in the New World. Meanwhile, in the Neotropics the pattern found is consistent with Bergmann's rule, with larger body sizes related with low temperature and high elevation variability.

S3. Poster

Patterns of acorn and seedling traits throughout the distribution range of *Q. ilex*

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Populations of broadly distributed species underwent a diversity of soil and climatic environmental factors which might result in pattern traits relative to Latitude (i.e. temperature, aridity), Biogeography (i.e. core vs. periphery differences) or colonization history. The analysis of these patterns is mandatory if we want to make predictions about the consequences of predictable climatic changes as well as for species management. Holm oak (*Quercus ilex* L.) is a circunmediterranean evergreen species which is the dominant tree in Mediterranean Basin landscapes. Here we discuss the geographic variation in significant functional traits of this species such as morphological acorn traits, germination dynamics, as well as seedling growth rate and structure; all which where characterised by a high degree of ecological plasticity. For this purpose we collected acorns from five populations of *Q.ilex* located across a latitudinal transect in the western part of distribution range of this species (from North Spain to South Morocco). Acorns were germinated in greenhouse conditions. Seedlings were potted in 1.5 litter pots, and grown in controlled chambers during 3 months in non limited (water and nutrient) homogeneous conditions. The results show significant differences among populations relative to acorn mass, germination rate, seedling mass and biomass allocation. Acorns and seedling traits displayed several patterns associated to both, species range and latitude.

S3. Oral

Digging up the roots of crop evolution

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The interaction among farmers, plant genotypes and the environment has shaped domestication processes. Understanding how crop plants have evolved requires understanding the ecology of their wild progenitors, and the selective pressures that cultivators exerted while selecting wild plants and managing the agricultural environment. For instances, manuring and fertilizing practices increased nutrient availability in croplands, as compared to the habitats where the wild progenitors of crops thrived. Root traits like root diameter, SRL (specific root length) or mycorrhizal dependence are involved in nutrient uptake and transport rates, and are thus responsive to nutrient availability. It is thus reasonable to expect that evolution under domestication triggered changes in root traits relevant to nutrient use strategies. However, little is known in this regard, other than results from a few crop-specific case studies. To fill this gap we used common garden experiments, where we grew cultivated and wild progenitor representatives of a large set of 23 phylogenetically diverse herbaceous crop species. We expected low biomass investment in roots, relaxation of mycorrhizal dependence, and correlated changes in other root traits, in response to domestication. In this contribution we will show the results of screening root traits in those experiments.

S3. Oral

Interspecific competition and spatial structure drive body size trends in new world monkeys

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Numerous historical and current factors may have a profound impact on the geographic distribution of body size of mammals. In this study we aim to uncover the forces that drive body size patterns in Neotropical primates. In this regard, we formulated four hypothesis: (i) Temperature hypothesis: body size increases with decreasing mean temperature (Bergmann's rule); ii) Primary productivity hypothesis: the central factor of food availability is positively correlated with body size; iii) Interspecific competition in complex habitats hypothesis: in complex habitats with strong interspecific competition we expect smaller-bodied primates; iv) Anthropic effect hypothesis: anthropogenic interference is negatively correlated with body size. We approached these macroecological questions from two different methodological perspectives: assemblage, using Spatial Eigenvector Mapping method (SEVM) and cross-species approach, using phylogenetic generalized least squares regression (PGLS) analyses. We analyzed 120 primate species from the New World (~95% of the extant species). Our results did not find support for Temperature, Primary productivity and Anthropic Effect hypotheses. Our results showed a concordance between both analytical approaches, finding evidence that the interaction of forest canopy height with interspecific competition is the principal force that drives body size in Neotropical primates (SEVM: slope=0.02; $p<0.001$; PGLS: slope= 0.6757, $p=0.009$). We show that spatial structure factors and biological interactions are the determinants of body sizes in New World monkeys.

S3. Poster

Patterns of genetic variation in narrow edaphic endemic vs. widespread taxa: the case of *Helianthemum* in Sierra Nevada National Park (Spain)

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Helianthemum is the most diverse and widespread genus within the family Cistaceae with about 90 species throughout the Paleartic in a variety of habitats and substrates. However, most of the diversity is centred to Mediterranean. It is highly remarkable the diversity of functional traits in the genus, with species differing in life-history, flower colour and size, mating system or seed coat hygroscopicity. We assessed patterns of genetic structure and diversity and their relationship with the ecological diversity in two taxa pairs within *Helianthemum* in the Sierra Nevada National Park. To this aim we compared two geographically restricted endemics on dolomitic soils, *H. pannosum* and *H. apenninum* subsp. *estevei*, against two widespread but taxonomically related taxa, *H. cinereum* subsp. *rotundifolium* (subgen. Plectolobum) and *H. apenninum* subsp. *apenninum* (subgen. Helianthemum), respectively. By using 12 microsatellite loci we found similar patterns of genetic structure across taxa pairs (Bayesian and frequentist analyses) and even slightly higher levels of genetic diversity (Ae, He) in endemic than in widespread taxa. Interestingly, inbreeding coefficients (Fis) were different between taxa, being close to panmixia in the taxa of the subgen. *Plectolobum* and significantly higher in the subgen. *Helianthemum*. This result is likely related to the mating and breeding system since the taxa of subgen. Plectolobum showed higher pollen/ovule ratios and a sharper herkogamic position of stigmas and stamens compared to taxa of subgen. *Helianthemum*.

S3. Oral

Moving forward from patterns to mechanisms; hierarchical effects of soil types and elevation in determining the spatial distribution of functional traits in Mediterranean shrub communities

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Understanding how environmental and biotic factors drive assemblages of communities is one of the challenges still facing ecologists. Community-level trait distributions have been widespread used for inferring the array of factors responsible for the assemblage of communities. However, such an approach might not suffice to infer the underlying mechanisms, as different processes can lead to similar community-level trait distributions. In this study, we scale down from community to neighborhood scale by exploring the spatial distribution of traits and phylogenetic structure within Mediterranean shrub communities. To do so, we recognize three different species guilds within the communities (solitary, canopy and understory plants respectively), and assess the role of soil types and elevation gradients in shaping guild-level trait distributions and phylogenetic structure. Overall, we found significant differences in trait distributions and phylogenetic structure occurred between species guilds in communities growing on harsh soils (i.e. crystalline dolomites) irrespective of elevation. In contrast, elevation was a more accurate predictor of guild-level trait distributions in communities growing under softer edaphic conditions (i.e. mica-schists), whereas slightly or no differences were observed between the species guilds. Our results suggest that an hierarchical interaction between soil types and elevation is driven the assemblage of communities, where plant-plant interactions seems to be a more determining factor under harsh edaphic conditions, whereas the effect of elevation increases in importance as the edaphic conditions become softer.

S3. Poster

Stebbins was right: n = 9 seems to be the ancestral chromosome number of the Asteraceae.

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The remarkable diversity of land plants is associated with immense genetic variation manifested also by a wide range of chromosome numbers. Changes of chromosome number during evolution of angiosperms are likely to have played a role in speciation, being their study of utmost importance, especially at the present time when a probabilistic model is available to study chromosome evolution within a phylogenetic framework. In the present study likelihood models of chromosome number evolution were fitted to the largest family of flowering plants, the Asteraceae. Specifically, the most recent and complete phylogenetic supertree of this family was used to reconstruct the ancestral chromosome number and infer genomic events, including whole genome duplications and dysploidies. The results of this work strongly evidenced that n = 9 is the most probable ancestral chromosome number of the family. Also, our models supported that genomic duplications, as well as, descending dysploidy, were common genomic events in the evolution of Asteraceae. The increase in the number of chromosomes through polyploidy events was related with a high frequency of chromosome losses, the most frequent event in the chromosome number evolution. More than a half of the duplication events inferred in this model occurred in lineages that experienced process of ancient climate changes. Further phylogenetic studies and genetic investigations focused in obtaining more complete phylogenetic trees will enable to more accurately date the time of occurrence of the ancient genomic duplications and to clarify the evolutionary impact of these genomic phenomena on the Asteraceae family.

S3. Oral

Phenotypic feedback in species interaction networks

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The role of phenotypic variation in evolutionary biology has been acknowledged for over a century. However, it has not been until recently that such widespread differences among individuals have been incorporated into ecology. Related to this ongoing link between ecology and evolution, we introduce a novel concept, which we have coined "phenotypic feedback", and which we believe should be widespread in species interaction networks. In an ecological network a node (or species) is linked to many other species, with which it interacts either positively or negatively. We hypothesize that species holding more links in a network have a higher diversity of selective pressures and that as a consequence maintain higher amounts of phenotypic variation in relevant (or functional) traits; and viceversa, that the standing phenotypic variation of a species determines the number of links that it establishes with other species in the network. A simple simulation model supports the hypothesis that the amount of genetic variation that can be maintained by a species is higher when this species interacts with more species. We also show field data which supports the "ecological signature hypothesis" of phenotypic feedback, which states that, due to immigrating individuals, experimentally increasing the number of links of a species in a locality should increase its phenotypic variability. The mechanism proposed here, together with the associated concept of "interaction drift" (Moya-Laraño 2010), can contribute to explain the positive association between species and genetic diversity found in communities, as well as why diversity is higher in tropical areas.

S3. Poster

Trade-offs between drought tolerance and avoidance mechanisms provide evidences for evolution towards deciduousness under drier climates in the neotropical oak species (*Quercus oleoides*)

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Water limitation is a critical selective force in nature. Two leaf habits have been associated with drought response in plants that inhabit seasonally dry environments: sclerophylly and deciduousness. We sought to (i) determine how leaf habit and traits related to drought-response, such as water potential at turgor loss point (ptlp), leaf area ratio (LAR) and growth rates have evolved in response to contrasting seasonal water availability and (ii) explore trade-offs between mechanisms mediating drought response in a neotropical oak species (*Quercus oleoides*). A greenhouse experiment was established with 1460 seedlings from five populations, originating from contrasting climates, and subjected to two watering treatments. Our results showed that after exposure to drought, populations from mesic environments had smaller, thicker leaves with lower specific leaf area and absence of leaf shedding, indicating longer-lived sclerophyllous leaves, compared to populations from drier habitats. Plasticity in response to water availability varied among populations for ptlp, photosynthetic rates (Amax), leaf loss, and LAR. Populations from mesic environments exhibited high plasticity in ptlp and Amax, showing more negative ptlp in the drought treatment but increased ptlp and Amax in the well-water treatment. Populations from drier environments had higher plasticity in leaf loss and LAR, showing increased LAR in the well-watered treatment but reduced LAR under drought, an effect mediated by increased leaf shedding. Together, these results suggest that, in response to drought, populations from dry environments exhibit a drought avoidance strategy of increasing deciduousness, whereas more mesic populations accumulate solutes and increase schlerophylly.

S3. Oral

A new method to correct for size when estimating phenotypic integration

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The integration of the phenotypes has functional implications that may shape the evolution of phenotypes. One problem with phenotypic integration studies is how to correct the integration measures for body or organ size because integration values might result from resource acquisition variability between individuals. This problem is particularly serious when traits analysed are resources allocated to different components of a given organ (e.g., floral parts) or individual (e.g., body parts). When resource availability is not controlled for, larger individuals or organs may have larger components, driving a correlation between components partially due to variation in resource availability. This correlation may obscure others that are unrelated to size. We present a size-controlled integration index using a modification of the widely used Wagner (1984) index, in which the size of the studied structure, as a proxy of resource availability, is taken into account. In addition, we introduce an R package (PHENIX: PHENotypic Integration indeX) to estimate a size-controlled phenotypic integration index, including a bootstrapping and a randomisation method to simulate null-distributions and test its statistical significance. Although this method was developed to control for size, our functions allow to control for any other variable of interest other than size. Thus, this feature broadens the utility of this method beyond size-correction comparisons. Overall, this new package may improve the study of phenotypic integration by providing researchers with a framework to estimate and test the statistical significance of the magnitude of the integration with free statistical software.

Sessão 4. Ecologia Funcional e Alterações Ambientais / Sesión 4. Ecología Funcional bajo cambios medioambientales

S4. Oral

Functional diversity, trait matching and ecosystem functioning in plant-pollinator systems

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Drastic biodiversity declines have raised concerns about the deterioration of ecosystem functions. The link between species diversity and ecosystem functioning is assumed to reflect the fact that species rich communities also has a larger diversity of functional traits, which allow optimising the performance of a given function via niche partitioning. However, if the function of interest is achieved only by species with a given trait, optimising that function will depend only on this subset of species. Pollination is a key function which mediates the reproduction of 80% of plant species. Hence understanding how pollinator species and functional diversity relates to pollination function is crucial. First, I show that after an environmental change trait loss can be faster than species loss. Most importantly, I show that trait loss is not random, but species with particular traits are lost first. Second, I show that this has consequences for ecosystem functioning. While in general functional trait diversity tends to predict functioning better than species diversity on a variety of systems, focal functions are better described by single traits or trait matching between the pollinator community and the plant pollinated. Lastly, I will use an agricultural system, watermelon and its pollinators, to show that less functionally important traits are the ones to be lost first, and this confers functional robustness to the loss of species.

S4. Poster

Monitoring the effect of temperature and precipitation of three forests in the Montseny Natural Park

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We assessed the influence of some environmental conditions (temperature and rainfall) on the litterfall and BAI, in three close forests in the Montseny massif (NE part of Iberian Peninsula, Spain). Two of them are composed by deciduous species *Fagus sylvatica* and *Quercus petraea*, and the other is a Mediterranean evergreen species *Quercus ilex*. We collect data since 2007 of litterfall and radial growth, which have been correlated with the climate of the study area. Our results shows that *Fagus sylvatica* recorded the biggest drop in annual litterfall (6 Mg•ha-1•year-1), followed by *Quercus ilex* (4.34 Mg•ha-1•year-1) and *Quercus petraea* (4.4 Mg•ha-1•year-1) and all the values were similar to those observed in other forests and mountains with the same state of maturity. About the litterfall the investigation found a decline of the leaves fall in deciduous trees in years with hot summers. Also these warm summers produce a decline in the *Fagus sylvatica* BAI, but not in *Quercus petraea*. Concerning the growth, we found that Quercus petraea increase the BAI on the study period while *Fagus sylvatica* don't. In conclusion we believe that *Quercus petraea* in a future will be more tolerant to the warm conditions than Fagus sylvatica, making the first a possible replace of second specie.

S4. Oral

Successional dynamics in inland dune shrub communities drive changes in functional diversity

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Communities can be defined as assemblages of species coexisting under particular environments. The relationship between environment and species are regulated by both environmental requirements –which ultimately determine the species capacity to establish and survive in a particular environment– and the ecological interactions occurring during assembly processes –which also determine community composition by conditioning species coexistence. In this context, plant functional traits are attributes that represent ecological strategies and determine how plants respond to environmental factors and interact with other species. Therefore, the analysis of how traits vary through the dynamics of communities, such as along successions, can give insights about how environmental requirements and species interactions may determine the composition and functional structure of these communities. The xerophytic shrub communities inhabiting inland sand dunes in SW Portugal are characterized by successional processes that are mainly driven by local (edaphic gradients and human disturbance) and regional (climate) processes. Therefore, they constitute an appropriate system for studying species interactions and environment-community co-variations based on functional terms. Using these communities as a model, we evaluate the hypothesis that successional community changes in species composition of xerophytic shrub communities can result in concurrent changes in functional diversity

S4. Oral

Using leaf traits to explain woody species coexistence along a species richness gradient

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An increased number of trait-based studies have showed the relevant role of the trait variation within a species on the species coexistence in a non-random scenario of species assembly. Besides, this intraspecific trait variability has been recognized as a promoter of diversity and a key aspect in the evolutionary theory. In this study we tested how the trait variation within species may change along a species richness gradient. We compiled trait data of woody species from the understory vegetation in twelve different forest communities with contrasting species richness: from low as boreal and temperate European forests to high species richness forests as the tropical rainforests in Brazil and Ecuador. We used two leaf traits, specific leaf area (SLA) and leaf area (LA), to quantify the trait breadth for every species, and we also assessed the trait overlap between pairs of species in each community. Results showed a high intraspecific trait variability in either poor and rich species forest communities, and the trait breadth of both SLA and LA did not vary with species richness. However, we found a significant increase in the trait overlap of both SLA and LA with high species richness. These results suggest that species that coexist tend to have similar trait values, contrary to the niche packing theory and supporting the equalizing mechanisms theory. This study emphasizes the importance of considering the intraspecific trait variability on the species assembly, providing a better understanding about mechanisms and processes involved in species coexistence in plant communities.

S4. Oral

CO2, CH4, and N2O fluxes in semi-natural grasslands in the Pyrenees

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Mountain areas are identified by the IPCC report (2013) as particularly sensitive to climate change. The need to understand mountain grasslands is crucial since these ecosystems can act as both sinks and sources of CO2. Investigating CH4 and N2O fluxes is important because they can offset potential CO2 sequestration. While most studies focus on CO2, the knowledge on the temporal and spatial variability of CH4 and N2O, particularly in semi-natural mountain grasslands, is scarce. This study describes the magnitude and range of variability of the fluxes of CO2, N2O, and CH4 from four semi-natural pastures in the Pyrenees across an altitudinal gradient (1026 to 2436 m a.s.l.) during the growth period in 2012 and 2013. We measured GHG fluxes of the grassland during both light and dark conditions in the study sites using a photoacoustic field gas-monitor (INNOVA 1412, LumaSense Technologies). After completing the GHG measurements, we collected vegetation samples for the estimation of above-ground and below-ground biomass and separated them into functional groups and species. We present here the analysis of the relationship between GHG fluxes and above-ground biomass including the contribution of the relative abundance of plant functional types. Our preliminary results showed a clear seasonal pattern of GHG fluxes. We will further elaborate in-depth the effect of the temporal and spatial variability on the fluxes of CO2, N2O and CH4. Also, we will present the relationship between the GHG fluxes and the contribution of the vegetation in terms of the relative abundance of different plant functional types.

S4. Poster

Assessing the impact of groundwater lowering in coastal forest's functional groups: ecophysiological responses under Mesomediterranean and Mediterranean climate.

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Groundwater alterations and the impact of drought will affect ecosystems sensitive to water limitation, with consequent uncertainties about how vegetation will respond over the short and long term. This is particularly important in Mediterranean sites, where water availability is predicted to be reduced. Sand dune plant communities encompass a diverse number of species that differ widely in tolerance to drought and capacity to shift among water sources. We will try to answer some questions as: Do dune plants with different strategies show the same responses to groundwater changes? Do similar functional groups present the same response under different precipitation availability? We aim to evaluate the responses of coastal plant functional groups to changing groundwater availability. This study, developed in Portugal (Osso da Baleia) and Spain (Doñana), experiencing groundwater lowering, can provide an excellent insight of plant community functioning in natural ecosystems. Because an isotopic approach can show important seasonal and local changes in utilization of different water sources by vegetation, we used leaf d13C, d15N and xylem+water sources d18O as a tool to assess physiological performance and water strategies integrated with spatio-temporal water dynamics. Groundwater modeling was developed to assess the availability of groundwater in our study areas. Furthermore, an isotopic spatial approach provided the possibility to find general patterns of responses and predict effects of water availability changes. We analyzed two hygrophyte/phreatophyte species (*Erica scoparia* and *Salix repens*) and two *Pinus* species (*Pinus pinea* and *P. pinaster*) and they showed different water utilization and responded differently to groundwater availability.

S4. Oral

Climate change decreases nitrogen supply in northern hardwood forests

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Nitrogen (N) supply often limits the productivity of temperate forests and is regulated by a complex mix of biological and climatic drivers. In excess, N is linked to a variety of soil, water and air pollution issues. Here we use results from an elevation gradient study and historical data from the long-term Hubbard Brook Ecosystem Study (New Hampshire, USA) to show that changes in climate, especially during winter, have decreased N supply to northern hardwood forest ecosystems. Low elevation plots with less snow, more soil freezing, and more freeze/thaw cycles supported lower rates of N mineralization than high-elevation plots, despite having higher soil temperatures and no consistent differences in soil moisture during the growing season. These results are in line with historical analyses showing decreases in rates of soil mineralization and soil inorganic N concentrations since 1973, coinciding with long-term increases in mean annual temperature, decreases in annual snow accumulation, and a increases in the number of winter thawing degree days. This evidence suggests that changing climate may be driving decreases in the availability of a key nutrient in northern hardwood forests, which could decrease ecosystem production but have positive effects on environmental consequences of excess N.

S4. Oral

Dormancy induction by high temperatures and desiccation in seeds with innate morphophysiological dormancy: the case of two wild daffodils

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We analyzed the effects of stressing summer temperatures and/or desiccation on early and advanced stages of seed-embryo development in two daffodils, Narcissus alcaracensis and N. longispathus, which have morphophysiological seed dormancy (MPD). In N. alcaracensis seeds having overcome dormancy (embryo elongation= 27.14%), exposure to high temperatures induced secondary dormancy and reduced the subsequent embryo growth, needing three additional months of cold stratification for breaking secondary dormancy. Desiccation in early stages of embryo growth (elongation= 11.42%) also reduced following germination. In non-dormant seeds, desiccation induced secondary dormancy, which could not be surpassed with the three additional months of cold stratification. When desiccation was preceded by high temperatures, seeds overcome faster secondary dormancy. Seed viability was not affected by treatments. In N. longispathus seeds having surpassed dormancy (embryo elongation= 59.21%), exposure to high temperatures induced secondary dormancy. Then, they needed an additional stratification of 1 month at 15/4ºC + 2 months at 5ºC to reactivate the germination process. Seed desiccation when embryo elongation was 42.10% totally impede subsequent germination, and induced secondary dormancy in non-dormant seeds, which could not be overcome by the stratification treatment described above. When desiccation was preceded by high temperatures, seeds surpassed dormancy faster. Stressing treatments killed 5-10% seeds. The study suggests that seeds of species with complex levels of MPD are sensitive to desiccation in early stages of embryo development, as opposed to species with deep simple epicotyl MPD. Results are interpreted from an evolutive and ecological perspective.

S4. Poster

A meta-analysis on the effects of heavy metal contamination on litter decomposition in streams

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Many streams worldwide are affected by heavy metal contamination, mostly due to past and present mining activities. Here we present a meta-analysis of 37 studies published between 1978 and 2014 that reported the effects of heavy metal contamination on the decomposition of terrestrial derived litter in running waters. When considering the entire database (133 effect sizes; Hedges' g), heavy metal contamination significantly inhibited litter decomposition. The effect was stronger for laboratory than for field studies, likely due to better control of confounding variables in laboratory studies. For laboratory studies, only Cu+Zn mixtures significantly inhibited litter decomposition, while no significant effect was found for Ag, Al, Cd or Zn considered individually, but individual metals had low sample size. For field studies, coal and metal mine drainage strongly inhibited litter decomposition, while drainage from motorways had no significant effects. The effect of coal mine drainage did not depend on drainage pH. Coal mine drainage negatively affected leaf litter decomposition, independently of leaf litter identity; no significant effect was found for woody litter decomposition but sample size was low. Considering metal mine drainage, arsenic mines had a stronger negative effect on leaf litter decomposition than gold or pyrite mines, but all inhibited litter decomposition. Metal mine drainage significantly inhibited leaf litter decomposition driven by both microbes and invertebrates, independently of leaf litter identity; no significant effect was found for microbial-driven decomposition but sample size was low. Overall, mine drainage negatively affects leaf litter decomposition, likely through negative effects on invertebrates.

S4. Poster

Can forest fragmentation impact climate change? A global study.

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About a quarter of total anthropogenic emissions are due to worldwide forest loss. Deforestation often occurs with fragmentation, but how fragmentation affects climate change has yet to be evaluated. In this research we analyze the contribution of fragmentation, forest amount and climate on carbon sequestration, using tree height as a proxy of biomass amount. Results indicate that the resulting spatial configuration of forest remnants after deforestation is of greater importance than habitat loss for tree height and carbon sequestration, due to the important negative influence of edge effects. Given the rapid rate of forest fragmentation in the tropics such emissions may strongly exacerbate the effects of global warming above and beyond those caused by forest clearing per se. Planning clearing strategies to minimize habitat edges in managed landscapes might reduce considerably greenhouse gas emissions.

S4. Poster

Intraspecific variability of *Heliscus lugdunensis* in response to metal stress as analysed by cellulase gene expression

Fraga Sobral, O.S.[1], Seena, S.[1]

(1) CBMA.

Aquatic hyphomycetes are the major decomposers of plant litter and transfers energy and nutrientes from one trophic level to another. The important component of plant biomass is cellulose and its utilization by microbes is a key step in the decomposition of plant detritus. Portugal has a large number of abandoned mines discharging metals into natural waters. The effect of metals on aquatic hyphomycete species has been widely studied, but the metal stress at intraspecies level still remains unexplored. The main goal was to evaluate the intraspecific cellulase gene expression of the common aquatic hyphomycete *Heliscus lugdunensis* in response to mine drainage, mainly rich in copper and arsenic. Strains of *H. lugdunensis* were isolated from streams affected by mine drainage and from non polluted sites. The sequencing results of the ITS gene region of H. lugdunensis showed the existence of two genetically different groups. The results upon assessing Cellobiohydrolase I (cbhI) genes, which encode exocellulases, indicated a significant down-regulation expression when exposed to mine drainage. Each strain produced different cellulase gene expression profiles, indicating intraspecific variability in metal exposure sensitivity. We conclude that genetic variability plays an important role in coping with metal stress and shaping the ecological functions of aquatic hyphomycetes Acknowledgements: FEDER-POFC-COMPETE and the Portuguese Foundation for Science and Technology (PEst-OE/BIA/UI4050/2014, PTDC/AAG-GLO/3896/2012) supported this work, O. Sobral (PTDC/AAG-GLO/3896/2012).

S4. Poster

Intraspecific variability in physiological responses of *Heliscus lugdunensis* affected by mine drainage exposure.

Fraga Sobral, O.S.[1], Seena, S.[1]

(1) CBMA.

Aquatic hyphomycetes, are the major microbial decomposers of leaf litter and with a key role in detritus food webs of freshwater ecosystems. They are also known to be sensitivite to pollution. Metals in water and sediments interfere with fungal physiology and thereby affecting their functions in the ecosystem. The main studies of metal response on fungi are focused on interspecific comparisons; however the fungal intraspecific variability is not yet sufficiently investigated to understand its functional diversity on impacted ecosystems. The main goal of this study was to evaluate the intraspecific variation on physiological responses of the common aquatic hyphomycete *Heliscus lugdunensis*, during colonization of alder leaves (*Alnus glutinosa*) under mine drainage stress. Strains of *H. lugdunensis* were isolated from streams impacted by mine drainage and from reference sites. The fungal biomass, litter decomposition and oxygen consumption were assessed and compared with metal content in stream water. Results showed intraspecific differences in leaf decomposition (mass loss), oxygen consumption and biomass both in contaminated and reference fungal assemblages. We conclude that fungal intraspecific variability plays an important role in determining the ecological functions in stressed environments. Acknowledgements: FEDER-POFC-COMPETE and the Portuguese Foundation for Science and Technology (PEst-OE/BIA/UI4050/2014, PTDC/AAG-GLO/3896/2012) supported this work, O. Sobral (PTDC/AAG-GLO/3896/2012).

S4. Oral

Functional strategies to cope with resource limitation in Mediterranean woody plant communities

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The functional approach has been broadly used as a robust tool to understand the rules that govern the spectrum of functional strategies in plants and their relationships with key ecosystem processes. We present here results of three trait-based studies that were carried out to better understand the underlying mechanisms that control the distribution patterns and structure of woody plant communities along environmental and temporal gradients in south Spain. Our main objectives were: 1) to understand the functional trait variation at leaf, stem and root levels along the local and regional gradients; 2) to know how functional diversity and structure vary along these environmental gradients; and 3) to evaluate the resilience of a woody plant community after an extreme climatic event. We found a high degree of functional coordination between traits belonging to different plant organs. These traits tended to co-vary along the main axis of variation that defines the economics spectrum framework. Water availability was the main abiotic driver of community functional structure, mainly determined by a process of species replacement along the gradients. The disturbed plant communities exhibited remarkable resilience after the climatic event, as they quickly returned to their initial features; however the functional diversity was associated to a lower stability in species composition along time. In conclusion, the functional approach was a good tool to understand the coordination among traits at plant level, the specialization trends and economics spectrum at species level, and the changes in spatial and temporal functional structure and their drivers at community level.

S4. Oral

Extremes meet: shrub cover improves resource acquisition at both ends of the altitudinal gradient in a Mediterranean mountain

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Prostrate shrubs are a critical component in Mediterranean high mountains. Their contribution to diversity and biomass is amplified by their role as nurse plants. Shrubs facilitate the establishment and performance of a wide array of mountain plants, increasing their potential range, altogether leading to higher biodiversity levels. Through facilitative interactions nurse plants modify protégée resource acquisition patterns and this effect may be context dependent. Our aim was to analyze the effect of shrubs on resource availability, acquisition and investment of a Mediterranean forb, *Helleborus foetidus* L., along an altitudinal gradient with various degrees of water limitation in the Sierra de las Nieves Natural Park (Málaga, southern Spain). We sampled three sites at 1450, 1700 and 1850 m a.s.l. ranging from forest to above tree-line. Mean temperature decreased and soil water content peaked at the intermediate site. We collected 40-80 individuals per site and measured different functional traits related to resource acquisition (leaf nitrogen and total leaf area), plant performance (secondary growth and flower production), and micro-environmental context (soil depth and shrub cover). We constructed a structural equation model including these variables for each study site. At the most stressful low and high sites shrub cover indirectly increased growth and flower production by enhancing resource acquisition, whereas at the intermediate site, shrub cover exerted no effect, but soil depth decreased flower production. Our results reinforce the role of positive plant-plant interactions in Mediterranean mountains, stressing the similitude of mechanisms at both ends of the altitudinal gradient.

S4. Oral

Competition does not structure clustering phylogenetic patterns

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Ecologists have widely used phylogenetic clustering patterns to infer competition processes by taking Darwin's assumption that more closely related species less easily coexist. This expectation has however been challenged by recent hypothesis arguing that whether more closely or distantly related species coexist depend on how phylogenetic relatedness predict both the niche differences that stabilise coexistence and the average fitness differences that drive competitive dominance. A field experiment with 18 California annual plant species was designed to parameterize models of competitor dynamics from which niche and fitness differences can be assessed. Then, species' niche and fitness differences were related to their phylogenetic distance. Phylogenetic distance did not predict the stabilising niche differences between species but did predict average fitness differences between species. This meant that more distant relatives had greater competitive asymmetry, which should favour the coexistence of close relatives. Nonetheless, theoretical results from parameterising the model showed that coexistence proved unrelated to phylogeny. This important result was due in part to increasing variance in niche and fitness differences with phylogenetic distance, a previously overlooked property when considering how trait dispersion increases with phylogenetic distance. Together, these findings question the expectation that distant relatives should more readily coexist, and hopefully give further pause to investigators using phylogenetic patterns to infer competitive relationships, even when niche and/or fitness traits are phylogenetically conserved.

S4. Poster

Carbon Dioxide Exchange in Pyrenean Grasslands: Relative Influence of Vegetation and Climate

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Mountain semi-natural grasslands host a high biodiversity and provide fundamental ecosystem services, including their potential role in climate change mitigation. In these systems, Net Ecosystem CO2 Exchange (NEE) is usually near to the equilibrium and grasslands can act as sources or sinks depending on local conditions. We carried out a survey of CO2 exchange rates in two Eastern Pyrenees grasslands. The objectives of our study were: 1) to describe CO2 dynamics (daily and seasonally) during the growing season, and 2) to assess the influence of the temperature, Photosynthetic Active Radiation (PAR) and vegetation structure and composition on CO2 dynamics. The study sites were: La Bertolina (42°05'56"N, 1°39'40"E, m a.s.l) and Castellar (42°18'18"N, 2°02'01"E 1275 m a.s.l). At each sampling point, CO2 exchange was measured with soil chambers connected to an infrared gas analyser and two types of variables registered: NEE (translucent chamber) and Reco (ecosystem respiration; opaque chamber). Afterwards, vegetation was cut and sorted into plant functional types (PFT): legumes, non-fixing forbs and grasses. Aboveground biomass was determined and green leaf area (GLA) estimated by scanning and image processing. Daytime NEE was mostly dominated by assimilation, with maximums of 10.63 ± 1.89 and 15.97 ± 1.72 μmol m-2 s1 in La Bertolina and Castellar respectively, values in the range of other European semi-natural grasslands. Seasonal CO2 exchange variations showed a strong relation with GLA evolution. Daily NEE variations were related with PAR following a rectangular hyperbolic model, which improved the fit when it was calculated specifically for each PFT.

S4. Oral

Plant funtional traits after grazing exclusion in the Montado

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Montado is a semi-natural ecosystem typical of Mediterranean areas, classified as a biodiversity hotspot. Several threats to its long-term sustainability have been identified on the last years, namely regeneration difficulties and overgrazing. Knowing the ecosystem responses to management changes is essential to its maintenance and productivity. Functional traits are species attributes by which species relate with their environment and are determinant in the processes underlying community dynamics. There is growing evidence that functional diversity is a better predictor of ecosystem function than species diversity. The main aim of this study was to access shrub functional diversity in grazed and grazing excluded areas. Additionally, we used a time for space proxy approach to evaluate the effect of grazing exclusion in shrub community over 15 years. The study was conducted at central Portugal, with Mediterranean climate. We accessed shrub diversity in 15 randomly selected plots with 5 treatments: Grazing with seeded pastures, grazing with natural pastures and plots that were cattle-excluded for 5, 9 and 15 years. We measured shrub cover and species were assigned to functional groups based on traits databases. Species richness increased with increasing period of grazing exclusion. Although shrub cover reached a plateau in the first 5 years of exclusion, species richness continued to increase over 15 years. Functional composition changed abruptly after grazing exclusion, from a spiny species dominated community, to a functionally diverse community. Animal dispersed, and species with a transient seed bank had higher cover in plots excluded for 15 years.

S4. Oral

Spatial heterogeneity of a parasitic plant drives the seed-dispersal pattern of a zoochorous plant community in a generalist dispersal system

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Spatial heterogeneity originated by biota plays a central role in defining ecological processes and patterns. In this study, we explore how mistletoe-mediated forest heterogeneity can lead seed-dispersal patterns of a fleshy-fruited plant community, shaping the spatial configuration of seed-deposition sites through time. Mistletoes are fleshy-fruited plants that dwell in forest canopies worldwide, relying on frugivores for seed dispersal. Their population dynamic is characterized by strong re-infection feedback that seed dispersers generate in already parasitized trees. This phenomenon results in highly heterogeneous forests with clumps of abundant fruit supplies available on top of the canopy layer with a great potential to entice frugivores and, in the case of generalist seed-dispersal systems, to drive the seed-dispersal patterning of the zoochorous plant community in the forest. We focus on the mistletoe *Viscum album* subsp. austriacum, distributed throughout most European pine forests, coexisting with other fleshy-fruited plant species and being dispersed by a wide range of generalist seed dispersing birds. We expected and confirmed that frugivore birds by visiting parasitized trees preferentially to unparasitized ones drive a differential deposition of mistletoe seeds while including seeds of co-fruiting species that reach the soil. Moreover, as long-lived plants with temporally uniform fruit crops, mistletoes act as faithful agents of spatial heterogeneity, ensuring the temporal continuity of seed-deposition sites, although subject to temporal variability of the context. We conclude that mistletoes, by patchily growing on the canopy layer and concentrating zoochorous seeds underneath them, can introduce new assembly rules in the plant community.

S4. Oral

Predicting forest management effects on the oak-rodent mutualism

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Acorn dispersal in highly managed holm-oak woodlands depends on wood mice (*Apodemus sylvaticus*) activity. However, mice can act as either net seed predators or moderately efficient acorn dispersers depending on environmental conditions. We developed an agent-based model (ABM) that simulates acorn dispersal by mice in a anthropogenic habitats. In our model two cascade processes occur: (1) forest management modifies intraspecific competition for acorns and shelter availability, and (2) mouse adapt their foraging decisions to these new environmental conditions. Our model assumes that the main motivation of mice to mobilize and cache acorns is to store them for winter consumption. Therefore, mice carry seeds away from potential competitors taking an acceptable amount of predation risks during mobilization and caching them in areas where pilfering risks are low. Our model was calibrated with field data and validated with four independent landscapes that included forest interiors with contrasting stem densities, forest edges, small forest fragments, and savanna-like woodlands (dehesa). The model predicted acorn dispersal patterns with only a few empirical variables (habitat availability, stem density and shrub cover). Sensitivity analysis on landscape parameters revealed that habitat loss was a key factor on acorn dispersal quality. Shrub encroachment could buffer the negative effects of habitat loss on maximum dispersal distances. Finally, we simulated shrub encroachment effects on seed dispersal quality in a dehesa. Our model predicted that a 65% of shrub cover is needed in order to recover relatively high dispersal quality.

S4. Poster

Contrasting functional structure in Pyrenean alpine plant communities

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In the Alpine landscapes, dense vegetation mosaics are strongly tied to abiotic factors related to topography, soil quality and microclimate. However, changes in plant communities, thus in ecosystem properties and functioning, take also place as resulting of changes in herbivory regimes or in climatic drivers. Shrubby encroachment of grasslands has been described as an ongoing generalized trend in Arctic and in Alpine tundras. In European Alpine mountains this has been related to the rising release of traditional land use during the last decades, and secondly to climate change. We comparatively analyzed the main 16 Pyrenean plant communities of the alpine belt (i.e. grasslands and scrubs) on the basis of their functional structure and adaptive traits of main species, and also as related to terrain parameters. To do so, we analyzed the functional compartmentalization of those communities in 63 vegetation samples, and obtained the SLA of the dominant species. We also evaluated the space occupancy and the abiotic conditions for each community through GIS techniques. Structure and functioning of the communities studied responded to main limiting factors for distinct ecological locations, but also revealed particularities due to dominant species, which at their turn modulated local ecosystem properties through biomass and litter dynamics and soil interactions. This is well exemplified by most shrubby vegetation, due to its higher standing biomass, structure, and litter accumulation, and slower biomass turnover. Therefore, a hypothesised expansion of scrubs over grasslands in the high mountain would lead to noticeable changes in plant diversity and ecosystem functioning.

S4. Oral

Drivers of plant taxonomic and functional diversity along an aridity gradient in savanna-like Mediterranean woodlands

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Mediterranean drylands are particularly vulnerable to climate change. Water limitations already affect these areas and, in interaction with anthropogenic activities, may aggravate land degradation, decreasing biological productivity and thus ecosystem services provision. Predicted scenarios of increased aridity and changes in precipitation patterns, reinforce the need to understand and to be able to anticipate which may be the consequences for ecosystems functioning. As functional traits are the means by which species affect ecosystem processes, functional trait diversity seems a good approach to track the effect of aridity on ecosystems. To address this issue, we studied the plant community of 49 savanna-like dryland sites occupied by Mediterranean holm-oak woodlands along an aridity gradient. Our aims were to: i) identify the main climatic variables driving changes in the plant community; ii) identify plant traits responding to aridity; iii) assess the response of plant taxonomic and functional diversity to aridity. We found a first environmental filter driving woody/herbaceous species dominance related to slope and precipitation seasonality, likely influencing water residence time in soil, which was positively correlated with herbaceous species dominance. The second driver found to influence the plant community was aridity. Several plant traits responded to aridity, including life cycle, height, specific leaf area, flowering duration, and seed-bank persistence. For the overall diversity, we found a more consistent response of functional diversity (computed for eight relevant traits) to aridity than of taxonomic diversity, although major environmental drivers of plant diversity differed between annual and perennial species and among different functional traits.

S4. Poster

Functional responses to experimental fire and drought of species differing in regeneration traits in a Mediterranean shrubland

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Shrublands dominate Mediterranean landscapes, where climate change is projected to increase drought frequency and intensity, as well as fire occurrence. This means that post-fire plant regeneration can occur regularly under drought conditions. In this context, it seems key to know the functional response of plants with different regeneration traits, since finally it could affect the regeneration and final configuration of the community. Thus, a Mediterranean shrubland of central Spain with a mix of seeder and resprouter species was experimentally burned and subjected to various levels of drought. The rainfall manipulations were conducted by means a system of automatic rainout shelters with irrigation facility before and after fire. The functional response of main species in the community was monitoring during the three first years post-fire through periodic sampling of their water availability (?pd), growth (AGR), leaf morphology (SLA) and gas exchange (d13C and instantaneous measurements). The seedlings of *C. ladanifer* (seeder species) showed higher ?pd, AGR, SLA and lower d13C than mature plants during the first two years post-fire. Likewise, plants under drought treatments suffered a decrease in ?pd and growth, and an increase d13C, mainly during springs and autumns. Meanwhile, resprouts of E. arborea, E. scoparia and *P. angustifolia* (resprouter species) recorded higher water availability and growth than mature plants during the first year post-fire, but no differences in leaf morphology and gas exchange were observed. Moreover, the resprouter species were largely unaffected by drought, although the two *Erica* species showed a different functional response to *P. angustifolia*.

S4. Poster

The impact of aridity in plant functional diversity in the semiarid ecosystem of Caatinga, Brazil

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The composition of plant communities together with their plant functional-traits related to water stress, allows us to understand vegetation response and resilience to drought and to climate change. Identifying plant traits in arid and semi-arid regions and grouping them according to similar morphological, physiological and ecological responses to environmental stresses is of paramount importance for the conservation of native plant species in these areas. In Brazil, the semi-arid region is mostly covered by Caatinga vegetation with some areas at high risk of desertification. Our aim was to understand the impact of aridity and anthropization in plant functional diversity in the area of Caatinga. We selected three areas representing different levels of desertification susceptibility and vegetation degradation (high, medium and low). In each of these areas 10 plots of 100 m2 (10mx10m) randomly distributed were evaluated. In each plot we measured diversity and richness of plant species and the morphological traits of the tree Poincianella pyramidalis: diameter (DBH) and leaf dry weight. We recorded 39 plant species in the medium and low susceptible areas and 21 in the high susceptible one. The diversity and the leaf dry weight in P. pyramidalis were significantly lower in the area with high susceptibility. The DBH showed a small variability between areas and seem to be more associated with the degree of anthropization. According to the conservation status of the areas, the changes in these parameters showed a potential to measure different degrees of susceptibility to desertification, and different levels of anthropization of the Caatinga.

S4. Oral

The functional approach as an useful tool for addressing central questions in plant community ecology

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The use of functional traits – i.e. morpho-physio-phenological attributes which have an indirect impact on fitness via their effects on growth, reproduction and survival – has been broadly extended in last years as a robust tool for addressing central questions in plant community ecology. First, the functional approach has been largely applied in many ecosystems and biomes for trying to discern which underlying mechanisms allow species to persist and be dominant under particular environmental conditions. A good example of this first approach is the broadly-known tradeoff between fast acquisition and efficient conservation of resources, which can be captured from the range of trait variation that defines the leaf economics spectrum. Second, functional traits can be also used to forecast how plants respond to changes in environmental conditions such as the expected increasing frequency of climatic extreme episodes. Third, trait-based studies have been recently used to better understand the rules that govern the assembly of communities, dissentangling the relative importance of habitat filtering and limiting similarity as drivers of this process. Finally, there is growing evidence that plant functional traits have a strong potential to infer relevant ecosystem processes such as net primary productivity or litter decomposition scaling up from the individual to higher levels of organization. In this respect, recent studies have highlighted the necessity of expanding the functional approach to a multitrophic level quantifying key attributes not only in plants but also in other organisms (e.g. soil biota) with which they interact for the provision of these ecosystem processes.

S4. Poster

Colonization pattern of *Quercus pyrenaica* in mediterranean abandoned croplands: a study case from Sierra Nevada (Spain).

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Land abandonment is a major global change driver in the Mediterranean Region where anthropic activity has played an important role shaping landscape configuration. Understanding the woodland expansion towards marginal areas (abandoned crops) is critical to develop effective management strategies. In this work we analyze the colonization pattern of abandoned croplands by *Quercus pyrenaica* in Sierra Nevada. We aimed to assess differences among populations in the rear edge of its distribution. For this purpose we characterized (i) the colonization pattern of *Q. pyrenaica*, (ii) the structure of the seed source (mature forest), and (iii) the abundance of the main seed disperser (European jay, *Garrulus glandarius*). The study was conducted in five abandoned croplands located in two representative populations of *Q. pyrenaica* located in contrasting slopes. We sampled three habitat types: mature forest, edge-forest and abandoned cropland. A total of 83 plots (10 x 30 m) were sampled. In each plot all tree individuals were counted. Basal diameter and height of each tree specimen were measured and sapling abundance was calculated. Abundance of European jay was determined by bird census (7-year) (line-transect method). Sapling abundance was different between northern and southern *Q. pyrenaica* populations. However, no differences on sapling abundance were observed among habitat types. Abundance of jay does not differ significantly between sites. On the other hand, forest structure showed differences between populations. Differences in colonization pattern could be explained by different management histories and (different land-use intensities) before abandonment of the croplands (biological legacies) and cattle management practices.

S4. Oral

Complementarity among shrub species enhances community richness and phylogenetic diversity along an environmental gradient in an alpine environment.

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Facilitator species can alter microhabitats by buffering temperature extremes and wind, maintaining higher humidity and nutrient availability than open areas. These effects are critical for species persistence out of their optimal distribution range. We studied the effects of seven potential facilitator species with contrasting morphologies on subordinate communities along an environmental gradient, linking such effects to microhabitat conditions under the canopy. We estimated complementary effects of co-occurring shrub species to community-level richness and phylogenetic diversity along the gradient. Our field site included two elevation gradients on opposing aspects in Sierra Nevada range (Spain). As expected, shrubs buffered harsh abiotic conditions compared to open areas all along the gradient. Composition of subordinate communities differed among shrub species and sites, and was correlated with relative humidity. Positive effects of shrubs on plant abundance and species richness prevailed in the most severe sites while under relatively milder conditions shrub effects were mostly neutral or negative. Shrub species had complementary effects in sites where microhabitat differences were most extreme and there was at least one shrub species facilitating community richness and plant abundance, promoting whole-community species richness and phylogenetic diversity. This complementary effect was absent where environmental severity was mild and shrub species had non-significant or negative effects on subordinate communities. These results highlight the importance of keeping shrub species, as their complementary effects may be critical to maintain biodiversity and ecosystem functions of this fragile ecosystem.

S4. Oral

Assessment of imputation methods using varying ecological information to fill the gaps in a tree functional trait database.

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Plant functional traits are increasingly being used in functional and community ecology to study global-change-related questions. The analysis of large ecological databases is increasing our understanding of the spatiotemporal and environmentally-driven variability in plant functional traits. However, these databases contain a large fraction of missing data and casewise deletion of missing data limits statistical power and may lead to biased analyses. Here, we assess the performance of different methods to impute missing data of five tree functional traits (leaf biomass to sapwood area ratio, foliar nitrogen, maximum height, specific leaf area and wood density) in the Ecological and Forest Inventory of Catalonia, an extensive spatial database (covering an area of 31900 km2). In a complete dataset for all five traits (13 species, 630 plots) we randomly introduced different replicated levels of missing data (10-50%, in 10% increments).We tested the performance of a single imputation method (k-nearest neighbours: kNN) and a multiple imputation method (multiple imputation with chained equations: MICE) against a simple imputation using the species-specific mean value. Using only functional traits as predictors, both kNN and MICE greatly improved the precision over the mean imputation method but MICE yielded imputations which better preserved the covariance structure of the data. MICE imputations of all traits but maximum height greatly improved when species identity was added to the predictor matrix. Adding stand structure reduced the imputation error of maximum tree height, but climate and spatial structure did not lead to significant improvements for any of the traits.

S4. Oral

Genetic variation in circadian regulation of nocturnal stomatal conductance enhances carbon assimilation and growth

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Circadian resonance, whereby a plant's endogenous rhythms are tuned to match environmental cues, has been repeatedly shown to be adaptive, although the underlying mechanisms remain elusive. The adaptive value of nocturnal transpiration in C3 plants remains unknown because it occurs without carbon assimilation. These seemingly unrelated processes are interconnected because circadian regulation drives temporal patterns in nocturnal stomatal conductance, with maximum values occurring immediately before dawn. We grew six *Eucalyptus camaldulensis* genotypes in naturally lit glasshouses and measured sunset, predawn, and midday gas exchange, and whole-plant biomass production. We tested whether sunrise anticipation by the circadian clock, and subsequent increases in genotype predawn stomatal conductance, lead to rapid stomatal opening upon illumination, ultimately affecting genotype differences in carbon assimilation and growth. The time for stomata to respond to light inputs at sunrise decreased with increasing predawn stomatal conductance. Moreover, genotype early morning and midday stomatal conductance and carbon assimilation, leaf area and total plant biomass were all positively correlated with genotype predawn stomatal conductance. Our results lead to the novel hypothesis that genotypic variation in the circadian-regulated capacity to anticipate sunrise is an important factor underlying intraspecific variation in tree growth.

S4. Poster

Balance between carbon gain and loss under long-term drought: impacts on foliar respiration and photosynthesis in *Quercus ilex* L.

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Terrestrial carbon exchange is a key process of the global carbon-cycle consisting of a delicate balance between photosynthetic carbon uptake and respiratory release. We examined the seasonality of photosynthetic and respiratory traits and evaluated the adaptive mechanism of the foliar carbon balance of *Q. ilex* L. experiencing a long-term rainfall-exclusion experiment. Day respiration (Rd) but not night respiration (Rn) was generally higher in the drought treatment leading to an increased Rd/Rn. The limitation of mesophyll conductance (gm) on photosynthesis was generally stronger than stomatal limitation (gs) in the drought treatment reflected in lower gm/gs. The peak photosynthetic activity in the drought treatment occurred in an atypical favourable summer in parallel with a lower Rd/Rn and higher gm/gs. The plant carbon balance was thus strongly improved through (i) higher photosynthetic rates induced by gm and through (ii) decreased carbon losses mediated by Rd. Interestingly, photosynthetic potentials (Vc,max, Jmax, TPU) were not affected by the drought treatment suggesting a dampening effect on the biochemical level in the long-term. In summary, the trees experiencing a 14 year-long drought treatment adapted through higher plasticity in photosynthetic and respiratory traits, so that eventually the favourable growth period was exploited more efficiently.

S4. Poster

Thermal plasticity of photosynthesis in a Mediterranean mixed forest

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Temperature is a major ecological variable that determines the natural distribution of plants. The negative effects of temperature on the photosynthetic system and the feedback to the global carbon cycle remain key uncertainties in scenarios of future climate change, especially in the Mediterranean region. We constructed temperature-response curves for mature trees of four Mediterranean species and recorded the net assimilation rate (Anet) in parallel with the electron-transport rate based on chlorophyll fluorescence (Jcf) in six seasonal campaigns. We assessed two formulations that modelled the temperature responses: the peaked function (Medlyn et al., 2002) and the model by June et al. (2004). The peaked function modelled the observed temperature responses better. The thermal optima of Anet and Jcf across all species and seasons were 24.7±0.5 and 30.3±0.6 °C, respectively, but varied significantly between seasons. The curvatures of the response curves were only partly affected by seasonal acclimation. The photosynthetic system was generally impeded primarily by high, not low, temperatures and was better acclimated to heat stress in the drier and hotter year. Species-specific acclimation partly offset these general trends. Our results indicate that Mediterranean climax species exhibit a strong capacity to acclimate to warmer and drier conditions.

S4. Poster

Fire and management legacies induce state shifts in a *Pinus pinaster* forest in Central Spain

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World forests are undergoing contrasted trends. While in some areas pressures continue, in others these are decreasing, setting forests into a trajectory of recovery towards their initial state. However, disturbances can interact with this process, inducing shifts towards alternative states. Here we investigated post-fire recovery of an ancient *Pinus pinaster* forest with *Quercus pyrenaica* in the understory in Central Spain, in which intensive management had decreased. We used BRT models to predict pre-fire stand structure based on stand history, and to predict post-fire vegetation based on stand structure, geophysical variables and fire severity. We found that pre-fire *Quercus* stem density tended to be higher in stands without recent management plans, suggesting colonization after abandonment, although overall stand structure was poorly predictable. The post-fire forest was dominated by *Pinus, Quercus*, or a mixture of both. *Pinus* density was unrelated to pre-fire stand structure, while *Quercus* abundance was highly dependent on its pre-fire stem density: In stands with over 200 *Quercus* stems per hectare, the post-fire forest was dominated by *Quercus*. Therefore, fire mediated a forest shift from *Pinus* to *Quercus*, driven by the pre-fire colonization of *Quercus* in the understory in areas with a longer time without management plans. In a scenario of more frequent fires, this kind of shifts may continue occurring where Pinus is still dominant. However, in the longer term, *Quercus* persistence in the area is threatened by climate change, since the climate space will be drastically reduced for *Quercus*, not for *Pinus*.

S4. Poster

A comparison between abundance and presence-absence pairwise gamma-diversity components of plant functional groups at temporal scale in a Mediterranean grassland context

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Recent approaches such as functional ecology and diversity partitioning, have proved to be very useful to explain ecological factors influencing community composition and structure, however, few studies address the quantitative response of individual species. Our aim is to investigate whether there is a pattern in the assembly process of plant communities from a functional point of view, across a temporal scale of eleven years of secondary succession after fire disturbance in a Mediterranean grassland exposed to high grazing pressure. We hypothesize (1) that there are differences between qualitative and quantitative responses of the pairwise gamma-diversity components between groups; (2) that some functional groups are more influenced by year-to-year environmental fluctuations than others.

For this purpose, we used the framework proposed by Podani & Schmera (2011) and Podani et al. (2013); this method is based in the partitioning of pairwise gamma diversity into additive components that can be easily interpreted from a two-dimensional simplex diagram. The study of the relative importance of these components, which measure similarity, replacement and differences of species for all pairs of sites, help us to reveal underlying patterns in community structure.

Our results showed that there are great differences in the relative contribution of the gamma diversity components for plant functional groups when we consider abundance data that are not detected in the presence-absence analysis. In our dataset, there were big differences in species abundance between years, this situation, can lead to the misinterpretation of the results when we do not consider functional groups.

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S4. Poster

Nutrient resorption and functional traits, how do they relate each other in 33 woody Mediterranean species?

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Green leaf traits are very important for plant functioning and can also influence litter traits and therefore litter decomposition and C nutrient cycling. Thus, the mechanism of carbon and nutrients resorption can affect litter quality and at the end, soil fertility. Green leaf traits (structural and chemical) can provide key information about the causes of the differences between species and functional groups on nutrient resorption efficiencies. We studied structural and chemical leaf traits in 33 woody Mediterranean species (15 deciduous and 18 evergreens) in green and senesced leaves. The aims of this study were to know: (i) if species and functional groups (deciduous and evergreen) differ in the relationships between traits of green and senesced leaves and, (ii) if green leaves traits can be the possible causes of the different nutrient resorption efficiencies. Our results showed that the importance of the green functional traits on the senesced leaves depends on the type of traits (structural or chemical) and on the functional groups considered. The structural traits (leaf mass per area or thickness) of green leaves had a huge effect on the structural traits of senesced leaves, irrespective of the functional group. However, the relationships of nutrients (N, P and K) concentration between green and senesced leaves were dependent on the functional group. We found a strong relationship for the deciduous species, while this was not true for evergreens (which presented weak or null relationships). Considering all species, there was not any green leaf trait related to nutrient resorption efficiency.

Sessão 5. Ecologia Marinha/Sesión 5. Ecología Marina

S5. Poster

The impact of the invasion of the brown alga *Sargassum muticum* on benthic food webs in Iberian Peninsula: the influence of the environmental context

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The risk of biological invasions on marine coastal habitats is rapidly increasing in concomitance to the recent climatic changes. Despite it is generally agreed that the simultaneous effects of climate change and invasive species may modify the structure and functions of coastal assemblages, our knowledge on the nature and intensity of those changes is limited. Our main aim was to study if the presence of the large invasive brown seaweed Sargassum muticum affects the structure of natural assemblages and the benthic food webs, using intertidal rockpools communities as study systems. We carried out a large spatial-scale survey in Atlantic and Cantabrian shores of Iberian Peninsula, in locations with different upwelling intensity where the presence of the invader *S. muticum* was manipulated. In the studied shores, we analysed the structure of tide-pool assemblages and trophic webs, through the analyses of natural abundance of stable isotopes (carbon and nitrogen) in consumers and potential food sources at two sampling times. Preliminary results indicated changes in the trophic position of some consumers and increases in the food chains length under upwelling conditions. They also suggest a strong context dependency (upwelling influence and Cantabrian vs Atlantic shores differences) of the effect of the invader on the assemblage composition and trophic structure of the benthic food webs. This is important for predictions of invasion impacts, as it has been acknowledged that climatic change may induce changes in the upwelling strength, including the Iberian system.

S5. Oral

The conceptual problem of creating, understanding, and testing environmental management scenarios in estuaries and coastal zones

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To achieve ecological sustainability and sustainable development represents a crucial challenge for the human kind, which depends on numerous driving forces, frequently opposing each other. Nevertheless, when dealing for instance with estuaries and coastal areas, three major drivers may in any case be identified, which are the search for human well-being in its several aspects, the conservation of environmental equilibrium, essential to ecological sustainability, and systems' resilience in face of an increasing human pressure, resulting from population size and prosperity demand. To build and test environmental management scenarios involves therefore complex conceptual problems, demanding appropriate conceptual tools as for example the Ecological Sustainability Trigon (EST). Conceptually, the EST allows addressing the referred main drivers by using the human society view as a common currency, and to describe our behavior, energetics (economy), and dynamics based on ecological theory. Besides, the EST behaves promisingly as a gap analysis tool and a mean to address new research questions. Since its proposal, the EST has been further tested, namely in relation to the functioning and management of estuarine ecosystems and coastal areas, taking the Mondego Estuary (western Portugal) as core case study.

S5. Oral

Large-scale prediction of seagrass distribution: the case of *Cymodocea nodosa* (Mediterranean-Atlantic)

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Understanding the factors that affect seagrass meadows encompassing their entire range of distribution is challenging yet important for their conservation. We model the environmental niche of *Cymodocea nodosa* using a combination of environmental variables and landscape metrics to examine factors defining its distribution and find suitable habitats for the species. The most relevant environmental variables defining the distribution of *C. nodosa* were sea surface temperature (SST) and salinity. We found suitable habitats at SST from 5.8 ºC to 26.4 ºC and salinity ranging from 17.5 to 39.3. Optimal values of mean winter wave height ranged between 1.2 m and 1.5 m, while waves higher than 2.5 m seemed to limit the presence of the species. The influence of nutrients and pH, despite having weight on the models, was not so clear in terms of ranges that confine the distribution of the species. Landscape metrics able to capture variation in the coastline enhanced significantly the accuracy of the models, despite the limitations caused by the scale of the study. By contrasting predictive approaches, we defined the variables affecting the distributional areas that seem unsuitable for *C. nodosa* as well as those suitable habitats not occupied by the species. These findings are encouraging for its use in future studies on climate-related marine range shifts and meadow restoration projects of these fragile ecosystems.

S5. Poster

Local Ecological Knowledge (LEK) contribution for fisheries management in marine protected areas (MPAs) in Portugal.

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Given the recognition of the enormous impact of humans on marine environments, new conservation and management tools are recommended. The use of "local ecological knowledge" (LEK) emerged as a methodological tool to assist the management of complex socio-environmental systems (understanding the socio-environmental dynamics in resource-dependent communities resilience). In this study we highlight the experiences of the use of LEK in Brazilian conservation areas and we propose biodiversity management scenarios, using the LEK, in marine protected areas of Portugal. Ethnobiology studies in the Portuguese Coast are scarce. Even with its local and social importance, and providing livelihoods for coastal communities, the Portuguese artisanal fisheries faces several difficulties, which endangers the permanence of this activity as well as fishers' local ecological knowledge. Besides the possibility of the emergence of new methodological approaches in the understanding of the dynamics of these local communities and better management of MPAs in Portugal Coast (e.g. MNR Berlengas, Peniche), studies exploring the local ecological knowledge can provide and predict possible new forms of applications and modeling the use of LEK in fisheries management in the European Atlantic coast.

S5. Oral

The small shall inherit the ocean: Observations and experiments on warming-associated size reduction in bacteria

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A decadal time-series analysis of coastal heterotrophic bacterioplankton in the southern Bay of Biscay revealed strong seasonalities in the abundance, size and biomass of the universal flow cytometric groups of low (LNA) and high nucleic acid content (HNA) cells. The variability of LNA bacteria was consistent with ecological theories linking temperature, abundance and individual size. Concurrent with rising temperatures during the growth season, significant interannual trends of increasing standing stocks (3% year-1) accompanied by decreasing mean cell size (-1% year-1) suggest a major shift in community structure, with a larger contribution of LNA cells to total biomass. LNA cells were likely dominated by members of the SAR11 clade at this site, as found elsewhere. The finding that bacteria were apparently already responding to the hypothesized temperature-driven decrease in body size was supported by perturbation experiments carried out during 2012, which showed consistent cell shrinking with warming in several bacterial groups, especially from March through June. We hypothesize that the growing prevalence of smaller microbial genotypes and phenotypes will severely impact food webs and carbon fluxes in the future ocean.

S5. Oral

Settlement and recruitment success of *Semibalanus balanoides* at its southernmost European distribution limit (Galicia, Spain) in a Climate Change context

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Climate change has had effects on many marine ecosystems and it is expected to affect geographic distributions of species which life cycles are usually influenced by temperature. As a result, there is considerable interest in predicting the effect of climate change on biogeography. Strong correlations have been found in previous studies between sea surface temperature and recruitment in the acorn barnacle Semibalanus balanoides, the most widespread intertidal barnacle in the Northern Hemisphere communities. Temperature-dependent variations in recruitment has been shown to cause year to year fluctuations on geographic limits of the species in Southwest England, France and Spain. Its southern limit distribution is the Northwest of Iberian Peninsula so it is expected that slight temperature change would acutely affect the recruitment. We studied the recruitment of *S. balanoides* in the Ría de Arousa, Galicia (NW Iberian Peninsula), where two sampling stations were set where significant differences in sea surface temperature were previously recorded. Artificial collectors of 2 different substrates (cement discs/rough tape plates) and two different treatments (painted with a mixture of crushed adult barnacles/not painted) were fixed on the intertidal zone during the recruitment period (45 days). Collectors were changed every three/four days and cyprids and early recruits were counted under dissecting microscope. Recruitment was highly variable in time and space, although there were evidences of a main pulse followed by scarce disrupted recruitment. Recruitment in the cold locality was higher than in the warm one. Differences in substrate selection were not conclusive.

S5. Oral

Understanding the mechanistic link between environmental heterogeneity, physiology and metapopulation structure to forecast the effects of climate change at continental scales

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The intertidal is strongly influenced by meteorological conditions, providing a direct link between climate and biodiversity. Together with collaborators, I have shown that temperature played a major role in determining modern and historical distributions of several key intertidal species. Yet, the mechanisms translating small-scale, individual patterns in temperature into large-scale invasions and range shifts remain virtually unknown. To tackle this issue, we have been collecting data from a unique network of biomimetic sensors deployed along the European coast. Coupled with in-situ measurements of sub-lethal thermal stress (via Heat Shock Protein expression and cardiac activity), these data suggest that intertidal habitats are a mosaic of very stressful environments interspersed with areas of low stress. We are trying to understand the importance of this variability in determining large-scale macroecological processes. Of central interest is the degree to which environmental variability modulates (exacerbating or buffering) the long-term effects of global warming.

S5. Oral

Estuarine nursery colonization patterns in flatfish: a latitudinal approach

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Recruitment variability in marine flatfish is determined mainly in the pelagic stage, where recently hatched larvae are transported to estuarine and coastal areas and metamorphose into benthic juveniles. At this step, the main ontogenic processes are driven by environmental conditions, whose unpredictability convey a great deal of variability in recruitment, associated with growth and survival of early life stages. In addition, a latitudinal cline in the colonization of nursery areas by juvenile fish has been described, but not thoroughly investigated for flatfishes. We studied the colonization patterns of two marine flatfish with distinct biogeographical ranges (European flounder, Platichthys flesus, temperate, and common sole, Solea solea, sub-tropical), by estimating the duration of the pelagic and metamorphic stages, as well as the duration of the spawning period, in several nursery areas across their geographical distribution range in the Western Atlantic and Mediterranean coasts, using otolith microstructure analysis. A general latitudinal cline was observed for the onset of each stage (spawning, larval pelagic and metamorphosis) for both species, with up to two months delay between the southernmost and the northernmost areas, as well as a shorter duration of pelagic and metamorphosis at the extremes of each species distribution. Results also suggested the existence of a counter-gradient growth compensation mechanism in the northernmost populations. Apart from temperature, which sets the metabolic pace of marine organisms, differences between sites were also related with species-specific tolerance and habitat features, such as the extension of the continental platform and adaptations to transport and retention mechanisms.

S5. Poster

Effects of temperature and salinity on larval development and recruitment of the invasive mussel *Xenostrobus securis*

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The pygmy mussel *X. securis* (Lamarck, 1819) (Mollusca Bivalvia Mytilidae) is a native species to brackish waters of Australia and New Zealand. This specie was cited as invasive, in the first time, in the Italian coastal lagoons expanding from the Mediterranean Sea to Ria de Vigo (Galicia, Spain). *X. securis* has the ability to colonize all substrates. There is currently little information about larval development or reproductive capacity of adult *X. securis* in different environmental conditions, nor either on the larval behaviour, settlement or recruitment. This information is necessary to determine the degree of threat to the ecosystem and to mussel (*Mytilus galloprovincialis*) farming because many recent studies indicate that invasions of non-native species are a significant stressor agent and it may be responsible for significant changes in marine communities. Spawning was induced in laboratory using different environmental conditions. Approximately 1000 adult specimens of *X. securis* collected in the Ria de Vigo and exposed at an orthogonal combination of 4 temperatures (18, 20, 22, 24ºC) and 4 salinities (20, 25, 30, 35). Analyses revealed that only the lowest experimental salinites induced the release of gametes by adults. With the data obtained from this study was possible to obtain a table of embryonic and larval development at 18 °C and 25 of salinity. Trochophore larva was obtained at 48 h and pediveliger larva 20 days after fertilization. Results also indicated a significant effect of salinity on the initial size of larvae at 48 h and on the initial size of recruits.

S5. Oral

Benthic juveniles of an estuarine invertebrate display contrasting performances over four consecutive supply events of pelagic larvae

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The pelagic and benthic life of marine invertebrates with bi-phasic life cycles was commonly studied assuming that metamorphosis would delete larval history. Presently, it is acknowledged that benthic life of adults, namely females, significantly influences larval performance during their pelagic life and that larval history can shape the postmetamorphic performance of benthic juveniles and population dynamics. In the present study we evaluated the larval competence and juvenile performance of the green crab *Carcinus maenas* in Ria de Aveiro (Portugal), during four consecutive larval supply events in 2013. The larvae were kept in the laboratory under controlled conditions mimicking those experienced in the wild. After metamorphosis juvenile crabs were randomly separated in two treatments: exposed to starvation (S) and provided with food ad libitum (F). In the F treatment juveniles were kept until they had reached the fifth juvenile instar (C5). Results showed that larval quality shifted along supply events, with this being reflected in juvenile performance until C5. Overall, optimal grow-out conditions did not delete the larval history experienced by the larvae from each supply event. We analysed the influence of upwelling index (UI) in larval quality and juvenile performance, using general additive models (GAM), with UI explaining a significant % of deviance in larval quality and juvenile crab performance.

S5. Oral

Distribution Models of the tropical hydrocoral *Millepora alcicornis* in Climate Change Scenarios

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Ocean temperature increases and other environmental changes linked to Climate Change are causing shifts in tropical species distribution. One example is the new occurrence of the hydrocoral Millepora alcicornis close to the Atlantic coast of Tenerife in the Canary Islands. Species Distribution Models (SDMs) are focused on the association between organisms' range margins and climatic factors and allow predicting current and future species' potential habitats. To develop the *Millepora alcicornis* SDMs, species occurrences were gathered from literature reviews and database portals. Marine environmental variables related to coral reefs were regionally scaled, and different statistical techniques like MaxEnt (Maximum Entropy Modeling), Classification Trees (CT) and GLM (Generalized Linear Models from R-packages Mumin and BIOMOD) were developed to build our final model. The main predictors selected were maximal and minimal sea surface temperature, salinity, aragonite and pH. We used MaxEnt to predict the *Millepora* Distribution Models in different IPCC scenarios. The results obtained by these analyses showed high probabilities of expansion in some regions and contraction in others. The tropicalization of temperate regions could compromise native communities, like macroalgae, due to the capacity of this hydrocoral to create new habitat and displace local species. In addition, a significant coral reef biodiversity loss will occur where the contraction is predicted. Despite of these results, when the predictors are outside their present range, the interpolation must be interpreted with caution and further research is needed. Hence we propose physiological thresholds experiments to enhance the SDMs.

Sessão 6. Ecologia e Sociedade/Sesión 6. Ecología y Sociedad

S6. Poster

Modeling current and future suitable areas for cultivation of *Sinapis alba* (Brassicaceae) as an oilseed with potential for biodiesel

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Oilseed species are cultivated as biofuel sources the world over, with several mustards (Brassicaceae) playing a prominent role for biodiesel and as additive lubricants. The commonly used mustards (e.g., *Brassica napus*) occur naturally in mesic temperate conditions. Global warming and increased aridity may make thus increasingly difficult to obtain appropriate crops of these species in many regions. A possibility to compensate oilseed demand in the future is the development of new crops based on oilseed mustards naturally adapted to more arid conditions. An alternative to conventional *Brassica* species for biodiesel production is *Sinapis alba*, a mustard native of the circum-Mediterranean region with a seed lipid content of around 40% (dry matter). Here we model the area suitable for cultivation for *Brassica napus* and *Sinapis alba* in Europe, north Africa and Near East under present climatic conditions and under different scenarios of Climate Change. We show that under current climatic conditions the suitable areas for cultivation of *S. alba* are not overlapped with those of *B. napus* and that it could be cropped through ample areas of the circum-Mediterraenan region without irrigation, which is not the case of *B. napus*. Increasing aridity and mean temperatures in the future would allow expanding the appropriate areas for its cultivation in Europe while shortening them for *B. napus*. We suggest taking advantage of the fact that *S. alba* is a common weed in olive groves to crop it as a herb coverage, decreasing soil loss and maintaining biodiversity and ecosystem function in these agroecosystems.

S6. Oral

Effects of edge in urbanized areas about microclimate on an ecological park in Cuiabá-MT

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(1) Cuiabá.

This study presents the approach on how the concentration of buildings and pavements can interfere on the microclimatic elements of an urban ecological park in the city of Cuiabá. The variables, temperature and relative humidity were used for the points close to the area which concentrates the buildings (P), near the paved areas (A) and internal points inside the park (V), ie, distant from the perimeter of the park. Monthly measurements were made in loco on thirty points distributed in the park, from October 2014 until March 2015. The variables of the three sets were compared statistically by multivariate analysis of variance (MANOVA), with the comparison of the three groups considering the temporal and locational factors, presenting different means. Following in the multivariate analysis (MANOVA), analysis of variance was applied (ANOVA), with the test of effects of each factor on the dependent variables (between-subjects effects test) that proved the difference between the means. The determination of the value of the differences occurred by applying the Tukey test (honest significant difference). The differences occurred, in particular, in the set of points near the paved areas A which presented an average temperature of 1.73 degrees Celsius higher than the points in the P region, and 1.34 degrees Celsius higher than the V. As for relative humidity, A areas showed a relative humidity, on average, 5.5% lower than the P and 6.5% lower than the V. Key Words: Urban climate. MANOVA. Ecological Park. Cerrado.

S6. Poster

Spatial and temporal dynamics of urban sprawl in Coimbra and its impacts on cropland loss and soil sealing during a 20-years period

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Its well-known urban expansion will highly impact development in the 21st century. The concentration of people in densely populated areas, especially in developing countries, will undoubtedly continue to increase as the majority of the world's population will live in urban settlements. This study analysed the spatial and temporal urban expansion in the Coimbra city during a 20-years period (1990-2010). Results revealed an urban expansion of 1 142 ha during these last two decades, corresponding to a mean growth value of 57 ha/year, land that was taken mostly of at expense of cropland areas. This expansion however, has not been followed by an equally rapid population growth. While the urban area expanded 16%, resident population only increased 3%. This physical pattern of low-density expansion in built-up areas contributed to a less compact city evolution, clearly an indicator of urban sprawl. The loss of cropland areas and increase of soil sealing intensify the probability of occurrence of hazards such as floods, landslides, heat waves, and fires, and is the main reason for habitat fragmentation and loss of ecosystem's services. Therefore, urban stakeholders face an important challenge in designing and implementing suitable strategies that are able to reduce these harmful impacts. A better understanding of the spatial and temporal dynamics of the city's expansion may be a helpful contribute for a better planning and management of local human activities and for future sustainable urban development of Coimbra.

S6. Oral

Strategies to promote the knowledge and to raise awareness of the ecological value of marine and estuarine ecosystems and threats that they face: linking science and society in the scope of the ECORISK project

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Marine and estuarine ecosystems are greatly affected by diverse stressors, pollution being one of the most concerning. In this context, science has a great responsibility in contributing to ensure a sustainable exploitation of marine and estuarine resources through knowledge, technologies and translation of scientific production to the general public to assure its increasingly involvement in those issues. In this scope, one of the goals of the project ECORISK - Ecological risk assessment of oils and hazardous and noxious substances in the NW Portuguese coast is to inform and develop consciousness among citizens about several topics related with the sustainability of marine ecosystems, especially, the problems caused by oil and hazardous and noxious substances spills. Therefore, in the ECORISK several science communication activities have been developed, including some especially prepared for children and youth, to increase their understanding about biodiversity, services, and ecological and economic value of marine ecosystems and the importance of their conservation. Those actions included: the creation and updating of a website (www.ciimar.pt/ecorisk) and of a facebook page (https://www.facebook.com/ecorisk); the production of brochure;, the organization of workshops for children and youth; the organization of activities for the Verão em Projeto programme of the Universidade Júnior of Porto University; the production of an exhibition about oil spills; a book for child/youth and the construction of a pedagogic kit about oil spills.

S6. Oral

The environmental licensing instrument of social control of the paleontological heritage

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The state of Rio Grande do Sul, in Brazil, has enormous potential for Paleontological Tourism, as is the case of Paleorrota, in the central region, with fossils of the Triassic period, (between 210 and 290 million years), as the Staurikossaurus pricei, the “first Brazilian dinosaur" (perhaps the oldest ever found in the world), collected in Santa Maria, the Paleontological Site Jazigo Cinco, by Llewellyn Ivor Price, in 1936. The region has contributed to the understanding of the Earth changes since the end of the Permian era, when there were mass extinctions, succeeded by Triassic era, but even before this paleontological wealth, the tourism in the area is still undervalued: less than 10,000 annual visitors. The regional economy focuses, primarily, on small agriculture, specifically smoke, culture to be eradicated due to the adhesion of Brazil to the Framework Convention on Tobacco Control, and it does not seem that the search for development alternatives involve the valuation of the natural resources/paleontological heritage, as ecological tourism.The basis of this work is the study of Paleontology as a tourist interest activity, combined with its scientific importance for the understanding of life on Earth and the need for social control on this heritage – of Environmental Licensing type - from the intervention in the territory of owners (rural, especially, that conform the local economy); the Government (responsible for regulating both); researchers (usually unrelated to the environment) and especially, the local community, most interested in these actions, given its role in the so-called "spirit of place".

S6. Oral

Evaluation of environmental contamination resulting from two necropolises in groundwater in the municipality of Belo Horizonte-MG/ Brazil

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This study demonstrates the analyses of groundwater samples (phreatic aquifers) of Paz's and Saudade's cemeteries, located in the municipality of Belo Horizonte, in the State of Minas Gerais, Brazil. These cemeteries lie in different geological, lithostratigraphic and hydrogeological conditions. The object of research consisted in cemeteries as possible pollution sources and aimed to diagnose and compare different contexts of possible environmental contaminations. The microbiological contamination indicators considered, coming from the cemeteries, were fecal and total coliforms, sulphite-reducing clostridia, fecal enterococci, proteolytic bacteria. The presence of these microorganisms proved to be consistent with the direction of the underground hydraulic flow and the depth of the phreatic level. It was found that the waters did not present satisfactory hygienic and sanitary conditions. Moreover, in Paz's cemetery high levels of ammonia nitrogen were found. It was also detected the presence, among other chemical elements, of metals like lead, zinc, copper, cadmium, chromium, nickel and aluminium, which could have its origin in masonry and coffins. A direct relation was observed between the aquifer pollution and the geological and hydrogeological conditions and the funeral practices used in the studied cemeteries.

S6. Oral

Biodiversity Safeguard for Sustainable Development: An Unesco Chair at the University of Coimbra

Freitas, H.[1]

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The Chair in Biodiversity Safeguard for Sustainable Development aims to create an integrated network of research, teaching and transfer of knowledge between the University of Coimbra and higher education institutions in Portuguese-speaking countries in Africa, in the areas of biodiversity, ecology, and conservation, in step with the need for sustainable use of biological resources and population development, in such regions.

Under the scope of the Chair's domains, we aim to: provide training and scientific resources by promoting the exchange of students and researchers among partner institutions; enhance scientific knowledge for the benefit of the environment and the sustainable management of biological resources; value and share historical biological knowledge pertaining to Africa; make use of digital tools for faster, more effective knowledge-transfer. Several actions will be implemented, including training, both on site and e-learning, exchange of human resources, the development of science and conservation projects, and publications.

S6. Oral

Understanding Global Change: a Network of European sites to demonstrate Global Change processes to the general public.

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Protected sites such as Parks or Reserves focus on natural elements, species and ecosystems. Human interventions or the ecological history of the site are seldom presented. Alternatives to conservation such as exploitation of natural resources are not discussed, assuming visitors are concerned with natural elements only. Surroundings of protected sites undergo intense changes driven by agriculture, industry or urban spreading and yet the economic analysis or description of environmental gains of preservation vs. exploitation, is ignored in visits. Sustainability demands a comparison of management alternatives to an area, a natural resource or a system. Protected sites provide excellent examples of management options if compared to surroundings and duly documented. Sustainability implies restrictions to use or to consume in order to abate some Global Change processes. People´s acceptance will depend of their understanding of the scientific basis of enforced limitations. In a democracy, it is only general opinion what drives political options between alternatives; public vs. private, preserved vs. exploited, restored vs. abandoned. It is suggested that a Network of European sites to demonstrate Global Change processes will provide a valuable tool to document Global Change examples and concepts to the general public. Desirable characteristics for Network sites are discussed. Global Change information from three sites is demonstrated for Doñana Parks, Marismas del Odiel and Espinho (Portugal).

S6. Oral

Web-Mapping of invasive plants in Portugal: involving the public and promoting awareness

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Raising awareness amongst Portuguese population about biological invasions has been one of our priorities since we started working with invasive species in 2001. We´ve used different approaches to engage the public and in March 2013 a new approach was launched: a citizen science platform, available online, which aims to get public participation in the mapping of invasive plants in Portugal: http://invasoras.pt/mapa-de-avistamentos/. To support the web-map, a new version of the website invasoras.pt and a field guide (available both on paper and online), with species profiles to assist in the identification, were developed. Any citizen can register in the platform and report sightings, either on the website or through an App for Android devices. Data gathered is freely available both on invasoras.pt and on the GBIF database. In order to actively engage the public in the mapping of invasive plants, the project is promoted through different media, Facebook and training workshops, targeting different groups (ENGO, schools, etc.). The outreach of this citizen science platform is being evaluated mainly considering the number of registered users and of sightings reported, but also visualizations of the map. By March 2015, 545 users had registered in the mapping platform; 177 were active users and submitted more than 5000 sightings. The species registered more often were Arundo donax (1101), Acacia spp. (1401), Ailanthus altissima (320), Cortaderia selloana (318) and Carpobrotus edulis (215). The mapping platform is the 4th most visited page of invasoras.pt, with about 3% of the visits of the total 380 000 pageviews.

S6. Oral

"Chave-In - illustrated dichotomous key to identification of the Portuguese vascular flora in the North Region"

Martins, M.[1], Garcia-Cabral, I.[1], Silva, N.[1], Gomes, A.[1], Branco, J.[2], Luís Crespi, A.[3], Morais, R.[4]

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Technical and scientifically, accurate identification instruments of the biological resources are increasingly important. Specifically, as structuring elements of the terrestrial ecosystems, the knowledge of the flora and vegetation is critical to the ecological characterization, planning, sustainable management and nature conservation of a given territory. In view of the growing demands in the area of botany and plant ecology, the idea arise of creating an innovative system structured in a digital format, to easily identify the Portuguese vascular flora. "Chave-In - illustrated dichotomous key to identification of the Portuguese vascular flora in the North Region" includes over 1500 taxa existing in the provinces of Portugal: Douro Litoral, Trás-os-Montes and Minho. The vast collection of the Botanical Garden of the University of Trás-os-Montes e Alto Douro (UTAD)'s Herbarium, with more than 20 000 plant specimens, forms the physical basis of work to photographic illustrations and taxonomic descriptions. The descriptive effort is complemented with field work and additional plant material gathered in other herbaria of the Index Herbarium network. This project, sponsored by PRODER funds, is being developed since the beginning of this year, in a partnership between the UTAD (coordinator) and the Federação Nacional das Associações de Proprietários Florestais (promotor). Hopefully, such tool will become useful for the technical (eg environmental impact assessments, ecological rehabilitation projects and landscape architecture) and scientific (eg in education in schools and universities, scientific research) communities, local populations and general public. Thus it will be available through its own website, to be accessible to a wide audience.

S6. Oral

Participatory mapping workshops: a methodology to obtain and validate historical information of land use changes at Sierra Nevada (Spain).

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(1) IISTA-CEAMA.

Traditional knowledge about the distribution of vegetation and the type and intensity of human intervention in the territory in the past is valuable to understand the current functioning of Mediterranean ecosystems. But it is very difficult to obtain. In this work, we present a case study that demonstrates the usefulness of traditional knowledge to analyze changes in vegetation and land use in a forest area of ??Sierra Nevada (Granada). We conducted a series of semi-structured individual interviews and joint workshops to map all the collected information.. Selected participants were retired elder whose jobs were related to the environment: farmers, shepherds and loggers. The information was collected on three thematic areas: distribution and dynamics of vegetation, land use (crops, livestock, firewood, mining and traditional activities) and relevant events (fires, forest pests, afforestation and landslide events). We present the information obtained in the workshops as well as an analysis of the evolution of vegetation and land use in the last 250 years in the southern hill of Sierra Nevada. We observed that the socioeconomic status of the studied area matches with land use changes. E.g. . e Plowing of large areas of forest when the settlers arrived after the expulsion of the Muslims in 1571 or the regeneration of holm oaks and oaks after the economic crisis of the 1950s, when the population and crops decreased.

S6. Poster

Motivations of non-governmental actors on urban green spaces initiatives across Europe

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Urban green spaces provide a number of environmental and social benefits for city residents (e.g. climatic regulation, air purification, flood control, education, recreation, tourism). By being an active part of green space planning and management, non-governmental actors can thus have an important role in the ecosystem services provided by green spaces, and ultimately in human wellbeing. Their motivations to take action, can be environmental and/or social. For this we assessed the green space initiatives highlighted by the city officials coming from non-governmental actors across 20 European cities, and their main social and environmental objectives. In each of the cities, two to five examples of green space initiatives were described in a total of 60 green space initiatives. Of all collected green space initiatives, 40% aimed to increase urban green space area, while a similar percentage of initiatives was aimed at promoting contact with nature and green spaces. At the other end of the spectrum, only 7% explicitly aimed for the promotion and enhancement of ecosystem services. Similarly, only 8% aimed for enhancing connectivity between existing urban green spaces. A comparison by European region of the motivations collected, showed that the Scandinavian and Mediterranean examples aimed the higher diversity of objectives, but while in Scandinavia the focus was mainly social, in Mediterranean the focus was mainly environmental. Since results are just based on stakeholders choice, further research is needed to better understand the differences in motivations of non-governmental actors to take action across the 20 EU-cities regarding urban green spaces.

Simpósio 1. Ecologia insular/Simposio 1. Ecología insular

Sp1. Oral

Using species abundance distribution models for biogeographical analyses

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Island biogeographical and ecological theories are dominated by patterns and processes related with species diversity and in particular species richness (S). Now we have some understanding about processes of species diversification and the roles of area, habitat diversity and island age on the number of species on islands. However, we lack completely a theory relating island geographical variables with species abundance and community assembly at both local and regional scales in islands. In this contribution we use standardized arthropod and vascular plant datasets from the Azores, Canary Islands and La Reunion to investigate for the impact of habitat (land-use) island characteristics in species abundance distributions (SADs). We found that in Azores a large number of communities are bimodal, comprising a mode of very rare species and a mode of relatively common species, the rarer mode prevailing containing a higher proportion of satellite taxa, introduced species and species that are more adapted to anthropogenic land uses that surround the native forest. We also found that SADs changes as a function of sample size, or in other words to its scaling properties. At this respect, island species communities are more important than trophic group in the properties of SADS. The consistent island observed differences in the shape and parameters of SAD models demonstrate that the study of relative species abundances is potentially useful for biogeographical purposes.

Sp1. Oral

Multi-scale environmental and landscape effects on the local diversity of ground beetle assemblages (Coleoptera: Carabidae) of Madeira Island Laurisilva

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Diversity is known to be determined by factors acting at different spatial scales. For example, local diversity is determined not only by habitat-related factors operating at the landscape and local scales, but also by several large scale drivers, such as climatic conditions and historical factors. Our main objective is to determine how local diversity of ground beetle assemblages (Coleoptera, Carabidae) from the native laurel forests of Madeira Island is influenced by environmental and landscape factors acting from local to regional scales. Ground beetles were collected using pitfall traps, with specimens being identified to species level and traits being obtained either from direct measurements of individuals, literature sources or expert knowledge. Diversity was measured through species richness, species evenness (Simpson index) and functional diversity (functional richness and functional dispersion). Environmental and land use data were obtained at six different scales (buffers of 100, 200, 500, 1000, 2000 and 5000 m around each sampling point) using a 100 m x 100 m resolution GIS database. The influence of such variables on local diversity was evaluated using generalized regression models. Preliminary results indicate that species richness and functional richness are influenced by the slope of the terrain when estimated at small scales, while climatic variables seem to affect functional richness and functional dispersion at intermediate and large scales. At large scales, the number of land-uses influenced species evenness and functional dispersion.

Sp1. Oral

Establishing pre-human vegetation baselines using the fossil record in the Canary Islands

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The Canary Islands represent one of the most biodiverse regions within Europe and therefore are a key region for conservation. Traditionally, humans have been considered an important driver of vegetation change in the islands, although the precise time and extent of human impact is not well known. The study of fossil pollen records provides an excellent tool to determine the effect of human settlement on vegetation and to establish pre-human colonization baselines. This information can also help to inform both conservation and restoration strategies. Suitable sites for fossil preservation were selected in three islands: Tenerife, La Gomera and Gran Canaria, where sedimentary sequences, spanning part of the Holocene, were obtained. Each sequence was analyzed for fossil pollen content and charcoal concentration in order to reconstruct both vegetation and fire dynamics. Statistical multivariate analyses were applied to detect changes in composition, taxonomic richness, and turnover. Pre-human vegetation baseline in the three sites consisted of different types of forested vegetation. Tenerife and Gran Canaria underwent the most significant changes in vegetation after human settlement, involving the increase of fires, the decline and disappearance of species, and the introduction of cultivated plants, while in La Gomera the forest remained almost intact.

Sp1. Oral

Leaf litter decomposition in Atlantic islands is driven by microbes and depends on litter quality and environmental conditions

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Leaf litter decomposition is an important process in many streams. The flow of carbon and nutrients to higher trophic levels generally depends on litter characteristics and environmental conditions, and is mediated by the activities of detritivores and microbes. However, little is known about what drives litter decomposition in Atlantic islands, where invertebrate communities are species-poor. In this study we assessed the relative importance of litter quality (by using three leaf litter species with distinct chemical composition: *Acacia melanoxylon, Clethra arborea*, and *Pittosporum undulatum*) and environmental conditions (by using six Azorean streams over a gradient of nutrient concentration and temperature) on mass loss of litter exposed to and protected from macroinvertebrates (by using coarse and fine mesh bags, respectively). No significant differences in litter decomposition rates were found between coarse and fine mesh bags suggesting that in these streams microbes are the key players in litter decomposition. Litter decomposition rates were in the order *A. melanoxylon* < *C. arborea* < *P. undulatum* and were negatively related with initial lignin concentration. Litter decomposition rates differed among streams. There was a hump-shaped relationship between decomposition rates and nitrate concentration and a U-shaped relationship between decomposition rates and water temperature. These relationships are explained by the limitation of the potentially stimulatory effect of the highest nitrate concentration on microbial activity by low temperature and a stimulation of microbial activity at the lowest temperature by high nitrate concentration, respectively. Nutrient availability and water temperature thus interact to determine litter decomposition.

Sp1. Oral

To swim or not to swim: on the poor oceanic dispersal potential of Azorean fleshy fruits

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How plants arrived to originally sterile oceanic islands have long puzzled naturalists. Dispersal syndromes (i.e., diaspore traits that promote dispersal by long-distance dispersal vectors), are considered to play a determinant role in the process. However, the association between the diaspore traits and the potential vectors that disperse them is not always obvious. Fleshy fruits are considered to have evolved chiefly to stimulate the internal dispersal of seeds by frugivores (endozoochory), however some fleshy fruits can also float in saltwater, being (potentially) transported by sea (thalassochory). We performed saltwater flotation and viability experiments with fruits of the 14 European fleshy-fruited species that naturally colonized the Azores archipelago. Only Corema album and Juniperus oxycedrus diaspores floated for as long as 60 days, the estimated minimum time needed to reach the Azores by oceanic currents. Exposure to saltwater reduced the viability of most seeds of the 14 species (46% of viability decline within 15 days and 77% within 60 days of immersion), including those of C. album (61%) and J. oxycedrus (83%), at the end of the experiment. Only the seeds of Rubus ulmifolius and Frangula alnus germinated after 60 days of immersion, however these did not float for more than 20 days. Floatability and viability trials suggest that while some fleshy-fruited species might have arrived to the Azores by oceanic currents, such would have required extreme meteorological events to reduce the duration of the trip. Thus, the hypothesis that fleshy-fruited species were mostly dependent on endozoochory to colonize these islands is reinforced.

Sp1. Oral

The Macaronesian bird element:: why insects keep visiting red flowers?

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Shifts in the assignment of ensembles of floral traits to different pollinator determine their role in mutualistic networks. Within the Macaronesian flora, members of the "Macaronesian ornithophilous element" have appeared within different families. Our study focuses on pollination visits and color traits for attraction and nectar reward in natural populations of the relict endemic Navaea phoenicea (Malvaceae). Patterns of nectar production, sugar concentration and composition, were assessed. Color was analyzed to explore the cryptic chromaticity with respect to birds and insects visual systems with reflectance measurements of individual organs, background vegetation and flowers of co-flowering species. Flowers showed high daily amounts of diluted nectar (x=0.088±0.070 ml) with volume varying across flowering stages, but not concentration (8-13%). Nectaries from upper petals yielded higher volumes. Volume varied significantly across years and removal significantly increased the total amount. Composition was glucose (58%) and fructose (42%), with significant variability between nectary position and individuals. Such variation did not affect the suite of pollinators. Reflectance spectra was similar across parts of the petals and other floral organs. However profiles showed two peaks: one peak in the UV-blue wavelength and another stronger associated to red reflectance. The color and nectar volumes are consistent with the bird pollination syndrome, but the UV-blue reflectance peak match those found in other enthomophilous mallows. Our conclusion is that, within the anthocyanin chemical suite, red pigments may be an adaptation to bird pollination and UV-blue second peak explains the flower attraction for insects.

Sp1. Oral

Plant invaders on islands: an overview and the Azores as a case study

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Plant invaders are recognized as one of the major factors leading to relevant alterations of the biosphere, and have led to a global homogenization of the floras, particularly on islands. The Azores show a relatively high proportion of non-indigenous plants, namely when compared to other Macaronesian archipelagos such as the Canary Islands. Several of those plants are presently widespread in the Azores, contributing to the emergence of profound changes in plant communities (e.g. impeding regeneration), while still having the ability to further spread. Here we present several methods that are being used to model plant community change, distribution and the potential impact of plant invaders. The possibility of using energetic valorisation of woody plant invader biomass as a management tool is also being investigated, with the support of private companies, involving forest surveys, species distribution modelling, the use of allometric equations to estimate biomass based on dendrometric traits, and tree age determination. Within this context, the implications of the recently issued EU regulation on invasive species and of the recent removal of one plant invader from the official Spanish list by the court are discussed, as well as the public perception of the different components of the flora, including the non-indigenous and the invasive components.

Sp1. Oral

Colonization success by insular plants displaying LDD adaptations

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Four long-distance dispersal (LDD) modes have been generally considered to play central roles in island colonization by plants: anemochory (dispersal by wind), thalassochory (dispersal by oceanic currents), endozoochory (internal dispersal by animals) and epizoochory (external dispersal by animals). However, seeds can also be transported by vectors different than the ones to which they are best adapted (non-standard dispersal), precluding the inference of the actual vector of colonization based on diaspore traits alone. We propose an alternative approach to explore the relative contribution of LDD syndromes for the colonization of oceanic islands. In particular, we scored the presence of syndromes relevant for LDD in the native floras of Europe (c. 10,000 species), Azores (148 species) and Galapagos (313 species), and performed contrasting analyses. Only thalassochory appeared to have significantly favoured the colonization from Europe to the Azores and among Galápagos islands. The presence of LDD syndromes did not significantly improve the distribution of plant species across the Azores, except for the moderate advantage of endozoochorous diaspores. Indeed, most native species in Europe (63%), mainland Portugal (67%) and Azores (63%) produce unspecialized diaspores. In summary, diaspore adaptations are not always critical for LDD to oceanic islands.

Simpósio 2. Interações planta-solo/Simposio 2. Interacciones planta-suelo

Sp2. Oral

Effects of the intensity of above- and belowground herbivores on plant fitness and mutualist and antagonist insects

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In natural conditions, plants are simultaneously attacked by many insect species. This interaction may occur at different densities and plant compartments. As a result, aboveground and belowground herbivores can affect plant traits and fitness, and each other mainly by trait-mediated indirect effects. The intensity of the interaction between the different components of the food web will depend among others on the number of individuals of each herbivore group feeding in the same individual plant. However, because not all herbivores provoke the same effects, the intensity of above- or belowground herbivory should affect plants and other associated organisms differently. To test this hypothesis, we conducted an experiment with the short-lived herb *Moricandia moricandioides* (Brassicaceae) in a semi-arid ecosystem from southeastern Spain (Baza Basin, Granada). Both belowground and aboveground herbivore densities (0, 1 or 2) were manipulated in a split-plot design. *Cebrio gypsicola* larvae were used as root herbivore, and Euchloe crameri/Pontia daplidice pierid catepillars as floral herbivores, which are keystone herbivores in this system. Our results suggest that complex interactions occur between both compartments. Herbivory intensity affected plant reproductive traits, defensive compounds and nutrient acquisition. Additionally, herbivory intensity also affected aboveground free-living herbivores and pollinators abundance. Herbivores responded to the treatments depending on their specialization degree and feeding strategy (chewers, suckers or pre-dispersive seed predators).

Sp2. Oral

Rainfall, microhabitat, and small mammals influence the abundance and distribution of soil microorganisms in a Chilean semi-arid shrubland

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Soil water availability is considered to be the main driver governing dryland ecosystems. While the ways in which water limits net aboveground primary production has been widely explored, there is a paucity of long-term studies analysing associations between precipitation, plant communities, and soil microorganisms, although they may be critical to understand soil biotic-driven ecosystem processes. Over ten consecutive years we measured the abundance of vesicular-arbuscular mycorrhiza (VAM), soil heterotrophic bacteria and saprophytic fungi in a semiarid community in Chile. This effort spanned both high- and low-rainfall years, and we sampled soils under shrub cover and in open microhabitats, both where small herbivore mammals have been excluded and in control plots. While the percentage of root length with VAM was higher in dry compared to wet years, free-living soil bacteria and fungi were more abundant during wet years. All microorganisms were more abundant in the resource islands beneath the shrubs compared to open spaces, although the relation between soil biota and the concentration of some particular nutrients was negative. These patterns were modulated by the presence of small mammals, which enhanced root colonization by VAM whereas their presence negatively affected saprophytic soil fungi. Soil bacteria abundance showed a more complex response to the presence of small mammals and was dependent on microhabitat and year. The spatial and temporal heterogeneity of resources and the activity of small mammals are important modulators of subterranean biotic responses to rainfall, the primary factor affecting soil microbiota abundance in this semiarid ecosystem.

Sp2. Poster

Oak decline reduces the stability of soil processes against changes in soil moisture and temperature predicted by climate change scenarios

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Cork oak forests (*Quercus suber*) of the Iberian Peninsula are affected by severe problems of tree decline and mortality induced by global-change drivers such as exotic pathogens (*Phytophthora cinnamomi*) and climate change. Previous studies have shown that oak decline translates into alterations of ecosystem processes such as mineralization and nutrient availability. We hypothesize that these indirect impacts of global change on soil processes might be amplified in a near future by direct effects of changes in temperature and rainfall on soil processes. To test this hypothesis, we conducted a factorial experiment where we analyzed the effect of projected changes in climate on C mineralization and N and P availability in soils taken under Q. suber trees differing in health status (healthy, defoliated, dead). Soils were incubated during a 28-day period under three different scenarios of temperature (average spring, +3ºC and +5ºC) and four soil moistures (wet spring, the average spring soil moisture, a reduction of 20% in soil moisture and an extremely dry spring). We detected a general reduction in C mineralization and N and P availability as a consequence of a decrease in moisture; meanwhile the increase of temperature had a low impact on these variables. However, the negative effect of moisture reduction on soil variables was higher under defoliated and dead trees than under healthy trees. In summary our results suggest that the process of oak decline induces changes in soil properties that reduce their stability against the direct impact of climate-change type drought.

Sp2. Poster

Trends in plant and soil microbial diversity associated to Mediterranean extensive cereal-fallow rotation agro-ecosystems

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This study examines plant and soil microbial diversity in a cereal-fallow rotation scheme in the cereal steppes of Castro Verde, Southern Portugal, which have an important conservation value. For that we monitored plant and soil microbial diversity during 4 years including all stages of the rotation cycle. The structure and composition of plant and soil communities during wheat crop were clearly different from those found in the fallow years, although the effect of wheat crop on soil bacteria was still noticeable in the 1st year of fallow. The main changes in the structure of microbial communities happened between the first and second year of fallow, probably due to changes in the quality and quantity of litter inputs. As expected, we observed an overall decrease in plant diversity in the wheat stage. Fallows have a positive impact on plant species diversity by allowing the maintenance of a seed bank and controlling the simplification of weed communities. However, the impact of fallow on microbial communities is more complex: bacterial diversity was higher in the wheat stage while fungal diversity was either higher or unchanged. These results suggest that the rotation stage is the main driver of the diversity and composition of soil microbial communities, probably through changes in the plant community that deserve further examination. Inter-annual fluctuations in rainfall did not impact significantly the studied communities, indicating that they are likely adapted to the characteristic fluctuation of annual rainfall in areas under Mediterranean climate.

Sp2. Poster

Can plant-soil interactions drive plant species communities in Mediterranean agro-ecosystems?

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Negative plant-soil feedback is thought to facilitate coexistence contributing to higher local plant species' diversity while positive plant-soil feedback drives oscillations in plant communities contributing to the dominance of few species. In this study we tested the role of plant-soil interactions as a potential driver of fallow plant species' communities in a cereal-fallow rotation agro-ecosystem in Southern Portugal. If the dominant species have an effect on the soil community which indirectly contributes to the plant community pattern it is expected that dominant plant species will perform better in non-sterilized soil while non-dominant species should growth better in sterilized soil. A pot experiment was carried out using sterilized and non-sterilized soil and six plant species, including both dominant and non-dominant. Plant species selection was based on a 4 year field survey and was made so that different functional groups (grasses, forbs, and legumes) were represented. The soil was collected in the monitored areas, and should therefore be pre-conditioned by the existing species community. We assessed plant performance by measuring plant related traits such as plant survival, vegetative height and biomass. Preliminary results suggest that the effect of the soil community is weak and may be limited to species that are host to either beneficial or pathogenic organisms.

Sp2. Poster

Deforestation negatively impacts rhizospheric microbial communities of tara (*Caesalpinia spinosa* (Mol.) Kuntze) in a Peruvian fog forest

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Deforestation is a main cause of habitat loss and environmental degradation. In the southern coast of Peru, isolated green formations surrounded by desert surviving from fog-water inputs are highly deforested. This is the case of Atiquipa lomas fog forest, where the main tree species tara, *C. spinosa*, has been uncontrolledly exploited for decades, seriously endangering the whole ecosystem. Because microorganisms are key components of ecosystem functioning and recovery, our objective was to determine to what extent deforestation had affected the microbial communities associated with recruited and remnant adults of tara. Physicochemical soil properties were determined and phospholipid fatty acids analyses carried out on rhizospheric soils of adult and juvenile taras located in two contrasted zones: preserved and deforested, differentiating between planted and natural recruits in the last case. Deforestation negatively affected total microbial biomass and the abundance of Gram+ bacteria and fungi. Deforested areas showed reduced Gram+/Gram- and bacteria/fungi ratios. In the preserved forest, the microbial community was similar under adults and juveniles, as well as under remnant adults in the deforested zone, whereas natural recruits and planted trees in the deforested area presented a very different microbial community. The pH, organic matter, Na and Mn were identified as the main edaphic factors controlling the microbial community structure. Our results show that deforestation negatively impacts the rhizospheric microbial community of tara, which does not recover its original composition during natural regeneration and reforestation. However, remnant adults maintain the original microbial community, which provides potential microbe reservoirs for future restoration projects.

Sp2. Poster

Strong resilience of soil respiration components to drought-induced die-off resulting in forest secondary succession

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We studied total soil respiration (RS) and its heterotrophic (RH) and autotrophic (RA) (further split in fine root [RR] and mycorrhizal respiration [RM]) components in a mixed Mediterranean forest where Scots pine (*Pinus sylvestris* L.) is undergoing a drought-induced die-off and is being replaced by Holm oak (*Quercus ilex* L.). Soil respiration and its components were measured every two weeks during one year at four stages of the die-off and succession process (non-defoliated pines, defoliated pines, dead pines and Holm oak), using the mesh exclusion method. The aims were to determine whether die-off and forest succession were reflected in soil respiration and its components and to determine the influence of environmental and biotic variables on the soil respiration components. Drought-induced pines die-off was not reflected in RS nor in its components, which denotes a high functional resilience to pines die-off of the studied plant-and-soil system. Despite this resilience to die-off, the succession from Scots pines to holm oaks resulted in a reduction of RH and thus in important decrease of total respiration (RS was 36% lower in Holm oaks than in non-defoliated pines). Since Scots pine die-off and *Quercus* species colonization seems to be widely occurring on the driest limit of the Scots pine distribution, the functional resilience of the soil system over die-off and the decrease of RS from Scots pine to holm oak could have direct consequences on the carbon balance of these ecosystems.

Sp2. Poster

Seed coating with mutualistic microbial inoculants: a route for a more sustainable agriculture

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Intensive agriculture relies on increased use of agrochemicals. However, the current rates of application of chemical fertilisers lead to reduced ecosystem functioning and environmental degradation. There is, thus, an increasing need to find alternatives to intensive agriculture. Plant growth promoting soil microorganisms such as plant growth promoting rhizobacteria (PGPR) and arbuscular mycorrhizal fungi (AMF) may reduce the need for chemical input, while improving plant growth, nutrition and yield. Currently, there are no feasible technologies for application of AMF and PGPR in large scale agriculture. The seed coating technique has the potential to allow the use of minor amounts of inoculum, resulting in cost reduction and efficiency increase. The aim of this study was to reduce the application of chemical fertiliser by using beneficial microorganisms inoculated via seed coating. Seeds of common wheat (Triticum aestivum) were coated with inoculum of *Rhizophagus intraradices* BEG140, *Pseudomonas fluorescens* F113 or a mixture of both microorganisms and germinated in agricultural soil under controlled conditions. Plants were grown under different regimes, ranging from no input to high input of chemical fertiliser. Results showed that both the application of chemical fertiliser and microbial inoculation influenced plant growth. Plants inoculated with AMF via seed coating were successfully colonised. Seed coating may represent a viable technique for large scale application of beneficial microorganisms, while reducing the input of agrochemicals.

Sp2. Poster

Mycorrhizal fungal communities associated with *Arbutus unedo* and the potential for the formation of common mycelial networks with *Pinus pinaster*

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Arbutus unedo is a common understory shrub in *Pinus pinaster* dominated forests in Portugal and plays an important role in ecosystem recovery after disturbance. This positive effect has been related to mycorrhizal fungi, but there are few molecular-based studies of the mycorrhizal fungal communities associated with *A. unedo* and the potential for the formation of common mycelial networks with *P. pinaster*. We examined the mycorrhizal fungal communities associated with *A. unedo* shrubs during two consecutive growing seasons in a field site located in Tábua, district of Coimbra. The site has been clear-cut following pine nematode infection ca.7 years ago and shows natural pine regeneration. Because spores and other fungal resistant propagules play an important role after severe disturbance, we conducted a greenhouse experiment to examine the mycorrhizal colonization of *A. unedo* seedlings in bioassays. Also, *A. unedo* seedlings were planted in the field to compare mycorrhizal communities between shrubs and seedlings. Finally, we addressed the question whether mycorrhizal fungi can mediate pine regeneration through the identification of fungal species shared between *A. unedo* shrubs and *P. pinaster* saplings growing at the site. From the various experiments, we collected representative samples of mycorrhizal roots from each plant and used ITS sequencing to identify the fungi. After the first season of sampling, we identified 10 fungal taxa, dominated by the genus Tomentella, in association with *A. unedo*. Results are discussed in relation to the role of *A. unedo* in maintaining mycorrhizal fungal inoculum to support the later establishment of *P. pinaster* seedlings.

Sp2. Oral

Plant-soil interactions in degraded and remediated soils

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Increasing soil quality and C sequestration in degraded terrestrial ecosystems is one of the main current environmental challenges in the Mediterranean area. Plant species differ in their mechanisms of C-fixation, C allocation into different plant organs, and interaction with soil microorganisms, all these factors influencing the dynamics of soil functioning following the afforestation of degraded soils. In this presentation we summarize the results from different experiments aimed to study the influence of woody plant species on soil properties and functioning in degraded and remediated Mediterranean soils from SW Spain (Guadiamar Green Corridor, Seville). In a three-year field experiment we tested whether the facilitation of the establishment of holm oak seedlings under the cover of pre-existing shrubs was mediated by improvements in soil quality and microbial activity. The facilitation of oak survival was mainly due to the improvement of light and temperature conditions, and not related to increases in microbial activity (soil extracellular enzymes) in the soils underneath shrubs. In another study we analyzed the effects of four afforested species on different soil C fractions, soil nutrient availability, microbial activity and soil CO2 fluxes 15 years after being planted in the remediated soils from former agricultural lands. The influence of the planted species was more pronounced in the more acidic and nutrient-poor soils. Changes in total soil C stocks after the afforestation of the soils were hardly detectable at that time-scale, although more dynamic variables (microbial biomass, CO2 fluxes) were influenced by the plant species.

Sp2. Poster

The role of soil-borne pathogens on seedling emergence and survival of *Quercus suber* and coexisting woody species

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Exotic pathogens are an important cause of tree decline and mortality in forests worldwide. In the Iberian Peninsula in particular, the exotic oomycete *Phytophthora cinnamomi* is considered the main biotic driver of the mortality of evergreen oaks (*Quercus suber* and *Quercus ilex*). However, its role as a limiting factor of oak regeneration has been poorly assessed under natural conditions. Here we aim to analyze the effect of soil-borne pathogens and their interaction with abiotic conditions (light availability, soil moisture) on woody species recruitment in declining *Q. suber* forests of Los Alcornocales Natural Park (southwestern Spain). For this, we sowed seeds of Q. suber and 7 coexisting tree and shrub species along abiotic gradients of light and moisture with and without an oomycete-specific fungicide (Armetil 5G). Seedling emergence, survival and growth were monitored during 18 months. We found that the application of fungicide increased *Q. suber* emergence and survival as much as 30% and 50%, respectively. The positive effects of fungicide were particularly large in microsites characterized by high water and light availability, conditions known to favor pathogen abundance and cause hydric stress in *Q. suber* seedlings. The fungicide application had null or very small effects on the emergence and survival of the remaining woody species. Our results experimentally indicate that soil-borne pathogens (particularly *P. cinnamomi*) act as a limiting factor of *Q. suber* regeneration in declining forests, making difficult to compensate for adult mortality and threatening the dominance of the species in the long term.

Sp2. Poster

The productivity of the azorean pastures benefits from the indigenous arbuscular mycorrhizal fungi (AMF)

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Arbuscular mycorrhizal fungi (AMF) are ubiquitous, underground, symbiotic associations involving a wide diversity of plants (approximately 80%). In this intimate association the obligate biotrophic fungi provide terrestrial plants with minerals, nutrients (particularly inorganic phosphate) and water increasing the host resistance to biotic and abiotic stresses, including pathogens, water limitation and environmental pollutants in return for photosynthates. However, degree of AMF benefit to a host plant varies in function of plant species, which is usually measured in terms of mycorrhizal dependency. Therefore, to better understanding the ecological functioning of these mutualistic microbial symbionts, we assessed the patterns of interspecific variation in host-plant benefit from the symbiosis with native AMF among the three most abundant grasses used in pastures of the Azores – Holcus lanatus, Lolium multiflorum and Lolium perenne. Our results confirm that the degree of AMF benefit to a host plant depends on plant species. L. perenne was the most mycorrhizal dependent plant (DM= 62%), followed by H. lanatus (DM= 40%) which resulted in an increase of foliar biomass more than 30 % in both plant species caused by inoculation with native AMF. Conversely, L. multiflorum was the less mycorrhizal dependent (DM= 27%) plant and also the less colonised. Thus, AMF may play an important role in ecosystems functioning, since their appropriate management can reduce the use of chemical and energy in agriculture and consequently lead to a more economical and sustainable production systems.

Sp2. Poster

The influence of plant-host sex on the plant-parasitic nematode community in dioceous plants

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Corema is a dioceous genus of the Ericaceae family, which includes two species: *C. album*, endemic to the Atlantic coast of the Iberian peninsula; and *C. conradii*, endemic of the Northeastern coast of North America. Reproduction implies different costs depending on sex, as flowering is metabolically more expensive for male plants and fruit production only to female plants. Hence, nutrient allocation and resource needs differ between male and female plants, potentially altering their ecology and performance, as suggested from above ground studies. Using a below-ground approach, we focused on the interactions of both species of *Corema* with plant-parasitic nematodes (PPN) and possible sex-related differences regarding those interactions. Soil and root samples were collected from the rhizosphere of *C. album* (Portugal) and *C. conradii* (Nova Scotia, Canada) during the flowering season. Nematodes were extracted from the samples, observed, quantified and classified into trophic groups; PPN were identified to genus level using simple diagnostic keys. The PPN communities associated with each species differed in composition, however, data on the abundance and distribution of PPN genera suggest host sex-related differences on the PPN communities for both plant species. Agricultural pests, *Meloidogyne* and *Pratylenchus* showed different trends in *C. album*, the first exhibiting higher numbers in females and the latter in males. Also *Helicotylenchus* and *Tylencholaimus* both presented more abundantly in *C. conradii* males. Our results suggest that plant sex is an important factor affecting the below-ground ecology of dioceous plants and their relationships with the soil biota.

Sp2. Poster

Short-term prescribed fire hinders soil microbial biomass in *Pinus canariensis* Chr. Sm. Ex DC forest plantation

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The main objective of this study was to measure changes in the soil microbial communities immediately after a fire, and their further recovery after prescribed burning in two *Pinus canariensis* Chr. Sm. Ex DC forest plantations. The studied stands differed on their vegetal structure. We hypothesized that (1) microbial biomass and soil chemical properties differ between high density forest plantations with a poor understory and, low density forest plantation with an understory rich in leguminous species; (2) fire alters the understory vegetation structure while it doesn't affect the tree layer; (3) burned stands should exhibit higher nutrient availability; (4) fire may cause an initial decline in the amount of microbial biomass-N and microbial biomass-C; (5) microbial biomass recovery would differ between forest plantations, and it would be evident 6-months after fire;. We examined vegetation structure, soil chemical properties, microbial biomass-N and microbial biomass-C, soil DNA concentrations and genetic microbial diversity, one month before three and six months after a wild fire. Results indicate strong differences in all the analyze variables between stands and particularly due to the vegetation structure. The richer the understory the greater diversity at micro and macro levels.

Sp2. Oral

Temporal dynamics of biotic and abiotic litter decomposition drivers

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Litter decomposition is known to be driven by climate, litter quality and soil decomposers. However, we know remarkably little about the contribution of these drivers at different decomposition stages. Three main gaps still limit a rigorous assessment of decomposition temporal dynamics: i) litter chemistry pathways, ii) community-level microbial and faunal shifts, and iii) microclimatic fluctuations. To fill these gaps we measured soil climate, litter polyphenols and decomposers community composition (microbes and nematodes) in high and low litter quality mixtures incubated at five forest sites in southern France during 3, 7 and 11 months. We then compared their relative importance for litter C and N loss along contrasted stages of the decomposition process. Polyphenols initial differences between litter qualities converged over time. Decomposers exhibited different patterns, as nematodes composition shifted between litter qualities after 7 and 11 months, but microbial communities showed distinct catabolic profiles between litter qualities only after 3 months. The implications of such temporal dynamics varied along the decomposition process. In the early stages, whereas microbes and nematodes regulated both litter C and N loss, polyphenols were only important for C loss. In the late decomposition stages, soil moisture and changes in litter quality (independent of polyphenols) drove the losses of litter C and N. Our field-based results indicate that temporal patterns of biotic and abiotic drivers should be incorporated to predict litter C and N dynamics, which ultimately will determine the amount and chemical composition of litter-derived soil organic matter and its stability under global change.

Sp2. Poster

The impact of *Acacia dealbata* Link on Arbuscular Mycorrhizal Fungi community in invaded shrublands and physiological consequences on *Plantago lanceolata*

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(1) Universidad de Vigo.

Arbuscular mycorrhizal fungi (AMF) usually required soil mutualists that establish intimate relationships with 80% of terrestrial plant families. AMF obtain carbon from the host plant and contribute to the acquisition of mineral nutrients, mainly phosphorus. The presence of invasive plants has been identified as a soil disturbance factor, such as in the microorganism's function or structure. Despite the investigation of many aspects related to the invasion of *Acacia dealbata* Link, the effect produced on the structure of AMF communities has never been assessed. We hypothesize that *A. dealbata* modifies the structure of AMF community, influencing the establishment and growth of plants that are dependent on these mutualisms. In this assay, DGGE fingerprints indicated an alteration in the structure of AMF communities in invaded soils. To validate our hypothesis, we also grew plants of *Plantago lanceolata* in pots containing sterilized soils with roots of species from native shrublands or from A. dealbata as inocula of AMF. After 15 weeks, we found that plants grown in pots containing native inoculum presented higher stem and root growth and also produced higher biomass in comparison with plants grown with *A. dealbata* inoculum. Furthermore, plants that presented the highest biomass and growth exhibited the maximum mycorrhizal colonization and phosphorus content. Fluorescence measurements indicated that plants grown with *Acacia* inoculum presented higher photosynthetic damage. Our results indicate that despite *A. dealbata* not being dependent on AMF associations, the presence of the invader could modify the composition of the fungal community, conditioning the establishment of native plants.

Sp2. Poster

Under the mistletoe: the herbaceous understory of parasitized pines is more abundant, more diverse and more visited by mammalian herbivores

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The tissues of mistletoe (*Viscum album*) have higher nutrient concentration than those of their hosts, Black (*Pinus nigra*) and Scots (*Pinus sylvestris*). As a consequence, the soil beneath the canopy parasitized pines is enriched by the mistletoe litterfall. In this work we analyse if 1) the higher nutrient richness promotes a higher cover and diversity of herbaceous vegetation under parasitized pines, and 2) this higher herbaceous diversity produces, in turn, a higher use of the parasitized pines by mammalian herbivores (red deer *Cervus elaphus*, domestic sheep *Ovis aries* and rabbit *Oryctolagus cuniculus*), in comparison to unparasitized ones. The study was performed along an altitudinal gradient (1300-1700-1900 m a.s.l.) in Sierra de Baza (SE Spain). We marked three 1 m2 quadrats under every pine, in which estimated herbaceous diversity on a semiquantitative scale and quantified mammal use by collecting and weighing their excrements. Overall, both herbaceous cover ($P=0.0072$) and diversity ($P= 0.0061$) are in general higher under parasitized pines, although differences are scant at 1700 m. With respect to the effect on herbivorous mammals, the three species varied in altitude ($P<0.004$ all), red deer shows a stronger effect of habitat (more frequent in woodland than in open areas, $P<0.0001$) than pine parasitism, while only rabbit clearly prefers grazing under parasitized pines ($P<0.0001$). These results evidence that the changes promoted by mistletoe go beyond the host tree, affecting the whole plant community and their consumers.

Sp2. Poster

Arrested succession as outcome of the interaction between plants and soil microorganisms

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The tussock grass *Lygeum spartum* frequently dominates extensive areas of abandoned fields in arid environments in what seems arrested succession. We evaluated whether the competitive ability of this species is linked to its associated soil microbial community and soil properties or whether it is a consequence of the plant´s life strategy. We grew plants of this species along with individuals of *Salsola oppositifolia*, a shrub dominant in late successional stages. Plants grew in either intra- or inter-specific interaction on sterile soils inoculated with either alive or sterile soil extracts collected in the field under each species. We established three parallel experiments using seeds, saplings, and young adult individuals. At harvest, soil nutrient content and shoot mass were determined and soil microbial communities were characterized by pyrosequencing of the 16S rDNA. We found that soil microbial communities and soil properties associated to Lygeum did not prevent but rather facilitated *Salsola* establishment, such that saplings and adult *Salsola* individuals showed faster growth rate than Lygeum plants. The competitive advantage of *Lygeum* was linked to the positive effect its own soil extracts have on seed germination and growth. Combined, *Lygeum* clonal growth strategy, its fast seed germination rate and the positive feedbacks with soil microorganisms explain the dominance of this species and the apparent arrested succession recorded in some semiarid abandoned fields.

Sp2. Poster

Ecohydrological implications of the soil wetting processes in a semiarid mediterranean watershed with scattered tree cover

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Water distribution through the soil profile plays a critical role on water availability for plants. This is particularly important in semiarid ecosystems with Mediterranean climate, where soil moisture constitutes one of the major ecological factors for maintenance and equilibrium of these systems. In this work, soil wetting processes at high temporal resolution were studied in order to get a better understanding of spatio-temporal variability of water resources and its ecohydrological implications. Soil water content was monitored continuously with a temporal resolution of 30-minutes by means of capacitance sensors, along of more than two hydrological years (mainly 2010–2012). They were installed at 5, 10 and 15 cm, and 5 cm above the bedrock and depending on soil profile. This distribution is justified because soils are generally very shallow and most of the roots are concentrated in the upper layer. The sensors were gathered in 9 soil moisture stations characterized by having mainly two different vegetation covers: under tree canopy and grasslands. A general behavior of soil moisture dynamics based on the dominance of slower soil wetting processes and a low occurrence of those faster processes was observed. The ecological consequence of the slower flows can be seen in the frequent supply of water for the herbaceous layer in the topsoil. Nevertheless, when the total volume of water was considered, faster flows became the dominant process. This is ecologically relevant because they determine the water amount reaching the deeper layers of soil and influence the water availability to trees and some shrubs.

Sp2. Poster

Functional traits of trees and effects on soil functions and ecosystem services

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(1) CSIC.

Tree-soil interactions are complex and depend on the site conditions. The functional diversity of trees will affect differently the soil functions and ecosystem services. Here we present results from the Guadiamar Green Corridor (Sevilla, Spain). A former cropland was affected by a mine-spill (in 1998), then the soil was cleaned-up, remediated and afforested with several native shrub and tree species. In 2014 we studied functional traits of leaves and roots in seven of the afforested tree species, with contrasted leaf habit: deciduous (*Populus alba*, *Celtis australis*, *Fraxinus angustifolia*) and evergreen (*Quercus ilex, Olea europaea, Ceratonia siliqua* and *Pinus pinea*). We sampled five replicates of each tree species and the soil underneath in a random block design, including adjacent open soils as reference. We studied the differential effects of the contrasted tree functional traits on two ecosystem services: 1) the regulation of soil quality by immobilization of trace elements (the remediation technique called "phytostabilization"), and 2) the mitigation of climate change by carbon sequestration in biomass and soils.

Sp2. Poster

Biological Soil Crust as a physical barrier affecting soil respiration in stabilized sand dunes of SW Spain.

Muñoz Ulecia, E.[1], Saez Sandino, T.[1], Gallardo, A.[1], Covelo, F.C.[1]

(1) Universidad Pablo de Olavide.

Biological soil crust (BSC) is an important component in stabilized sand dunes ecosystems of SW Spain. The BSC is dominated by lichens of the genus *Cladonia*, although other species, such as *Diplochistes scrupossus*, *Cyanophiceae* and mosses are also occasionally found. *Cladonia rangiformis* is a dominant fruticose lichen that can reach more than 20 cm tall. We hypothesize that the cover of *Cladonia rangiformis* should influence soil biological activity, by modifying the amount and quality of organic matter, the soil water content and the temperature under their thalli. To test this hypothesis we measured soil respiration rates under lichen cover, on adjacent bare soils, on soils where lichens were removed and in bare soils artificially covered by lichens by using an EGM-4 IRGA system. Soil organic matter and soil water content were significantly higher under *Cladonia rangiformis* than in bare soil. The temperature under the lichen was lower during the day, but higher at sunset and during night than in open plots. Soil respiration rate was not significantly different under lichen than under bare soil, and increased from early morning to sunset. Plots with removed lichen cover showed soil respiration rates significantly higher than unaltered lichens most of the day, but the difference disappeared at the end of the day. Transplanting lichen cover to bare soil had no significant effect on soil respiration. Our data showed that the reduction of lichen cover predicted by climatic change in some semiarid environments may enhance the flux of CO2 from soil to the atmosphere.

Sp2. Poster

Seed coating as an arbuscular mycorrhizal fungi inoculum delivery system for large scale agriculture

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(1) Centre for Functional Ecology, University of Coimbra, (2) Symbiom Ltd., Lanskroun, (3) Institute of Botany, Academy of Sciences of the Czech Republic.

Arbuscular mycorrhizal fungi (AMF) are soil microorganisms known to form symbiotic associations with plants, improving their performance. The exploitation of these beneficial microorganisms has become of great interest in agriculture due to their potential roles in sustainable crop production. Nevertheless, the application of AMF by broadcasting in large scale agricultural fields is not feasible because non-targeted spreading of inoculum over large areas results in high cost per plant. Seed coating has the potential to reduce the amount of inoculum needed, resulting in cost reduction and efficiency increase. The aim of this study was to assess whether seed coating with AMF inoculum is a feasible delivery system for large scale agriculture. Maize seeds were coated with inoculum of *Rhizophagus intraradices* BEG140 and germinated in agricultural soil under controlled conditions. A treatment using uncoated seeds with direct soil inoculation of R. intraradices was included as positive control. Plants had percentages of root length colonised higher than 60% either after direct soil inoculation or with coated seeds, with no significant differences between the treatments. Results indicate that seed coating can be used to apply lower amounts of inoculum. Seed coating is an innovative approach for large scale application of AMF, which may result in economic and environmental benefits.

Sp2. Poster

Dynamics of CO2 behavior within different vadose zone layers of a karstic ecosystem: production, transport and exchange with the atmosphere

Oyonarte, C.[1], Perez Sanchez-Cañete, E.[2], Serrano-Ortiz, P.[3], Curiel Yuste, J.[4], Pérez-Priego, O.[5], Domingo, F.[6], Kowalski, A.S.[3]

(1) Universidad de Almería, (2) University of Arizona, (3) Universidad de Granada, (4) Museo Nacional de Ciencias Naturales CSIC, (5) Max Planck Institute for Biogeochemistry, (6) Estacion Experimental de Zonas Áridas (EEZA-CSIC).

Knowledge about subterranean CO2 has focused individually on soils or the rocky part, while integrative understanding of the systems as a whole is lacking. In this regard, the vadose zone contains CO2-enriched air with as much as 5% by volume and its exchange with the atmosphere represents up to 70% of total ecosystem CO2 emissions. Here we study two and a half years of concentrations, dynamics, transport and emissions to the atmosphere of soil CO2 from the vadose zone of a karst ecosystem in southeast Spain. The experimental design includes an holistic approach to continuously measure the CO2 from deeper to shallower layers and from areas of net biological CO2 production (under-plants) to areas of low or no CO2 production (bare-soil). We found that CO2 concentrations followed similar seasonal patterns for the different layers forming the vadose zone, with maximum seasonal CO2 values delayed with depth. However, the behavior of CO2 transport was markedly differed among layers. Advective transport induced by wind, seems to dominate the CO2 emission both in shallow soil layers and the rocky part, but with negligible effects on the deeper soil layers. Our study further provides the first evidence that enrichment of CO2 in shallow soil is due to transport from the root zone and is mainly driven by wind. This process doubles the CO2 molar fraction values in the subsoil, and thus also the CO2 efflux, but exclusively under plants. By contrast, in bare soil, windy days cause CO2 losses and therefore reduced CO2 effluxes.

Sp2. Poster

Shrub encroachment changes soil chemistry and soil microbial biomass of abandoned pastures from the Pyrenees

Palacio Blasco, S.[1], Maestro, M.[1], Santamaría, B.[3], Jiménez, J.J.[1], Lahoz, E.[1], Azorín, J.[1], Montserrat-Martí, G.[1]

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In mountain areas across Europe, the abandonment of traditional pasture management has led to the encroachment of abandoned pastures by shrub communities, with important consequences on the landscape and functioning of ecosystems. In this study we analyzed the changes in soil chemistry and soil microbial biomass along chronosequences of shrub encroachment in the Spanish Pyrenees. Soil collected under open pastures, young (less than 20-year-old) and old (more than 40-year-old) individuals of the main shrub encroaching species of the area (*Juniperus communis*, Echinospartum horridum and Buxus sempervirens), was analyzed for N, C, ammonium, nitrate, P, K, pH, electric conductivity (EC) and organic matter (OM) concentrations and for the %C and %N in the soil microbial biomass. Although most effects were species-specific, the encroachment by all three study species led to an increase in nitrate concentrations in the soil. Encroachment by the legume *E. horridum* further increased total soil N, C and OM, while decreased soil microbial biomass and the amount of N cycled through soil microbia. Finally, the colonization by B. sempervirens led to an increase in soil pH and EC, probably due to the leaking of alkaloids from box leaf litter. Our results indicate that the colonization of abandoned pastures by shrubs has profound effects on soil properties, with important implications for the restoration of mountain pastures.

Sp2. Poster

Effect of below-ground biota in the germination and establishment of *Cedrus atlantica*: an intercontinental comparison

Pérez Fernández, M.[1], Lechuga-Ordóñez, V.[1], Gallego, J.[2], Elliot, C.[3], Linares-Calderón, J.C.[1]

(1) Universidad Pablo de Olavide, (2) Universidad Complutense de Madrid, (3) Science Directorage.

The regeneration of Atlas cedar, *Cedrus atlantica*, from seed is very low despite the fact that seed germination is not the bottle-neck in plant establishment. Seedling survival is lower in even-aged forestations in southern Spain than that in natural stand in northern Morocco and from. As most environmental traits in the areas were C. atlantica grows both in Spain and in Morocco are similar we hypothesize that differences in soil micro-biota might account for contrasting regeneration of this species in natural stands. We tested the effect of below-ground biota on the germination of Atlas cedar seed and further plant performance using soil extracts from the understorey of adult plants of the target species collected in Sierra Nevada (southern Spain) and in Talasemtanne (northern Morocco). Soil bacteria from extracts were analyzed using meta-sequencing. Soil biota had a significant effect on the germination and survival of Atlas cedar with extracts from the Moroccan population inducing better plant performance than those from the Spanish one. Significant differences in soil micro-biota were observed between Sierra Nevada and Talasemtanne. Soil extracts from the Talasemtanne provenance accounted for a higher richness and biodiversity. The observed differences indicate how complex below-ground interaction can shape above-ground ecosystems.

Sp2. Poster

Soil carbon and nitrogen microbial biomass and microbial metabolic activity along the latitudinal gradient of Cedrus atlantica.

Pérez Fernández, M.[1], Lechuga-Ordóñez, V.[1], Arévalo Rey, S.[1], Elliot, C.[2], Linares-Calderón, J.C.[1]

(1) Universidad Pablo de Olavide, (2) Kings Park and Botanic Gardens.

Understanding large-scale patterns of soil microbial processes is critical to understand the environmental factors that regulate them as well as to scale up these processes to ecosystem. Few studies have related the broad-scale distribution of plant species with the micro-scale distribution of microorganism and their activities. Here we investigated soil extractable organic carbon (EOC) and nitrogen and carbon, microbial biomass and microbial metabolic activities at eight different sites along the latitudinal range *Cedrus atlantica*, covering different altitudes and soils characteristics. The microbial variables ranged significantly among different areas depending on the soil characteristics and the altitude at which soils had been collected. Usually, larger differences were observed in the higher latitudes, compared to the drier southernmost distribution limit, for soil microbial biomass C, N and soil respiration. A multidimensional scaling analysis showed that the stands at the highest altitudes had distinct microbial and biochemical characteristics comparing with the other areas. Overall, microbial activity, as measured by soil respiration, is higher in forests subjected to lower human pressure than in stands highly degraded, probably reflecting the quality of litter input that results of the influence of local assemblage of different tree, shrub and annual species, though changes in the soil N and C contents. Indeed, total soil C and N contents explained the microbial properties at every scale.

Sp2. Poster

Altered soil stoichiometry in the rhizosphere of *Helianthemum squamatum* shrubs under climate change

Prieto, I.[1], León Sánchez, G.[1], Albaladejo, J.[1], Querejeta, J.I.[1]

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Changes in primary productivity and/or vegetation cover in response to climate change could increase desertification risks and loss of biodiversity in semi-arid ecosystems. To evaluate the vulnerability of these ecosystems to climate change, it is necessary to conduct manipulative field experiments simulating the future climatic conditions predicted by IPCC models. In a field study conducted in a semi-arid shrubland ecosystem in central Spain on gypsum soils dominated by *Helianthemum squamatum* shrubs, we evaluated the effects of warming (2.7ºC temperature increase), rainfall reduction (30% rainfall exclusion) and their combination, on rhizosphere soil stoichiometry. After 3 years, rainfall reduction decreased total nitrogen (N) concentrations, increased carbon-nitrogen ratios (CN) and reduced soil potassium (K) concentration in rhizosphere soil. These reductions in soil N and K appeared to exert detrimental effects on the nutrient status and physiological performance of *Helianthemum* shrubs, as suggested by correlations between soil and leaf N concentrations and soil and plant CN ratios and between soil N and the quantum efficiency of the photosystem II of plant leaves in rainfall exclusion plots. Warming increased soil organic C, Mg and Mn concentrations, most likely through changes in plant mortality and transpiration fluxes. All these changes in rhizosphere soil stoichiometry will be discussed in the context of plant-soil interactions in a climate change scenario.

Sp2. Oral

Plant-soil interactions and plant community dynamics

Pugnaire, F.[1]

(1) C.S.I.C.

Plant and soil ecology have traditionally evolved as nearly separate worlds, regardless of the strong evidence linking both fields. However, the recent use of molecular techniques to taxonomic approaches is showing the extent to which soil microorganisms control ecological processes. Some examples of such interactions come from arid environments, where soil microbes influence important processes such as secondary succession, community assembly, or species interactions. Although yet to demonstrate causal relationships, feedbacks between plants and soil microbial communities may influence which plant species remain in a community or are competitively displaced, or control the timing of plant community development.

Sp2. Oral

Mycorrhizal mediation of vegetation responses to forecasted climate change in a semiarid shrubland

Querejeta, J.I.[1], León-Sánchez, L.[1], Nicolás, E.[1], Goberna, M.[2], Maestre, F.[3]

(1) CEBAS-CSIC, (2) CIDE-CSIC, (3) Universidad Rey Juan Carlos.

We conducted a three-year field study in a semiarid shrubland in Central Spain to investigate the responses of the native shrub *Helianthemum squamatum* (Cistaceae) to forecasted climate change. The climate manipulation treatments evaluated were Warming (W: 2.7º C increase in mean annual temperature), Rainfall Reduction (RR: 30% rainfall exclusion) and W+RR. Warming reduced net photosynthetic rates by 30-40% and increased stomatal conductance and transpiration by 30-40%, thus leading to drastic reductions in water use efficiency (WUE, >50%). Warmed plants had lower leaf N and P concentrations, LMA and d13C values than plants exposed to ambient temperatures, and also showed an advanced shoot growth phenology, which partly buffered the negative impact of warming-induced soil drying on shoot elongation. Post-summer survival decreased sharply in W plants during a drought year, especially when in combination with RR (41% in W+RR, compared to 70% in Control). RR by itself only caused moderate reductions in net photosynthesis (15%) and transpiration rates (18%). Pyrosequencing showed that all the climate manipulation treatments evaluated led to sharp declines (>60%) in the relative abundance of ectomycorrhizal fungi (EMF) in the rhizosphere of H. squamatum, particularly for members of the Pezizales (*Picoa*, *Helvella*, *Tuber*, *Geopora*). These changes in the structure of mycorrhizal fungal communities could explain the lower leaf nutrient status and lower photosynthetic rates and WUE of shrubs exposed to climate change conditions. Overall, the results of this study indicate that mycorrhizae could play a key role in the mediation of vegetation responses to climate change in semiarid shrublands.

Sp2. Oral

The biodiversity right beneath our eyes: Using above and belowground approaches to understand the ecological units of the Gorongosa National Park - Mozambique

Rodríguez-Echeverría, S.[1], Teixeira, H.[1], Correia, M.[1], Timóteo, S.[1], Ferrero, V.[2], Heleno, R.[1]

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The Gorongosa National Park covers nearly 4000 square-km in central Mozambique, at the southern end of the Rift Valley, and it is considered one of the most diverse parks in Africa. The Park extends from the alluvial plains to the Gorongosa Mountain, but 73.7 % of the territory is in the Rift Valley and Midlands. Periodic flooding associated with the rainy season regulate the structure and dynamics of these ecosystems. We distinguished four different ecological units defined by the flooding regime. From areas flooded for almost 6 months to areas never flooded we found grasslands, a transition area with Faidherbia albida and Acacia xanthophloea, mix dry subtropical forest and miombo woodlands. We verify that these a priori defined ecological units present differentiated vegetation communities and, also, different assemblies of mammals and birds. In order to evaluate if these ecological units are also relevant for belowground biota, we present the first extensive study on the diversity of arbuscular mycorrhizal fungi (AMF) in Africa. We sampled soil from the four defined ecological units and used pyrosequencing to examine the communities of AMF from each habitat. In spite of the low specificity of this symbiosis, our results show differences in the belowground communities of mycorrhizal fungi resembling the aboveground structure determined by plant communities. Thus, we confirmed that the ecological units defined aboveground are mirrored by the fungal diversity hidden in the soil and suggests an ecological specificity of these crucial fungal symbionts.

Sp2. Oral

Impact of decaying holm oaks on soil microbial diversity and functioning

Rodríguez Pereiras, A.[1], Curiel Yuste, J.[1], Rey Simo, A.[1], Durán, J.[2], Boudouris, I.[3], Gallardo, A.[4], Valladares, F.[1]

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Holm oak forests are key ecosystems in the Iberian Peninsula because of its extension and socioeconomic value. In the last decades, these forests have shown drought-induced defoliation and mortality rates never registered before. This trend in forest decline can be exacerbated in the near future, since drought events are expected to become more frequent and intense in the coming decades. However, the relationships among this forest die-off and important aspects of soil, such as the diversity of the microbial community and the carbon (C) and nitrogen (N) cycling, are far from being understood. In spring and summer 2013, we collected soil samples under the canopy of holm oak trees with different defoliation degree and in open areas of a holm oak forest from the Continental central part of the Iberian Peninsula (Chapinería, Madrid). Our main objective was to explore how holm oak decaying relates to soil microbial functional diversity and biomass, and to soil C and N mineralization rates. Additionally, we carried out a laboratory experiment to test how contrasting water regimes (constant versus fluctuating soil moisture) could affect the microbial-mediated C and N mineralization of these soils. Preliminary results show a significant and negative effect of the degree of defoliation on the pool of soil mineral N, on microbial functional diversity and on microbial C mineralization rates. On the other hand, fluctuating soil moisture similarly decreased soil N mineralization and increase soil C mineralization compared to constant moisture in soils collected under holm oaks with different defoliation degree.

Sp2. Oral

Soil amelioration by nurses in central Chilean Andes: variation within and among species along altitude

Sánchez Álvarez, A.M.[1], Mihoc, M.[2], Giménez-Benavides, L.[3], Sánchez Pescador, D.[3], Cavieres, L.[2], Escudero, A.[3]

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Soil resources improvement by nurses has been described as one of the primary mechanisms involved in plant to plant facilitation. However, we do not know if the soil amelioration effect is constant for different nurse species appearing along broad environmental gradients and within a nurse species distribution range, especially for those able to cope with a broad environmental heterogeneity. In central Chilean Andes there is a complete guild of nurse species covering a large altitudinal gradient. Some of them are erect shrubs while those characteristic of higher altitudes present cushion like habit. We surveyed soil beneath nurses and in the bare soils nearby in thirteen plots from 2100 m to 3574 m. Soil amelioration was evaluated through soil texture, pH, conductivity, resource stocks (N and P contents) and soil enzymatic activities. Our main results showed that nurse effect on soil properties was exerted by all study species irrespective of their habit and altitude.

Sp2. Poster

Genetic diversity of bacteria nodulating leguminous trees in the Gorongosa National Park (Mozambique)

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(1) Centro de Ecologia Funcional, Universidade de Coimbra.

In spite of their ecological and socio-economic importance, woody legumes from Eastern Africa have been little studied for their ability to nodulate and fix nitrogen. In this study, we examined the genetic diversity of symbiotic-nitrogen fixing bacteria associated with *Acacia xanthophloeae, Faidherbia albida* and *Albizia versicolor* in the Gorongosa National Park (GNP), Mozambique. GNP covers nearly 4000 square-km in central Mozambique, at the southern end of the Rift Valley, and it is considered one of the most diverse parks in Africa. The three selected species occur in sandy alluvial fans in the Rift Valley. *A. xanthophloea* and *F. albida* are the first woody species appearing at the edge of the floodplains dominated by grasses. A. versicolor grows in the mixed subtropical dry forest in areas that do not get flooded very often. Root nodules were obtained from 4-month seedlings grown in soils collected from 4 sites underneath each plant species. Isolates were grown in YMA plates. BOXA1R-PCR was used to discriminate different bacterial isolates and PCR-sequencing of the 16S, glnII and recA genes was used to identify the obtained bacteria. Our results show a low phylogenetic diversity of symbiotic bacteria associated with these three legumes. Three different bacterial genera were found: *Bradyrhizobium, Ensifer, Mesorhizobium* and *Rhizobium*. *Bradyrhizobium* was the most abundant genus among the isolates, representing the only genus nodulating *A. versicolor* and *F. albida*. Remarkably, *A. xanthophloea* and F. *albida* associated with a completely divergent array of rhizobial species in spite of growing near to each other.

Simpósio 3. Ecologia das interações com uma abordagem espacial/Simposio 3. Ecología de las interacciones con un enfoque espacial

Sp3. Poster

Do hyper-accumulator plants make good neighbours?

Azevedo-Pereira, H.M.V.S.[1], Saha Sonet, S.[2], Costa, J.M.[1], Heleno, R.[1], Gonçalves, S.[1], Sousa, J.P.[1]

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Hyper-accumulator plants can be found in many types of soils with high concentrations of metals, including in serpentine outcrops, and a knowledge gap still exists at the insect community level in these regions. Few field studies have been performed to understand the relevance of the hyper-accumulator plants and the insects potentially feeding on them (at the community level). In this work, the effect of heavy-metal hyper-accumulation at the herbivory level of an accumulator plant and its co-occurring species has been evaluated. The hypothesis is that Ni accumulation will reduce the diversity and abundance of herbivores, and as a consequence hyper-accumulator plants will interact with a distinct subset of the herbivores of the other plants in the community. *Alyssum pintodasilvae*, a recognised Ni hyper-accumulator, is endemic and highly abundant in the north-eastern serpentine areas of Portugal, and was chosen for this study. The field work was performed in the serpentine area of Samil, Bragança (NE Portugal), and three vegetation succession sites were defined in this area. Four visits were performed and plant-animal interactions were registered in each site. Plants were identified (in the field and in the laboratory), insects were collected and morphotyped/identified, and ecological networks were used to assess the biotic interactions in this ecosystem. The results describe the links between the existing plant species and the insect community.

Sp3. Oral

Geography and major plant evolutionary transitions shaping macroevolutionary patterns of host use by parasitic spider mites.

Calatayud Ortega, J.M.[1], Magalhães, S.[2], Hórreo, J.L.[3], Madrigal, J.[1], Rodríguez, M.A.[1], Hortal, J.[4]

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Understanding the factors that generate and constrain plant-herbivore interactions is a key issue in many fields of investigation. From an evolutionary perspective, evidence shows that ecological interactions are evolutionary conserved, leading to the assumption that the traits regulating these interactions are mainly an ancestor's legacy. Yet, patterns of evolutionary conservatism can be also the result of biogeographical processes, as related species tend to co-occur in same regions and hence to experience similar environmental and biotic conditions. Using information on the distribution and interactions of 1194 species of spider mites (Acari: Tetranychidae) known to parasite on 1429 plant genera, here we show how patterns of phylogenetic signal in host-plant use appear as a consequence of biogeographical rather than evolutionary processes. On the contrary, plant relatedness seems to constraint spider mite host usage, regardless of geography and especially when plants are separated by major evolutionary transitions (i.e. the one when gymnosperms and angiosperms split and the one giving rise to commelinids). Our results show that spider mites are not constrained to evolve adaptations to parasite co-occurring but distantly related plants, even though patterns of host use are not neutral relative to plant phylogeny.

Sp3. Oral

Evaluating the regional cumulative impact of wind farms on birds: How spatially-explicit dynamic modelling can improve impact assessments and monitoring?

Coelho Bastos, R.[1], Pinhanços, A.[2], Santos, M.[1], Fernandes, R.[2], Vicente, J.[2], Honrado, J.[2], Morinha, F.[1], Travassos, P.[1], Barros, P.[1], Cabral, J.A.[1]

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Eurasian Skylark (*Alauda arvensis*) is very susceptible to the negative effects of wind farms. In North Portugal, this evidence is particularly severe due to Skylark preference for mountain breeding habitats where most wind farms are located. This study aims to develop and test a methodology to evaluate the cumulative impacts of wind farms on wildlife, by quantifying local and regional consequences on birds using Skylark as a test species, taking into account future predictable environmental changes. We propose a spatially-explicit dynamic approach that combines the results from multiple modelling techniques under a common framework, which includes: modelling the local impact of wind farms (in terms of collision mortality) on the Skylark population dynamics by developing an index for quantitative assessments, determining the actual and future Skylark breeding distribution across the North of Portugal, integrating the above contributions in an emergent spatially-explicit regional representation to capture the ecological cumulative consequences as a whole. The distribution area of Skylark breeding populations was predicted to decrease around 4.5% throughout a period of 15 years, as result of the scenario of climate and land cover changes in the study area. When combined with a concomitant drastic increase of Skylark global mortality (approximately 184%) induced by all wind farms of the study region, the above trend contributes to an intensification of the regional cumulative impact from 1.2% to 3.7% of the total estimated breeding individuals. The proposed modelling framework represents a step forward in evaluating the multi-scale cumulative consequences of wind farms on vulnerable birds.

Sp3. Oral

Some advances in point pattern analysis in ecology

De La Cruz, M.[1]

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The goal of this communication is to report on some recent advances in point pattern analysis. I will present new tools that expand the applicability of point pattern analysis in ecology. Specifically, I will show some examples of ANOVA-like replicated point patterns, analysis of tri-dimensional point patterns, analysis of taxonomic, phylogenetic and functional diversity around individual species (ISAR, IPSVAR and IFDAR).

I will also show the utility of some new null models and some tools for selecting them based in AIC and other criteria.

Sp3. Oral

Spatial patterns in invaded communities: novel interactions driven by new species.

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Invasive alien species can cause negative impacts on ecological systems, altering patterns of species diversity or inducing long-term changes in the composition and function of native ecosystems. Among other impacts, newly arrived species can displace native species or drive the disruption of existing interactions among natives. Furthermore, impacts may vary with increasing abundance of the alien species. We tested these ideas by comparing the spatial patterns of two coastal native plant communities with contrasting (low/high) abundances of the alien species *Oenothera glazioviana*. We mapped two plots of 100m2 in two similar coastal dune plant communities in Northern Spain, respectively, one with low abundance of *O. glazioviana* and other highly invaded. Then, we used spatial point pattern analysis to assess the potential species-pairs associations between *O. glazioviana* and the native species pool and to ask whether these alien species may drive the reshuffling of native species assemblages when it becomes abundant. Preliminary results show the existence of a mutual repulsion between *O. glazioviana* and several dominant species of the native community, such as *Euphorbia paralias* or *Eryngium maritimum*, but only in the high abundance scenario. At low abundance, *O. glazioviana* was not spatially associated with any native. Our results also suggest that community disassembly might take place at high abundances of *O. glazioviana*, since several significant spatial associations among natives found in the high abundance scenario disappear or switch direction in the low abundance one. These disruption processes may have important implications for community dynamics and functioning of invaded ecosystems.

Sp3. Oral

Plant spatial associations in semiarid gypsum communities of Middle Ebro Valley

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Spatial pattern in plant communities can be a good proxy to study biotic interactions, which influence community composition and dynamics. Therefore, it is possible to use spatial methods to identify the main interaction type (facilitation or competition) of species in the community. The aim of this study is to understand which role (facilitative or competitive) play gypsophyte and gypsovag shrub species on a gypsum community regarding the spatial relationship between them and the rest of the species and how this behavior could change with aridity conditions. This study was carried out in gypsum outcrops of Middle Ebro Valley (Zaragoza), in two sites with different aridity. In both sites, every species found each 20 cm in three 500 m linear point-intercept transects were recorded. From the collected data, ISAR (Individual Species Area Relationship) was calculated for several target species: *Gypsophila struthium, Helianthemum squamatum, Ononis tridentata* (gypsophytes), *Rosmarinus officinalis, Cistus clusii* and *Thymus vulgaris* (gypsovags). Preliminary results showed that around *G. struthium, O. tridentata* and *T. vulgaris* there were more species than expected, while around *H. squamatum, R. officinalis* and *C. clusii* less species than expected were found. These results suggested that some gypsophyte species have a facilitative role on the community being biodiversity accumulators, while gypsovags would be, in general, biodiversity repellers. The intensity of these interactions changed through aridity conditions, becoming facilitative species less accumulative and competitive species more repellent on higher aridity site.

Sp3. Poster

Effects of fragmentation on *Helianthemum squamatum* genetic population structure

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The process of fragmentation corresponds to a reduction of continuous habitat into several smaller spatially isolated remnants called patches, which over the time tend to be smaller, increasing the distance between them. Due to a loss on connectivity, populations tend to suffer a reduction on genetic variation and increased inter-population divergence. These processes may affect population viability, which in the long term might diminish allelic richness, ending in local extinction processes. Here we tested the effects of fragmentation on several genetic variables (i.e. genetic diversity, genetic structure and differences) of *Helianthemum squamatum* populations, a gypsophilous endemism of the Iberian Peninsula and Northern Africa. The genetic information was obtained from 392 individuals, using eight microsatellites molecular markers. We employed point pattern analysis techniques and Moran correlograms, to correlate the distribution of the patches with several parameters of genetic structure and variability. Our main finding was an important negative correlation between migration rate and the spatial distribution of populations at small distances. This information suggests a tendency of the species to overcome fragmentation processes maybe mediated by the dispersal ability of the species.

Sp3. Oral

Multi-scale competitive spatial interactions of soil invertebrate assemblages

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(1) IPE-CSIC.

Abiotic and biotic deterministic factors and stochastic colonization events are responsible for the observed structure of community assemblages. Soil invertebrates are spatially distributed at different scales, with stable patches of high- and low population density. Disentangling the spatial scales at which species assemblages are structured, and if these match those expressed by soil environment is of paramount importance in soil ecology. The combination of null-model analysis and competition indices like Pianka's Ojk with spatially explicit multivariate analysis and variation partitioning analysis constitutes a powerful package of techniques to assess the drivers that explain the spatial distribution of soil organisms. The results of several studies conducted in savannas and gallery forests of Colombia showed that competitors are spatially excluded in more homogeneous environments, whereas they coexisted in the same patch in nearby ecosystems where soil resources are more patchily distributed. The relationship between the spatial organization of earthworm assemblages and soil environmental parameters revealed explicitly multi-scale responses. Soil environmental variables explained from less than 1% to as much as 48% of the observed earthworm spatial variation. The root traits were correlated with areas of high soil nutrient contents at 0-5 cm depth. The effect of soil environmental heterogeneity on litter-feeding species but also the impact of endogeic species onto soil physical properties was unveiled. For some species, a large proportion of the spatial variation was not dependent on soil environmental variability what might indicate the influence of stochastic factors, contagious biotic interactions, or unmeasured soil variables.

Sp3. Oral

The interplay among acorn abundance and rodent behaviour drives the spatial patterns of seedling recruitment in mature Mediterranean oak forests

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The spatial patterns of seedling recruitment in animal-dispersed plants result from interactions among environment and behaviour. However, little is known about their contribution and combined effects. We performed a field study to assess the interplay between environmental and behavioural variables, and its contribution to oak seedling recruitment in a Mediterranean forest. In a spatially explicit design, we monitored intensively oak seedling emergence, shrub cover, acorn abundance, rodent abundance, acorn dispersal/predation by rodents, and rooting by wild boars in fixed points at a small spatial scale. The spatial patterns of seedling emergence were closely related to acorn abundance on the ground. Rodents changed seed shadows generated by mother trees by dispersing acorns from shrubby to open areas. However, neither the patterns of acorn dispersal/predation nor shrub cover had direct spatial effects on seedling recruitment. The role of facilitating shrubs may be context-dependent, having a little role in closed forests, or being overridden by the observed directed dispersal of acorns from shrubby to open areas. Rodents had direct negative impacts on oak recruitment as pilferers of cached acorns. Wild boars hindered recruitment as acorn predators but also biasing rodents' behaviour towards a higher consumption of acorns in situ. Hence, acorn abundance and the foraging behaviour of rodents and wild boars seem to drive the spatial patterns of seedling recruitment in mature oak forests. We warn about the need of using broad approaches that consider the combined action of environment and behaviour to improve our knowledge on the spatial patterns of natural regeneration.

Sp3. Oral

Grazing elimination interacts with resource availability and leads to competitive exclusion in Atlantic mountain grasslands

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(1) Euskal Herriko Unibertsitatea (EHU-UPV).

Consumption of competitive plant species by herbivores maintains plant diversity through the attenuation of competitive exclusion. Generally, such effects have been measured in productive ecosystems. Limitation of resources promotes coexistence providing more niche dimensions and limiting the growth of competitive species. We carried out a grazing exclusion experiment using three sites with contrasting water availability in the Aralar mountain range. After 8 years of exclusion, species composition and soil data were collected at a fine scale. Our main objectives were (i) to test whether competitive exclusion is enhanced in excluded areas; and (ii) to determine if variation in resource availability accelerates or attenuates this relationship. In all field sites, the excluded plots experimented species loss and just four highly competitive species (Festuca rubra, Agrostis capillaris, Trifolium repens and Galium saxatile) represented most of the canopy. However, the high local heterogeneity of environmental variables made each site a case study. In the two sites with higher water availability competitive species interactions were stronger in excluded areas, but competition for space was also observed in grazed plots. Only in the moistest site had the grazing exclusion dramatic consequences for species diversity, where Agrostis capilaris and Festuca rubra displaced almost completely the remaining species. In the most water-limited site, high pH heterogeneity was measured, particularly in the grazed area, and patterns in composition were mainly driven by this variable, both in the grazed and excluded plots. Our results provide insights to better understand the complex relationships among grazing, productivity and species diversity.

Sp3. Poster

Geographical divergence in plant defence against herbivory: a common garden experiment with the relict tree *Prunus lusitanica* L.

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(1) Universidad de Extremadura.

Herbivory may vary among populations of a species due to plant or herbivore properties resulting in geographical differences. The strength of herbivory interactions within plant ranges may additionally depend on the stage of coevolutionary arm races. The objective of our study is to test for the existence of a phylogeographical signal relating herbivory traits such as plant chemical defences with population genealogy. Additionally, we investigated whether defensive compounds are constitutive or inducible after herbivory attack. Our study species is *Prunus lusitanica* L., a paradigmatic example of a Tertiary relict tree persisting in the Mediterranean. We analyzed cyanogenic glycosides (prunasin and amygdalin) and phenolic concentration on 210 plants grown in the greenhouse through a common garden experiment, comprising 10 different populations across the range of the species which comprises the Iberian Peninsula, northern Morocco and Macaronesia. To test for the inducibility of defences, we artificially defoliated plants. Results showed that baseline levels of qualitative defences such as cyanogenics were significantly higher in older populations from Macaronesia, while baseline phenolic concentrations were significantly higher in young population from central Iberia. Regarding the inducibility of defences, we found exclusively a short term induction of prunasin in Moroccan populations, whereas short and long term reduction of phenols after defoliation was observed in the Iberian Peninsula together with a short-term decrease of phenols in Macaronesia. This divergence of defensive ecotypes is thought to have been facilitated by extensive range fragmentation, resulting in differential plant-herbivore coevolutionary stages among ancestral and more recent populations.

Sp3. Poster

Evidence of negative density-dependent recruitment in mixed Pine-Oak forests of southern Spain.

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(1) Universidad de Jaén.

Understanding the diversity of plants, the factors determining the number of species in a community and the mechanisms behind their long-term coexistence, is a prominent objective of ecology. Theory suggests that the mechanisms that allow the stable coexistence of species in a community can be classified in two general classes: "equalizing" mechanisms that decrease fitness differences among species, delaying competitive exclusion, and "stabilizing" mechanisms that increase (or decrease) the fitness of a species when it becomes rare (or dominant). Assessing the relevance of these mechanisms in forest communities is complicated by the slow pace at which changes occur. We are using spatial analysis to obtain evidence on the existence of negative density-dependence (a stabilizing mechanism) on the recruitment of woody plants in mixed forests of *Pinus halepensis-Quercus faginea* and *Pinus nigra-Quercus pyrenaica* from southern Spain. We mapped all adult trees in two 100 x 100 m plots, and all saplings in the central 50 x 50m square within each plot (4267 saplings from 25 species). We used common spatial statistics (L(r) and g(r)) to compare the distribution of saplings and adults. Our preliminary results for a subgroup of species (*Juniperus oxycedrus, Crataegus laciniata* and *Phillyrea latifolia*) suggest that recruitment is limited by negative density dependence in many species.

Sp3. Oral

"Islands in the stream": Effects of habitat spatial pattern and tree age in the lepidopteran community of *Q. ilex* in a savannah-like landscape

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The effects of habitat spatial pattern (e.g. patch size and connectivity) on biodiversity have been deeply studied. However, whether these effects may be modulated by habitat history (e.g. habitat age, land use legacy and changes in spatial pattern), has been seldom analyzed. The aim of the present study is to explore the importance of habitat spatial structure and age on insect community assembly, taking as a case study a lepidopteran community inhabiting Holm oak (*Quercus ilex*) trees in a savannah-like landscape in Central Spain. The lepidopteran community was sampled in a set of 24 oak trees during 5 consecutive years. We tested the effects of connectivity, canopy surface and tree age on total abundance, species richness, diversity and turnover, and community composition. From the 26 lepidopteran species identified, none was associated with the habitat factors studied; similarly, turnover was related only to distance between trees but not to any habitat variable. The main factor affecting total abundance, species richness and diversity was tree age, which was positively related with these variables. Age also mediated the effect of canopy surface; among small trees, older ones had a higher total abundance, species richness and diversity than expected by their size. We can conclude that there is a major effect of tree age on lepidopteran total abundance, species richness and diversity in these tree archipelagos, while species composition is mostly driven by random factors and attributable to a lottery effect.

Sp3. Poster

Large terrestrial herbivore regulates the spatial pattern of recruitment, but not density, of a keystone rainforest palm

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One of the major vertebrate herbivores in neotropical ecosystem is the white-lipped peccary (WLP). This ungulate has a recognized importance in herbivory, seed predation and trampling, and is considered as an “ecosystem engineer” because of its capacity in creating new habitats for plant recruitment. However, little is known about their role in determining the spatial pattern of plant populations. Here we assess the importance of WLP on the spatial pattern of recruitment of *Euterpe edulis*, a keystone palm in the Brazilian Atlantic forest. We compared the age structure and spatial distribution of seedlings, saplings and adults among in 11 plots of 25x50m in forests with and without the presence of WLP. Our results did not show differences in the age distribution among plots with presence and absence of WLP. However, the spatial structure of recruitment showed to be affected by the presence of WLP. Pairwise distances among seedlings and saplings to the nearest adult were longer in plots with presence of WLP, while in defaunated areas all these distances were restricted to 10m radius from the nearest adult. Our results suggest that the intensive herbivory, seed predation and trampling of large terrestrial herbivores regulate fine-scale spatial recruitment patterns of this rainforest palm, and contributes to understanding the effects of defaunation in plant recruitment.

Simpósio 4. Investigação ecológica de longo prazo/Simposio 4. Investigación ecológica de largo plazo

Sp4. Poster

Using surrogate NDVI images from low cost cameras to monitor productivity in forests ecosystems

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Collecting long term series about the structure and functioning of terrestrial ecosystems is very important to quantify the impacts of global change. The photosynthetic activity, through the normalized difference vegetation index (NDVI) is a good indicator of the vegetation status. Recently, in the opposite to purchase a high cost professional camera, it is popularized the use of a low cost system consisting of two low cost cameras: one to acquire the spectral reflectance of red region, and the other to acquire the near-infrared region. This double system has some important drawbacks that must be addressed: alignment of the images from the two cameras, different exposure time, angles, etc. It is possible to overcome these issues using a single camera that gather information to calculate a surrogate of NDVI. NDVI' is calculated using the spectral reflectance in the blue and near-infrared regions. We have designed an integrated device with a No-IR camera, a single-board computer and a set of luminosity sensors. This device acquires images of NDVI' with an intra-diary frequency. In this work, we show the results of the validation process for this new approach. We took during 3 months of an area covered by natural and afforested pine stands (*Pinus sylvestris*) in Sierra Nevada. These images were compared with the information provided by the MOD13Q1 (NDVI) product of the sensor MODIS for the same study area. The validation was carried out using correlation analysis between the NDVI values of MODIS and the NDVI' values of our integrated device.

Sp4. Oral

Integrating scales and LTER methods to better understand the overall dynamics of a mountain protected space: the Ordesa and Monte Perdido National Park

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The Ordesa and Monte Perdido National Park and the Pyrenean Institute of Ecology (CSIC) recently joined the Spanish LTER network. As part of our strategy to understand recent changes in this protected area, we are carrying out a number of projects to evaluate changes at different spatio-temporal scales, using a variety of methods and approaches. We highlight here some of the most consolidated ones: long-term reconstructions from sedimentary lake records and cave speleothemes, the dynamics of one of the few active Iberian glaciers, the physico-chemical components of alpine streams, springs and lakes, the fingerprint of climatic change from ancient trees, changes in the composition and structure of biodiversity of alpine communities, natural and man-made grasslands at different altitudes, and the treeline, and population dynamics of endangered species or habitat indicators. The ecological monitoring shows that changes in both climate and land use, are having a strong influence in the physiognomy and structure of some of the most iconic and abundant habitats in the National Park. However, we found an important spatial variability in some processes, and also that others do not fit the established paradigms. The integration of partial results obtained from different methodologies and approaches diminishes the importance of each perception separately, helps to evaluate current changes in a long-term framework (geological scale), and will serve to validate the forecasts when modeling future environmental scenarios.

Sp4. Oral

Assessing grazing effects in the LTER-Montado site: a long-term exclusion experiment

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Grazing is a key component of montado landscapes, a multi-use agroforestry system that requires a well-balanced management of the several practices occurring in a single space. While excessive grazing may have negative impacts in multiple taxa, its abandonment also represents a threat to the system by promoting shrub encroachment. To understand the long term effects of grazing and its exclusion, an experiment was set in one of the LTER Montado research and monitoring stations (Companhia das Lezírias), dominated by cork oak trees and used to raise beef cattle. Three sets of plots (representing different exclusion periods: 5, 9 and >15 years) and two sets of grazed plots, without and with medium-dense shrub densities, were defined. Lichens, vascular plants and vertebrates (amphibians, reptiles, birds and mammals) were studied and the first results show, as expected, clear differences between grazed and non-grazed plots but also between different exclusion periods. With few exceptions, a general trend is observed for plots excluded for longer periods to display higher species richness, diversity and/or abundance, or different species compositions, in close association with vegetation characteristics. To complement these results, a new research design was established to study cork oak tree growth and phenology, plus soil characteristics, under varying grazing pressures. Dendrometric bands were installed in 30 trees, from which leaves and acorns were collected for stable isotopes analysis, and soil cores taken for C/N and nitrification potential analysis. Data will be collected at a regular basis and will help defining management guidelines to achieve long-term sustainability.

Sp4. Oral

Factors affecting spread of woodland islets in restored Mediterranean farmland 22 years after planting

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We suggest "woodland islets" as an alternative way to achieve ecological restoration in extensive agricultural landscapes. We assessed a 1-ha plot that was planted with 16 100-m² islets of holm oak *Quercus ilex* subsp. *ballota* seedlings near Toledo (Spain) in 1993. In 2014 and 2015 we measured (1) acorn predation and (2) seedling emergence from seeded acorns at different distances from and orientations around the islets with half of the acorns protected to prevent predation, (3) survival of emerged seedlings, and (4) natural tree establishment outside of the planted islets. Most (96.9%) unprotected acorns were removed or predated. Seedling emergence from protected acorns ranged from 42.9% on the northern side of the islets to 13.2% on the southern side, suggesting a less stressful microclimate on the northern side. Survival of naturally established seedlings was 37.5 and 21.4% by the end of first summer and first winter, respectively. Density of emerged seedlings, surviving seedlings after first dry season, and established oaks > 1-yr old was similar at different distances from the islets. Over the 22 year time period, 58 new oak individuals >1-yr old have established (i.e. 3.3 new established individuals per ha per year) at an average distance of 6.3 ± 5.4 m away from the closest islet. We conclude that initial oak regeneration triggered by small planted islets in Mediterranean abandoned farmland is limited by high acorn predation, seedling herbivory, and stressful microclimatic conditions. Regardless, these islets are a viable tool for regeneration of Mediterranean oak woodland.

Sp4. Poster

Diet analysis of European Free-tailed Bats Tadarida teniotis using High Throughput Sequencing

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Insectivorous bats are voracious predators that can ingest as much as their own weight in insects per night. They provide important ecosystem services by controlling possible insect plagues, greatly reducing the costs of pest control in agriculture. European Free-tailed bats are a common Mediterranean bat species with a large knowledge gap. Traditional diet analysis of this species had an extremely low taxonomic resolution at the family level. Recent molecular techniques capable of generating large quantities of data have come to revolutionize diet analysis, allowing a species level identification of prey. Our study aimed to further study the diet of this species using high throughput sequencing and understand how season, bat gender and bat age influence diet composition. We collected guano pellets of 143 individual bats of 5 different roosts in the northwest of Portugal, from April to October between 2012 and 2013. Using PCR to amplify a small fragment (157bp) of the insect's COI gene, we then used the Lepidoptera BOLD database to identify the prey present in the pellets. A total of 115 different potential prey species were found, belonging to 5 insect orders and 17 families. The most common and diverse prey belonged to the Lepidoptera family Noctuidae. Results showed no marked temporal differences in diet composition, but resource partitioning was found between males and females, independently of bat age, with females consuming larger prey and of migratory behavior. This study illustrates the potential of fecal metagenomics to understand long term changes in predation patterns and food webs.

Sp4. Oral

Biomonitoring in mining sites as long term ecological studies

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The Iberian Pyrite Belt, is one of the largest metal-containing deposits of massive sulfides in the world, with a mining history that began in prehistoric times (2500 BC) and continues today. The exploitation of these natural resources is obviously associated with environmental impacts. Since 1994 we've been monitoring the air pollution impact of an underground mine site in this area. Methodologies based on lichen biodiversity and lichen metal content were developed to assess the impacts of air pollution resulting from mining activity at both spatial and temporal scales, in an integrated perspective. Spatially, lichen taxonomic and functional diversity decreased with increasing proximity to the mine site, particularly within 2 km of the mine. Lichen metal content revealed also the spatial pattern of metal deposition, and it was linearly correlated with the bio-available fraction of metals in soils, allowing its use as a tool for regulatory purposes. The area of impact remained constant from 1994 to 2011, with some local changes. Lichens have offered not only an effective tool to evaluate the long-term impact of fugitive dust emissions due to mining operations, at spatial and temporal scales, but this work also allowed us to have long-term data to assess other global change drivers acting in the region. From 2004 to 2011 we were able to observe, changes in the lichen communities related to climate change, emphasising the importance of long-term ecological studies to assess the effects of global change.

Sp4. Poster

Methodology to collect and store information about the historical distribution of vegetation and human land uses

Moreno-Llorca, R.A.[1], Pérez-Pérez, R.[1], Bonet, F.J.[1], Pérez-Luque, A.J.[1]

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The LTER network aims to assess the structural and functional responses of ecosystems to the impact of environmental and socioeconomic variables. In this context, events and anthropic uses occurring in ecosystems in the past could have an important impact to explain its current structure and function. It is therefore important to gather information of different temporal landmarks on the past about events, uses of forest resources and forestry actions. We present a novel methodology developed to collect spatial and temporal explicit information regarding several ancient milestones. The information collected is very diverse and presents differences in spatial and temporal scale, and different geometry type: spatial distribution of land uses, linear elements (irrigation channels, etc.), poligonal discrete events (wildfire), continuous events (natural succession), etc. We designed a flexible data model to store heterogeneous information on land use changes with a temporal and spatial component. This model has been validated gathering information from different historical sources: cadastral data, forest inventories, gazetteers and other administrative documents in Sierra Nevada mountains (south Spain). We compiled a database with information from 1748 to the present time. The created database allows the creation of queries to assess changes in land use between two dates.

Sp4. Poster

Interannual variability of carbon and water balances in Mediterranean grassland ecosystems (Almeria, SE Iberian Peninsula)

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Changes in water availability may involve alteration of the carbon cycle that could modify the behavior of an ecosystem as CO2 source or sink. Climate change projections point to changes in rainfall regime, which justify our goal of analyzing the seasonal patterns and interannual variability in carbon and water cycles across an aridity gradient in Mediterranean grasslands. Micrometerological Eddy Covariance stations located in two well-differentiated climate situations (especially regarding water availability) were used for measuring ecosystem-atmospheric carbon (NEE) and water balance (ET) variables. Additionally, soil respiration was monitored continuously. The data corresponding to 10- and 7-year time series (depending on station) have been summarized on an annual scale. The results show higher variability of NEE as aridity increases, and they vary as source or sink (-50/+50 gC.m-2.yr-1), while assimilation occurs under xeric conditions (70/-20 gC.m-2.yr-1). In both cases there is a significant component of non-biological flows, which must be differentiated for correct interpretation of ecosystem functioning. The water balances establish a precipitation-NEE relationship, with a threshold determined by rainfall distribution and the buffering capacity of the soil. Finally, it is also observed that under conditions of greater aridity, functioning in pulses prevails over seasonality, which in turn may determine the role as a CO2 source or sink.

Sp4. Poster

Are roadkilled data a good method to monitoring wildlife seasonal patterns? A hedgehog case study. Preliminary results

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A great impact on the Iberian biodiversity is caused by the road-network, which has both negative impacts on the ecological connectivity and a direct cause of death by roadkilling, among others well-known impacts. It was estimated that, in Spain, about ten million vertebrates die on the roads every year, and the majority of them are common species. Long-term roadkill monitoring could be a useful tool for blackspots searching and their constraints identification. Moreover, the roadkill frequencies time pattern could be used as an environmental quality index, and even uncover aspects of landscape and involved species ecology. In order to achieve these objectives, it was created the Iberian Roadkill Monitoring Network (RISFA) in November 2013. The aim of this study is to evaluate, preliminarily, the seasonality effect on hedgehog roadkills in Galiza (Iberian Northwest corner) by comparing data obtained in other similar projects carried out between 1990-92 (S.C.V.) and 2003-05 (G.E.A.S.), with the data collected in 2014 by the RISFA network for this species in Galiza. The results achieved allow us to link the number of reported cases with the species activity throughout its biological cycle, being spring and summer months where the eighty-eight per cent of the data were recorded, matching with certain key stages of the species annual cycle.

Sp4. Oral

Changes of flowering phenology in high mountain meadows: a long term study from Sierra Nevada

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The high-mountain meadows (borreguiles) of Sierra Nevada (SE-Spain) are a high diverse ecosystem, which harbors a large number of endemic and threatened plant species. This ecosystem (included in the Annex-I of Habitats Directive) is very sensitive to changes in water availability and temperature, making it an interesting community to study the impacts of climate change in high mountains. The aims of this work were to determine long-term changes in: composition, abundance, and phenology of flowering of this ecosystem in Sierra Nevada. To achieve this, we sampled permanent plots (1 m2) in two periods: 1988-1990 and 2009-2013. The sampling was performed every 15 days during the free-snow season. Presence/absence data and abundance-coverage were recorded. We counted the number of individuals belonging to three phenophases: vegetative, flowering and fruiting. We classified each species into phenological groups: early, middle or late species. We analyzed changes in composition species and abundance between the two periods. For 19 species we assed changes in phenological attributes (onset, end-date; duration and date of flowering peak) at community level and between phenological groups. Species composition and abundance did not show significant changes at community level between the two periods. Regarding phenology, we found a significant delay for all phenological attributes at community level. The flowering end-date showed the largest delay (+12.58 days). Analysis by phenological group showed that early species have significant delays for onset, end-date and date of flowering peak. On the other hand, late species did not show significant changes on their phenological attributes.

Sp4. Poster

What changes in 50 years? A landscape dynamics case-study in the Sabor valley

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In recent decades, a particular pathway of land-use (LU)/land-cover (LC) change has spread across the Mediterranean basin, especially in Europe: agro-pastoral systems of mountains and marginal farming areas are collapsing, and rural practices are being abandoned or replaced by different ones. The corresponding land cover changes may affect biodiversity as well as the structure and composition of biotic communities. These changes may trigger profound shifts in ecosystem functioning and the downstream ecosystem services. To document the patterns of LU/LC change, we are developing a case study in the catchment of the Sabor river, Northeast Portugal. Here rural landscapes have been under farmland and pastoral abandonment over the last five decades. The general objective was to analyse key land cover changes in the lower Sabor catchment in the last 50 years. This will allow inferring about land use dynamics and will enable the interpretation of current ecological patterns in terms of patch and landscape dynamics. Landscape characterization was based on manual photointerpretation of a sequence of orthorectified and georeferenced digital aerial photographs covering from 1958 to 2006. Changes in landscape patterns were analysed by estimating commonly used landscape metrics for each of the map years for each of the main habitat types and for the whole landscape area. Preliminary results indicate a recovery of natural Mediterranean forests (mainly *Quercus* spp. and *Juniperus oxycedrus* woodlands) over former agricultural patches, as well as a replacement of annual crops by perennial crops. We briefly discuss implications of these trends for biodiversity and ecosystem services.

Sp4. Oral

Building a network of volunteers and rangers to monitor species of community interest

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Long term population monitoring is a powerful tool to evaluate the conservation status of threatened species. The Habitats Directive requests all the European members to submit information every 6 years on the "conservation status" of "species of community interest" (SCI). Scientist from the Pyrenean Institute of Ecology (CSIC) and managers of the Aragon region recently launched an approach to involve rangers and volunteers in a monitoring network. To integrate participants with different age, skills or time availability, their collaboration has been split into four levels. The first deals with the distribution range and pursues the confirmation of old herbarium records and adding new ones through field prospections. The second level serves to characterize the population size and occupancy area. Levels 3 and 4 will show population trends and estimate vulnerability and extinctions risks, either by recording the number of individuals in permanent areas (count-based models) or individual monitoring of vital rates (matrix models). About 80 persons are now actively collaborating in the network, being responsible of monitoring more of 60 populations of SCI all around Aragon. A remarkable positive feedback has emerged: after getting some training in each particular population, participants show interest and carry out an excellent job, and in turn they get knowledge about plant biology and ecological methods. This interaction offers them the opportunity to contribute to the scientific knowledge, and points out the potential of Citizen Science in biodiversity conservation.

Sp4. Poster

Under cover: alpine treeline ecotone dynamics

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Climate warming and reduction in grazing influence forest density and may shift upwards the treeline in the Pyrenees. The transition from grassland to forest theoretically implies changes in plant biodiversity, which we have studied at microsite level over a 5-year period. In 2009 we established 10 permanent squares of 1 m side each in the alpine treeline ecotone in Ordesa y Monte Perdido Spanish National Park. The squares were placed in a way that one third of the surface lied under the effect of the tree canopy of a single shrub-like *P. uncinata*. In each square, the plant composition and abundance under and outside the pine shade was recorded using a number of 20 x 20 cm quadrats. Five years later, pines had considerably increased height and canopy, and intensified their influence over the surrounding grassland. The creeping shrub canopy underwent a slight reduction near the pine influence, being substituted by herbs. The abundance of species with calcareous affinity also decreased. In contrast, the pine-free grassland kept more stable with the exception of the strong irruption of *Thymus praecox*, a woody plant not recorded earlier. Our results show a microsite detectable dynamics of biodiversity in the studied alpine treeline ecotone in just 5 years, triggered by the tree canopy increase.

Sp4. Oral

Long-Term trends of Sierra Nevada ecological systems: a first diagnosis

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The synergies between researchers and managers have allowed to develop a monitoring program of ecological processes and information management in Sierra Nevada (South of Spain). Thanks to this common effort, we are able to make an initial diagnosis of the situation. We have identified the main expected impacts in the context of global change, and analyzed the biophysical and socioeconomic data available to assess exposure, sensitivity and adaptive capacity of ecosystems to new scenarios. Sierra Nevada ecosystems act as sensors for early detection of signs of change, due to the high altitude and geographical position of this Mediterranean Mountain. In our project, we are also evaluating the suitability of different management actions to improve adaptation and provision of ecosystem services in the new scenarios. The study incorporates a retrospective of past human management, in order to understand the current state of conservation of ecosystems and to make plausible forecasts on its response to future scenarios. The results show: 1) An ancestral human footprint on the ecosystems of Sierra Nevada, particularly evident during the twentieth century, 2) A Moderate climate warming and reduction and increased variability in precipitation, with a consequent reduction in coverage snow during the last decades, 3) Significant changes in biophisical characteristics of rivers and mountain lakes, 4) Changes in the altitudinal distribution and phenology of many species of plants and animals.

Simpósio 5. O papel das reservas de carbono no crescimento de plantas lenhosas/Simposio 5. El papel de las reservas de carbono en el crecimiento de plantas leñosas

Sp5. Oral

Allocation to stored C pools during recovery from severe drought

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Climate-related drought has been identified worldwide as a primary driver of recent tree and forest mortality, thus urgent need has raised to predict how forests will cope with increasing stress. While much research focused so far in understanding physiological tree death during drought, subsequent tree's ability to recover the physiological function is critical for forest fate and remains much less investigated. Although plants store non-structural carbon (NSC) to buffer against times of negative carbon balance during drought and following recovery phases, the regulation of NSC levels to meet C demands remains unclear. Here tree saplings (Tilia platyphyllos and Pinus sylvestris) were subjected to experimental severe drought during 10 weeks and stored NSC pools (soluble sugars, starch, neutral lipids) were monitored over time at the whole-tree level. Trees were well watered afterwards and simultaneous 13C labeling allowed to track C allocation to stored NSC pools and biomass during a time span of 20 days. Although the results are still preliminary it seems that lipids are little used during drought for both species. By contrast, soluble sugars and starch are significantly depleted. Compound-specific 13C analyses seem to indicate that both species allocate C assimilates primarily to soluble sugars, and only when a certain amount has been replenished starch starts to build up. These preliminary results would indicate the existence of certain thresholds of soluble sugars before other functions as storage are re-established during tree recovery from drought.

Sp5. Oral

Individual traits as determinants of time to death under extreme drought in *P. sylvestris*

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Recent drought-induced tree mortality processes have been described in forests worldwide. Plant responses to water scarcity vary between species and even between populations or individuals within species. A better understanding of droughtinduced mortality requires a greater knowledge of the physiological process involved and their interactions. Our objectives were to identify morphological and physiological attributes that determine plant survival under extreme drought within a species. We carried out a manipulative experiment under semi-controlled conditions where young trees of P. sylvestris growing on natural soil were submitted to extreme drought. Survival time under drought varied by almost four months across individuals and both initial functional attributes as well as dynamic responses during drought determined tree survival. Contrary to the classic perspective whereby increased water use efficiency increases drought-tolerance and survival, we found that individuals that survived longer prioritized carbon uptake at the expense of water loss. Further, dead trees exhibited much lower non-structural carbohydrates (NSC) values compared with living trees, indicating that NSC depletion is associated to mortality in *P. sylvestris*. Our study highlights that, at the individual level, survival depends on carbon supply. Consistently, photosynthesis and/or NSC explains survival variability in *P. sylvestris*, individuals with higher carbon supply survived longer.

Sp5. Oral

Dynamics of non-structural carbohydrates in terrestrial plants: a global synthesis

Martínez-Vilalta, J.[1,2], Sala, A.[3], Asensio, M.D.[1], Lloret, F.[1,2], Palacio, S.[4], Galiano, L.[5], Hoch, G.[6], Piper, F.[7]

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Plants store large amounts of non-structural carbohydrates (NSC). Although some functions of these stores are well known (e.g., buffering against times of carbon deficit), many aspects of the role and regulation of NSC remain unclear. For instance, the degree to which NSC accumulation reflects that high NSC concentrations are required for plant survival or simply corresponds to excess carbon supply relative to demand remains highly controversial. Here, we assembled a new global database to examine broad patterns of seasonal NSC variation across organs, life forms and biomes. We compiled seasonal data (>3 measurements over >4 months) for 179 species under natural conditions. Our results show that, on average, NSC account for ~10% of dry plant biomass and are highest in leaves and lowest in stems, whereas belowground organs show intermediate concentrations. NSC, starch and soluble sugars (SS) vary seasonally, with a strong depletion of SS during the growing season and a general increase during winter months, particularly in boreal and temperate biomes. Across functional types, NSC concentrations tend to be highest and most variable in herbaceous species and in conifer needles. Seasonal depletion of NSC or SS was rare, with seasonal minimums remaining =30% of the maximum. However, starch depletion was relatively common, consistent with a dual view of NSC function: whereas starch acts mostly as reservoir for future use, soluble sugars perform immediate functions (e.g., osmoregulation) and have to be kept above some critical threshold. Overall, our results suggest that NSC dynamics cannot be explained solely by source-sink imbalances.

Sp5. Oral

Does carbon limitation explain growth reduction in defoliated deciduous and evergreen oak species?

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Mechanisms regulating the formation of carbon reserves in trees are currently under debate, basically because it is not know if and under which circumstances carbon allocation to storage may compete with growth. We investigated if the growth decline in trees following early season defoliation is the consequence of prioritized carbon allocation to reserves over growth. To test this, we grew seedlings of evergreen *Quercus ilex* and deciduous *Quercus petraea* trees under low (140 ppm), medium (280 ppm) and high (560 ppm) CO2 concentrations and completely defoliated half of the seedlings in each CO2 treatment at the beginning of the growing season. In undefoliated trees, CO2 had a significant positive effect on the seasonal growth in both species. Defoliation had a strong negative impact on growth in the evergreen *Q. ilex*, but less in the deciduous *Q. petraea*. In both species, the relative growth reduction after defoliation was the same at all three CO2 concentrations. Non-structural carbohydrate concentration, decreased significantly in all investigated tissues of both species during the middle of the growing season under low CO2 concentrations and after defoliation, but increased to similar levels across all treatments by the end of the growing season, except for *Q. ilex* at low CO2. We conclude that growth decline after defoliation is not related to carbon limitation, but trees growing under low CO2 preferentially allocate photoassimilates to storage during the second half of the season. The implications of this study for our understanding of carbon storage regulation in trees will be discussed.

Sp5. Oral

Relations between hydraulic capacity, leaf phenology and earlywood formation are regulated by winter carbon reserves in two cohabiting ring-porous oaks.

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The status of carbon reserves in winter was suggested to be critical for deciduous oaks, which require high carbon supply to restore both photosynthetic and hydraulic architectures in spring. The contribution of carbon reserves in modulating relationships between hydraulic performance and cambial activity is here addressed in two ring-porous oak species (*Quercus robur* and *Q. pyrenaica*). We selected 120 trees of each species at three sites located in NW Iberian Peninsula, and one sapwood core per tree was taken in December 2012. Soluble sugars and starch concentrations in stem sapwood were quantified. The date of budbreak of each tree was recorded in spring 2013. The hydraulic diameter in 2012 and the number of vessels in 2013 were then calculated using the cross section of additional cores. Structural equation modeling (SEM) was used to unravel causal relationships between stem diameter, hydraulic capacity in 2012, winter carbon reserves, date of budbreak and the number of vessels in 2013. In both species, relations among variables were mediated by soluble sugars rather than starch content. High hydraulic capacity encouraged soluble sugar accumulation in December, which was in turn related to earlier budbreak in 2013. More numerous earlywood vessels were directly associated to higher soluble sugar concentrations in *Q. pyrenaica*, whereas this effect was indirect in *Q. robur* and mediated by its impact in budbreak date. Our results demonstrated that carbon pools can limit growth of adult trees.

Sp5. Oral

Unravelling the sequence of functional alterations leading to drought-induced plant death

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Understanding how functional changes precede drought-induced plant death is an important step towards improving resistance of plants and ecosystems to ongoing climatic changes. To this end, it is important to address plant responses to lethal drought with an integrated multi-scale approach. Here carbon- and hydraulic-related variables were measured in leaves, stems and roots of seedlings of two species of contrasting drought resistance: Quercus ilex and Ulmus minor. Watering cessation to potted plants caused increasing water stress. Below 75% stem relative water content, secondary growth stopped and stem respiration declined, whereas leaf net CO2 assimilation and whole-plant carbon balance inferred from gas exchange dropped to near zero. Dying plants showed evident symptoms of decay below -8 and -5 MPa xylem water potential in Q. ilex and U. minor, respectively. These values were attained twice later in Q. ilex than U. minor, and were associated to a 35% decline in weighted-average whole-plant concentration of non-structural carbohydrates (relative to well-watered control plants) for U. minor. However, plants of both species showed symptoms of decay at 80% loss of root hydraulic conductivity. The results suggest that hydraulic failure is a common major factor in plant mortality that occurs at variable depletions of carbon reserves between species. The higher depletion of carbon reserves in the riparian U. minor than the more drought resistant Q. ilex could be explained by higher leaf shedding and woody respiration in the former species.

Sp5. Oral

Pine mortality in southeast Spain after an extreme dry and warm year: interactions among drought stress, carbohydrates and bark beetle attack.

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Forests are extremely important for society given the many services they provide. Climate models reflect increases in temperature and less annual rainfall, which will generate hotter and drier environments. Under these conditions, it is predicted that forest ecosystems will be severely affected. In fact in recent years, several studies have accumulated evidence for drought-induced tree mortality. Consequently, many studies have attempted to explain mechanisms of survival and mortality in forest species. However, the physiological mechanisms underlying drought mortality are not completely understood. The aim of the present study was to analyse the effect of an extremely dry year on causing mortality of pines and forest decline in pine forest populations in southeast Spain. Specifically we studied interactions among drought stress that caused pine mortality, carbohydrates reserves and bark beetle attack. The results suggest that pine mortality can be attributed to an intense drought stress level, which caused pronounced xylem cavitation. Carbohydrate reserves were depleted as consequence of drought conditions. They also indicate that hydraulic failure and carbon starvation are likely to be interrelated, which makes separating both mechanisms from each other very difficult. Finally, the recorded bark beetles attack did not seem to be directly involved in mortality, at least not in forests with less intense drought conditions.

Simpósio 6. Resposta ecológica e evolutiva às alterações climáticas /Simposio 6. Respuesta ecológica y evolutiva al cambio climático

Sp6. Poster

Regulation of transpiration under water stress conditions: hydraulic signals vs chemical signals

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Mediterranean vegetation appears to be under the threat of climate change due to recurrent periods of drought: climate change models predict longer dry seasons and lower rainfall amounts. Thus it is germane to examine the ecological and physiological response of plants under drought conditions. The olive tree is appropriated to study this question not only for their drought tolerance, but also for their large agronomic impact. Hence we evaluated the role of hydraulic and chemical signals in stomatal conductance in *Olea europaea* under water stress conditions. The experiments were conducted in a commercial olive orchard consisting of *Olea europaea* L. 'Arbequina' (1667 trees ha-1). Three levels (100%, 60% and 30%) of regulated deficit irrigation (RDI) were applied. The instrumented field site made possible measurements of sap flow, relative water content in soil (RWC), stomatal conductance (gs), photosynthesis (AN), leaf area (LA), water potential leaf (?l noon and ?l predawn) and abscisic acid (ABA) in sap and leaf. Thus 30% and 60% RDI treatments showed a decrease of LA which had an effect on gs decreasing the AN. We found a high stomatal control of ?l noon which was kept above -1.5MPa coinciding with high values of hydraulic conductance (k). In contrast the ABA concentrations were not different between RDI treatments, suggesting that its role was not essential in stomatal regulation. Therefore, we observed hydraulic signals as an essential response to water stress of *Olea europaea*, but the role of ABA on regulation of transpiration under drought conditions is still unresolved.

Sp6. Oral

Above-ground and below-ground responses of *Vaccinium myrtillus* to four years of temperature increase under different scenarios of coexistence at the Pyrenean treeline

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High mountain ecosystems are known to be especially vulnerable to temperature change. At the alpine treeline in La Val d'Aran, Central Pyrenees, *Vaccinium myrtillus* has a substantial role in the shrub patches that progressively colonize alpine grasslands, where it grows together with *Vaccinium uliginosum* and *Rhododendron ferrugineum*. We evaluated the phenology and the above-ground (AG) and below-ground (BG) growth of *V. myrtillus* after four years of warming with open-top chambers under three situations of coexistence: pure stands, mixed with *V. uliginosum*, and mixed with *R. ferrugineum*. We hypothesised that *V. myrtillus* would show a phenological advance with warming, as well as greater AG and BG biomass. Moreover, following the results of a previous study in the area, we hypothesised that the coexistence with the other two species would not affect the direction nor the magnitude of this response. Our results showed that *V. myrtillus* early season phenology, i.e. bud burst, was slightly advanced by warming, while other phenological phases remained unchanged. We also found an AG biomass increase with warming but not a BG response. As expected, the coexistence with the other two species did not play a role in *V. myrtillus* response to warming. In conclusion, a temperature increase has an effect on *V. myrtillus* above-ground performance which can, in turn, lead to future changes in the behaviour of this species populations; a response that is not affected by the shrub community composition.

Sp6. Oral

Developmental responses to pond drying and predator presence cause alterations in fat storage, telomere length and oxidative stress in amphibian larvae

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Environmental heterogeneity often selects for adaptive plasticity, which allows organisms to adjust their phenotype to reigning conditions. However, natural environments are complex and organisms need to respond to multiple environmental factors simultaneously. Different factors may induce alternative or even opposite phenotypes, and we would expect that organisms express the phenotype that responds to the biggest immediate threat. Here we evaluate the consequences of exposing amphibian larvae to two common risks: presence of predators and pond drying. We expected these two risks to have opposite consequences for tadpole growth and development, as pond drying increases larval density and induces developmental acceleration whereas predators reduce density and induce delayed metamorphosis. We further hypothesized that pond drying would induce developmental acceleration even in the presence of predators. We recorded survival, time to metamorphosis, and growth rate, as well as fat body storage, telomere length, and antioxidant enzymes activity. We found that both factors decreased survival, although predators did so more markedly, and caused steep reductions in density. Pond drying induced accelerated development but metamorphs emerged smaller and with reduced fat storages. Conversely, thinning by predators reduced density to such extent that surviving tadpoles developed and grew faster than tadpoles exposed to pond drying, also presenting larger fat storages. However, the faster growth observed in tadpoles exposed to predators also caused shortening of telomeres, probably due to a higher rate of cellular replication. Our results suggest that both pond drying and predators profoundly affect amphibian development and body condition.

Sp6. Poster

Effects of drought during seed formation in *Cistus ladanifer*: growth, reproductive output, seed traits and germination

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Reproductive output and seed traits can be affected by water availability during seed formation and maturation. Understanding this is important for species in dry areas that are projected to suffer reduced precipitation with climate change, like the Mediterranean. We report results of a field-manipulative experiment that simulated three levels of drought in *Cistus ladanifer*, a plant with hard-coated seeds that prolifically regenerates after fire. Fruits and seeds from drought-exposed mother plants were collected and reproductive output and seed size determined, and seed anatomy studied. Seeds exposed or not to fire-cues were germinated under five levels of water stress (?s=0.0 to -0.50). Plant growth was sensitive to drought, but reproductive output, seed size, dormancy or viability was not. Drought significantly affected the thickness of the micropylar palisade layer. Drought, in interaction with fire-cues, negatively affected final germination. Water stress decreased final germination independent of drought, and interacted with fire-cues. Post-germination viability was negatively affected by drought, fire-cues and water stress. Fire cues made seeds highly sensitive to water stress (?b(50)=-0.25MPa). Overall, reproductive output was highly resistant to drought. However, effects of drought in the mother plant cascaded down to seed anatomy and germination in interaction with fire-cues and water stress during germination.

Sp6. Poster

Bryophyte life form and desiccation tolerance in habitats with contrasting water availability

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Bryophytes are poikilohydric organisms that equilibrate their internal water content with the surrounding environment. Although they lack some of the structures/components of vascular plants to prevent water loss, they were able to explore and colonize the terrestrial environment, ranging from full aquatic to desert environments. Evolution driven this group to develop the ability to tolerate the extreme dry environment, undergoing desiccation, a process in which tissues virtually lose almost all water, returning to normal function upon rehydration. Nevertheless, different bryophytes have different levels of desiccation tolerance (DT), which have been correlated to habitat water availability. However, recently it was demonstrated that even an aquatic bryophyte can be desiccation tolerant if slowly dried, i.e., if enough time is given to prepare for desiccation. To be able to control to some point the dehydration rate, we present the hypothesis that morphology, life form and colony structure, can be a determinant factor in the adaptation of bryophytes to each habitat and corresponding predicted levels of desiccation. Bryophytes which are organized in colonies with dense forms like cushions, naturally retain more water by capillarity, allowing to dehydrate more slowly, than those with less denser forms. We used bryophytes from two contrasting habitats (semi-arid and aquatic) and discuss the morphological adaptations as the main evolution driver for adaptations to new habitats, according to water availability, the implications in desiccation tolerance and also in “controlling” the water availability in dry habitats.

Sp6. Oral

Long-term impact of warming and drought on wet shrubland ecosystems: a positive climate feedback?

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Projected warming, and increasingly frequent extreme events such as drought, may substantially enhance soil organic matter decomposition in wet organic soils, contributing to the positive feedback between the terrestrial carbon cycle and climate change. Evidence suggests that, as wet organic soils contain large organic C stocks, acclimation to warming might occur more slowly in comparison to mineral soils. The long-term response of wet organic soils to drought remains however uncertain. We investigated the long-term (14 years) impact of warming and repeated summer droughts on soil respiration in a wet shrubland, using a whole-ecosystem climate-change experiment in North Wales, UK. The stimulation of soil respiration by drought was enhanced over the years, which was linked to major changes in soil structure that led to a 54 % reduction in water holding capacity. Microbial enzyme activity was not different across treatments when soils were sieved and incubated under standard temperature conditions, suggesting no physiological adaptation of the soil microbial communities to warming or drought. Plant productivity was very resilient to warming or drought, indicating that the increases in soil respiration have not been balanced by increases in C inputs to soil. The results indicate that the impact of summer drought could lead to a substantial loss of soil C that should be considered in the prediction of future C fluxes and climate feedbacks at regional and global scales.

Sp6. Poster

Morpho and ecophysiological post-fire responses of *Pinus halepensis* Mill. stands to drought induction and salvage logging

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In the Mediterranean Basin, drought and fire regimes are changing due to global change, i.e. climate change, land use change, etc. The ecological effect of salvage logging generated controversy but was the commonest post-fire emergency action in Spain. We followed the recovery of burned Aleppo pine stands (*Pinus halepensis* Mill.). in southeastern Spain. The experimental design included post-fire treatments (control and salvage logging) and induced drought (in the managed area) by using rain-exclusion shelters. The recruitment of the main tree species, pine, was low and we selected three companion species representative of different life strategies in Mediterranean environments, to monitor the ecosystem response: *Stipa tenacissima* (resprouter), *Cistus clusii* Dunal and *Rosmarinus officinalis* L. (obligate seeders). Morphological (growth in height and coverage) and ecophysiological response (transpiration ratio, net photosynthetic ratio, stomatal conductance and water use efficiency) of the selected species were recorded and related to water stress (predawn leaf water potential). After two drought periods (one and two years after fire), we found a significant lower water stress level for obligate seeders in the unmanaged area, which showed the highest size of resprouters. In the logged area, the lower growth ratios were found in plots with induced drought, mainly for seeders. Productivity was positively related to transpiration, stomatal conductance and net photosynthetic ratio. The lower water use efficiency was found in obligate seeders with no drought induction. Our results confirm that climate change influences the resilience and productivity of ecosystems in the short term, but depending on forest management.

Sp6. Oral

Divergent responses on silver fir neighbouring lineages to experimental warming and drought

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Recent changes in climate can alter current distribution and dynamics of tree species by altering their recruitment patterns, especially at the distribution rear edges. However, geographical patterns of genetic diversity could buffer the negative consequences of changing climate since rear-edge populations might also harbour individuals with drought-adapted genotypes. Silver fir (*Abies alba*) reaches its south-western limit in the Spanish Pyrenees, where recent climatic dieback events have disproportionately affected westernmost populations. We hypothesised that silver fir populations from the eastern Pyrenees are less vulnerable to the expected changing climate due to including drought-resistant genotypes. We performed an experiment under strictly-controlled conditions simulating projected increased temperature and drought compared with current conditions and we analysed physiology, growth and survival of silver fir seedlings collected from eastern and western Pyrenean populations. Genetic analyses separated eastern and western provenances in two different lineages. Climate treatments affected seedling morphology and survival of both lineages in an overall similar way: elevated drought diminished survival and induced a higher biomass allocation to roots. Increased temperature and drought provoked more negative water potentials and increased d13C ratios. Warming reduced nitrogen concentration and increased soluble sugar content, whereas drought increased nitrogen concentration. However lineage affected these physiological parameters, with d13C, nitrogen and soluble sugars in eastern and western seedlings responding differently to temperature or drought increases. Our results demonstrate that, in *Abies alba*, differences in the physiological response of this species to drought are also associated with differences in biogeographical history.

Sp6. Poster

Effects of gene flow in local adaptation: the role of marginal populations

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Are marginal populations able to adapt locally to the existing limiting environmental conditions, or are genetically impoverished and maladapted? What is the effect of gene flow between populations affected by contrasting limiting environmental conditions? To face these questions we used *Silene cililata* Pourr. (Caryophillaceae), a chamaephytic cushion plant that grows in alpine cryophylic pastures of the Mediterranean mountains. We selected several populations of the species along an altitudinal gradient from 1900 to 2400 m. Populations that grow at the lower elevations are marginal from the standpoint of the ecological range of the species and are probably a good representation of the future environmental conditions of all the distribution area of the species as a consequence of global warming. Populations that grow at the higher elevations could be considered central, i.e., in the ecological range optimum. We carry out an experimental design that involved artificial cross-pollination of mother plants from various marginal populations using pollen from the same population, other marginal populations and central populations. The performance of the resulting seeds was assessed sowing them in growth chambers under controlled conditions. This experiment has been complemented with common garden studies implemented in an ex-situ experimental facility to ascertain genetic differences in vegetative, phenological and reproductive traits of the species.

Sp6. Oral

Evolutionary consequences of climate-induced range shifts in insects

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Insects are particularly responsive to environmental changes because (i) basic physiological functions (locomotion, growth, and reproduction) are directly influenced by ambient temperature, (ii) and because many insects have short generation times, and (iii) high mobility. In Europe, poleward shifts and expansions have been recorded for lepidopterans, heteropterans, neuropterans, orthopterans and odonates. Species persistence can be affected in the new created areas of geographic overlap between formerly allopatric taxa by range shifts because of a warming climate and anthropogenic changes. We have reviewed short term processes which are causing the breakdown of reproductive barriers in newly created sympatric areas, and long-term consequences on the stability of hybrids zones, introgression and ultimately speciation and extinction rates. The evidence shows that long-term outcomes of this affect threaten species persistence and biodiversity as a whole. New areas such as the genomics of hybridisation and introgression, our ability to forecast range shifts, and the threat coming from insect vectors and pests on biodiversity, human health and crop production are some areas that deserve increased attention in the future, in a warming world.

Sp6. Oral

Combined effects of climate change and invasive species on the reproductive biology of an alpine endemic violet

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High-mountain ecosystems are particularly vulnerable to global warming. The ability of alpine plants to adapt to future warming might depend on the amount of intraspecific variation which is actually found along their elevational gradient. In this work, we studied variation in the reproductive biology (specifically, in the level of selfing, pollinator visitation, and reproductive success) of the endemic alpine plant *Viola cheiranthifolia* (Teide National Park, Canary Islands) across three altitudinal levels (2,500, 3,200 and 3,700 m a.s.l.) with different microclimatic and edaphic conditions to assess their vulnerability to climate change. Particularly, we examined whether this vulnerability can be enhanced by the simultaneous effect of another driver of global change such as the presence of invasive herbivores in the ecosystem. This information is going to be very valuable to build a more realistic predictive model for the future changes in the distribution and abundance of this species under different climatic scenarios.

Sp6. Poster

Interannual variation in early life history of *Pleuronectes platessa* (L.) in the northern distribution limit

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Plaice, *Pleuronectes platessa*, is a commercially exploited flatfish species in northern European waters. Despite numerous studies on plaice early life history, information for its northern range of distribution is still scarce. In this study, the otolith microstructure of post-settlement plaice, sampled from an inshore nursery ground (Valosen, Bødo, Norway) between 2005 and 2006, was examined to analyse interannual variation in early life patterns of juvenile plaice For that, 15 sagitta otoliths of each year were mounted in microscope slides using Crystalbond, with the concave side down. Otoliths were then hand-ground to the otolith core using sandpaper (3, 1 μm) and examined under transmitted light in a microscope linked to an image analysis system. Daily increments were counted twice and averaged values were used to determine hatch dates, larval duration, settlement dates and total age. A one-month difference in hatching and settlement times was found, with most hatchings occurring during May in 2005 and June in 2006, and settlement occurring during June in 2006 and mainly in July, in 2006. Larval duration was, however, similar in both years. The time between metamorphosis and completion of settlement was quite variable, considering all fish analysed. This results may be due to climate changes or not, since interannual variability could be a smaller-scale response to climate changes. However, further work needs to be done including estimation of larval and post-settlement growth rates based on otolith increment widths in order to fully understand temporal and spatial variation in plaice early life dynamics.

Sp6. Oral

Ecological and evolutionary responses to climate change: insights and caveats

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Organisms respond to climate change at two main time scales. In the short term they make use of their stress tolerance and their phenotypic plasticity while in the long term they make use of their capacity to evolve new traits and capacities. Our understanding of the two main groups of processes is fragmentary but different studies are revealing that we need to better uncover the extent and nature of population differentiation and local adaptation to realistically estimate their vulnerability to climate change. In other words: we need to decipher responses within species and not at the generic species level, exploring genetic and phenotypic variances and not only mean species values. I will illustrate how the explicit consideration of population differentiation regarding phenotypic plasticity and local adaptation can influence our estimations of species responses to climate change. Relatively high levels of stress tolerance and plasticity may have prevented population differentiation in some species, which could threaten survival in future climatic scenarios when the tolerance limits are reached and the rate of environmental change exceeds the rate of evolutionary change.

Simpósio 7. Biodiversidade, funções e serviços dos ecossistemas /Simposio 7. Biodiversidad, funciones y servicios ecosistémicos

Sp7. Oral

Insects at our service

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Human well-being depends on the services and goods that nature provides. Insects due to their huge diversity, ecological function and to the fact that they occupy diverse ecological niches are providers of several of these services and goods. Despite the recognition of pollination and biological control, several other important services provided by insects are not acknowledged at all, especially in western cultures. Here we assessed the provisioning, regulating and maintenance, and cultural services delivered by insects following the Common International Classification of Ecosystem Services (CICES) and identified several indicators which might underpin the mapping and valuation of the services delivered by insects.

Sp7. Oral

Functional role of amphibian larvae in temporary ponds: effects on zooplankton, plant biomass and seed dispersal

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Amphibian larvae feed on phytoplankton, periphyton, zooplankton, and aquatic macrophytes. However, the effects of amphibians on aquatic communities remain poorly studied. We experimentally assessed the influence of amphibians on the structure and functioning of temporary ponds using a mesocosm array at Doñana National Park. We tested for a) effects of the local amphibian community (larvae from six species) on macrophytes, plankton and water chemistry, b) feeding preferences of amphibian larvae regarding aquatic macrophytes, and c) capacity of anurans to disperse seeds and alter the germination rate of transported seeds. When at high density, urodeles caused a reduction in zooplankton diversity, shifting from cladoceran to copepod predominance. Anurans decreased macrophyte biomass, and increased water turbidity and nutrient content. Nonetheless, these effects were largely attributable to spadefoot toad tadpoles, the largest species in the guild. Interestingly, in the absence of spadefoot toads, the rest of amphibians positively affected plant biomass. Anurans showed preferences for some macrophyte species, but fed on multiple species and consumed both leaves and fruits. Also, we found that tadpoles often transported seeds of the plants consumed, with 6-28% of the tadpoles across four species transporting viable seeds. In view of our findings, we suggest that herbivory by anuran larvae can affect the composition, reproductive phenology or seed dispersal of plant communities. We thus show that amphibians are keystone species in the trophic network of aquatic systems, as they have a variety of functional roles and may influence the whole community structure.

Sp7. Poster

Assessment ecosystem services associated with traditional irrigation systems

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The agricultural sector is currently undergoing many changes ahead of its modernization, including the abandonment of traditional ditches. There are numerous ecosystem services that are associated with ditches, which could be costly to recover. The aims of this study are (1) to evaluate the abundance and biodiversity of pollinators in relation to different irrigation systems (traditional, intermediate and modernized); and (2) assess how these ecosystem services provided by the canals are perceived. The study will be carried out on three irrigation systems: traditional ditches (trace excavated soil and associated vegetation), concrete ditches (open ditches that have been concreted) and "piped ditches" (those with underground piping). We expect that traditional ditches will host the greatest biodiversity of insects, including pollinators. Therefore, these ditches will provide the pollination service to neighboring crops. Sampling will be conducted on the three irrigation systems, both in the vegetation associated with runway and its adjacent crops, using line transects and microplots to obtain data richness and an abundance of insects, including potential pollinators. Information regarding the effective rate of pollination will be obtained by plant focal sampling and line transects. To evaluate the way society perceived the irrigation systems and the pollinators we will perform surveys. We hope that the results obtained will characterize and validate the significance of these ancient activities in maintaining biodiversity and the ecosystem services that provide it.

Sp7. Poster

Runoff trends driven by climate and afforestation in a Pyrenean basin

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The abandonment of traditional rural life in mountain areas has favoured the expansion of forest in the headwaters of Pyrenean rivers. In this paper, we analyse hydro-climatic trends at the annual and monthly scales in three nested sub-catchments in a central Pyrenean basin and quantify the relative contribution of climate change and forest cover on the observed changes in runoff. Land use maps indicate an increase in the forest cover in all sub-basins for the period 1987-2009. Non-parametric Mann-Kendall statistic on annual and monthly hydro-climatic data from 1965 to 2009 was used to identify trends in climate and runoff data. To assess the potential influence of the period length, trends were also examined for the 1941-2009 stretch. Upward trends were detected for temperature and potential evapotranspiration, particularly during summer and winter months. Precipitation trends and their significance depended on the length of the period considered, although overall results indicated a decrease. The effects of climate change and land cover change on annual runoff were identified by means of a Change Point Analysis. Results indicated that a change in annual runoff took place in the 1980s, suggesting the non-linearity in the relationship between precipitation and runoff, and thus the influence of land-use factors. The influence of forest cover was confirmed by comparing observed runoff trends with those resulting from a hydro-climatic model that does not take into account land use changes. Divergence between both trends revealed that forest cover can account for ca. 40% of the observed decrease in annual runoff.

Sp7. Poster

Patterns of ecosystem functioning and functional diversity in mediterranean-desert-tropical transition ecosystems (Baja California, México)

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Biodiversity patterns had been frequently evaluated using structural and compositional components at the species level, but seldom using functional attributes at the ecosystem level. However, ecosystem functioning is central for conservation because global change effects are better perceived using functional traits at the ecosystem level. Transition zones including drylands are particularly sensitive to these effects since they may experience desertification processes with loss of biodiversity, ecosystem functions and services. Our aim was to characterize the regional patterns and drivers of ecosystem functional diversity in mediterranean-desert-tropical transitions. We hypothesize that transitional areas have more functional diversity than mediterranean or tropical by themselves. We identified Ecosystem Functional Types (EFTs) from three descriptors of the seasonal curves of MODIS Enhanced Vegetation Index (EVI): annual mean (surrogate of primary production), seasonal coefficient of variation (descriptor of seasonality) and date of maximum EVI (indicator of phenology). We only included natural pixels according to the Human Influence Index. We finally carried out a correspondence analysis between the EFTs classification and the ecoregions of Baja California. Most potential EFTs combinations were present in Baja California, but EFT richness varied across ecoregions. Transitional desertic zones showed many exclusive EFTs and the greatest EFT richness, with most levels of productivity, seasonality and phenology. Mediterranean areas showed relatively high EFT heterogeneity, that included intermediate productivity levels, low-intermediate seasonality, and maximum greenness in spring. Tropical ecoregions showed the lowest EFT richness, characterized by high productivity, high seasonality, and summer-autumn maxima.

Sp7. Poster

Coimbra peri-urban-area: plant diversity

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In spite of an escalating urban growth, some peri-urban areas have a considerable level of biodiversity. These ecosystems execute a cultural service in improving the inhabitant's quality of life and its conservation has been addressed at European level (e.g. FEDENATUR). Coimbra peri-urban area include a reticulation of commercial plantations of eucalyptus with low biodiversity, fallow fields where native species are recuperating well, and small pockets of more or less degraded original vegetation. Floristic composition was assessed in the two main soil types present in the area, limestone and phyllites, in two localities each; anthropogenic influence was also assessed. Plant diversity is high, with 190 genera and 61 families, partly from introductions but mostly from native species. Species such as *Cistus albidus*, *Cistus monspeliensis* and *Bellis perennis* predominate in soils of limestone; *Erica arborea*, *Cistus salviifolius* and *Glandora prostrata* subsp. *prostrata* predominate in phyllite soils. Anthropogenic influence proved to be a factor that increased species number and locally modified the floristic composition. Coimbra peri-urban area is an example of a splendid refuge of biodiversity that, under the protection it deserves, can play an important supporting ecosystem service.

Sp7. Oral

Effects of resource availability, aridity and soil conditions on the spatial and temporal variations on the structure of dung beetle communities

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Community composition can change significantly in space and time. This is particularly true in extreme environments, where species distributions are affected by resource availability and species interactions (along time and space), as well as by environmental gradients (mainly along space). Dung beetles (Coleoptera: Scarabaeoidea) are dependent on the availability of an ephemeral resource (herbivore dung) but their species distributions are also affected by environmental factors such as climate, soil and vegetation. We study the distribution and composition of Scarabaeoidea dung beetle communities along a 400km aridity gradient in East Morocco, ranging from the Mediterranean coast to the Sahara desert. Specifically we (1) describe the distribution of species along this spatial gradient; (2) analyze the relationships of several community features with aridity, vegetation, dung availability and soil type; and (3) overview the seasonal and yearly differences in community composition. The preliminary results based on five surveys (April and September 2013 and April, May and September 2014) show a clear species replacement along the aridity gradient, but also significant effects of soil type on community composition. Seasonal differences in community composition are also evident, showing distinct communities before and after the dry season (i.e., in July–August).

Sp7. Poster

Fire-derived effects on the germination of *Pinus canariensis* Chr. Sm. Ex DC and understory species of the pine forest

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Natural fire regime has been clearly exceeded in Canarian pine forest, where prescribed burning has been used as a management tool for fire prevention, especially in reforested stands. Knowledge on the germination characteristics of *Pinus canariensis* Chr. Sm. Ex DC. and common companion understory species can help in the understanding, prediction and management of the regeneration of burnt pine forests. The main objective of the present study is to determine the germination response of *P. canariensis*, three endemic legume shrubs (*Adenocarpus foliolosus* (Aiton) DC., *Chamaecytisus proliferus* (L. f.) Link and *Teline microphylla* (DC.) P. E. Gibbs & Dingwall) and three ruderal grasses (*Anisantha rigida* (Roth) Hyl., *Cynosurus echinatus* L. and *Briza maxima* L.) to different thermal shocks, smoke, ashes and drought treatments. Five replicates of 25 seeds per treatment were promoted. Seeds were sown on Watman nº2 ?lter papers in Petri dishes, which were incubated in a seed germinator at 25/15 ºC under a 14 h light/10 h dark photoperiod and maintained under constant moisture conditions. Germinants (2mm of radicle emergence) were recorded daily over a 40-day incubation period. Results indicated that cold-wet stratification and mild heat (except temperatures over 150ºC) enhanced germination of *P. canariensis* while high temperatures strongly inhibited it. Expositions of 120ºC during five minutes are pernicious for grass species, whereas temperatures between 60-100ºC favored germination in leguminous species. On the other hand, a significant negative relationship between drought and germination is evident for legumes, but not for understory grass species.

Sp7. Poster

Mind the gap: spatially-explicit indicators for effective assessment of High Nature Value forests

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Forests are important providers of ecosystem services (ES) and goods. Whilst maintaining and promoting forest resilience and multifunctionality has been highlighted as essential for many EU political commitments, EU forests have been under several threats, mostly derived from changes of land uses and forest management regimes, known to have profound impacts on forest structure and associated biodiversity. The High Nature Value (HNV) indicator, defined in the context of the Rural Development Programs (RDPs), comprises the identification and evaluation of forests that support high levels of biodiversity in Europe. Whilst EU-level guidelines and strategies to map and assess HNV areas have already been provided, the identification of suitable, spatially-explicit indicators is a challenge yet to tackle. Here, built on a comprehensive meta-analysis of published research, a preliminary framework of spatially-explicit indicators to assess HNV forests is proposed. Also, such indicators are analysed in their ability to express the natural value of forests and distinct levels of ecosystem services and goods provision, in the broad context of the implementation of RDPs across EU.

Sp7. Poster

Organic matter, riparian vegetation and invertebrate community connections in a Brazilian subtropical stream

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The organic matter input in streams can vary over time depending of the riparian vegetal composition. This input can influence the invertebrate fauna and carbon and nitrogen availability in the water. In this study, we evaluate the seasonal variation of riparian vegetation composition and stream invertebrates. We also evaluate the relationship among biological components and carbon and nitrogen concentrations dissolved in the water. This study was carried in a subtropical stream at southern Brazil. Monthly, during one year, we quantify the organic matter input by vertical and lateral way and the benthic stock. The invertebrates were collected of the leaves mixture incubated in litter bags. Finally, we collected water samples to quantify the dissolved organic carbon (COD) and total dissolved nitrogen (TDN). The vegetal composition was different between vertical and lateral way and stock benthic. The highest organic matter input was in the spring. The invertebrate composition was different over time, whereas DOC and TDN were similar. However, TDN concentrations show a positive relationship with lateral organic matter input. No relationship between invertebrate and riparian vegetation composition was registered. The vegetal species phenology vary in composition, resulting in a similar contribution of organic matter through the through the seasons. Thus, we conclude that stream invertebrates may be more dependent of the chemical detritus quality than the amount of organic matter. Furthermore, the water flow (leaching) is more important than the biological fragmentation for carbon cycling stored in the stream.

Sp7. Oral

The forgotten soil fauna: the neglected element controlling soil processes and ecosystem services

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The prevailing dogma in current global decomposition models is to simply consider litter chemistry and abiotic factors as the principal drivers of soil organic matter turnover and to consistently use a single averaged Q10 value to predict global climate change feedbacks. Whilst vegetation, microbial and biogeochemical activities are becoming increasingly recognised in climate change and global C cycle models, soil fauna are consistently excluded, despite their critical and long-recognised role as major agents of several ecosystem processes and services. Here I will show, through several field and laboratory-based examples, how predicted climate changes may impact on soil invertebrate populations with important implications for C storage that could lead to feedbacks to climate. This will be illustrated by evidencing how soil invertebrate populations adapt to changing climates and how these responses could exacerbate decomposition of long-standing soil carbon reservoirs and diminish the predicted respiration acclimatisation effects. These examples will reveal that climate change could be a powerful driver of soil organisms, whereby 'biological accessibility' instead of 'recalcitrance' might be the key factor regulating soil organic matter decomposition. Consequently, the extent of the effects and consequences for ecosystem processes are often not simple or straight forward and, therefore, need to be individually considered.

Sp7. Oral

Who did this ped and when? The fingerprint of ageing biogenic aggregates with NIRS analysis in mountain grassland soils of central Pyrenees

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In this study we used NIR spectroscopy and morphology analysis to discriminate biogenic aggregates produced by three earthworm species from the subalpine grazed pastures of Central Pyrenees in Spain, i.e. *Aporrectodea rosea*, *Lumbricus friendi* and *Prosellodrilus pyrenaicus*. Individuals were kept in microcosms with air dried and <2 mm sieved soil for one day and retrieved after they had deposited casts in the soil volume. Soil and casts were incubated to different times to a maximum of 64 days. All samples (control soil, casts and non-ingested soil) were sieved at 200 μm and read in a spectrophotometer (QualitySpec®). The original spectral values were further transformed to second derivative with the Unscrambler software. We aimed at comparing the NIRS signals with the temporal reference signatures of biogenic structures obtained in the lab. A Principal Component Analysis (PCA) of NIR spectra of casts clearly distinguished species and time elapsed since cast production and significance testing of their groupings with Montecarlo randomization test ($P<0.001$). The NIR spectral values of field data were projected onto the PCA axes and PLS regressions were used to identify the species responsible for the production of biogenic aggregates in the soil matrix. Our results indicate until a certain time lag casts produced by earthworms can be identified in field conditions, given that a library of NIRS signals are obtained in the lab. A clear earthworm function was detected in these grazed pastures and more studies are needed for the rest of ecosystems and land uses in these mountainous areas.

Sp7. Poster

Influence of surrounding environment on the abundance and diversity of pollinators in organic farming crops.

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Decline in pollinator populations is a phenomenon that observed worldwide since the late XXth century. This is compromising environmental and agricultural biodiversity their ecosystem services and subsequent food supply. It is believed that changes in land use and replacement of traditional practices by modernized practices are causing this decline in pollinator populations. This study aims to evaluate and compare the abundance and diversity of pollinators in organic production farms located in environments within a gradient of land uses. The protocol characterizes the organic crops structurally and functionally and their environment and, to quantifying abundance and diversity of pollinators, we will use linear transects, micro-plots and focal observations. We expect that the results obtained, in addition to a scientific benchmark for future studies on this field, will serve to ensure greater sustainability and resource management in agriculture, not only in the area of intensive field work, but also in other similar areas.

Sp7. Oral

Indicators for assessing resilience of forest ecosystem services: a review based on the DPSIR framework

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Forest landscapes face several pressures (from climate change and invasive species to land use change and wildfires) that can induce shifts on fundamental ecological functions and processes, threatening the provision of goods and services required for numerous dimensions of human well-being. Understanding the relations between drivers and pressures that can impact on ecosystem services (ES) provided by forest landscapes, and how these relations can be modulated by societal responses, are thus major challenges for forest sustainability. Resilience-based management has been proposed as a new paradigm to deal with these challenges, considering not only the ability of ecosystems to resist and recover from impacts but also their capacity to absorb disturbances and maintain core ecosystem functions. Yet, robust frameworks that allow the operationalization of resilience-based approaches are still lacking for managing ES in forest landscapes. Based on a thorough literature review, this study aims to identify a set of indicators which have been used to assess the general and specified resilience of ES in forests worldwide. The selected indicators are organized following the categories of the DPSIR (Driving forces-Pressure-State-Impacts-Responses) framework, adapted whenever necessary. Through an explicit linkage with resilience thinking, this study identifies the drivers and pressures that can impact ES in several forest types, across spatial and along temporal scales, identifying the resilience approaches behind such assessments. We argue that the integration of resilience-based indicators in a DPSIR framework can provide a useful adaptive management tool for generating solutions regarding common socio-ecological problems for forest researchers and practitioners.

Sp7. Poster

Leaf decomposition in a fluvio-estuarine system: the imbalanced role of microbes, meio- and macro fauna

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The importance of leaves in fluvial-estuarine areas as source of nutrients to the aquatic food webs is still not known. Here we assess the decomposition of alder (*Alnus glutinosa*) and poplar (*Populus nigra*) leaves and associated microbial, meio- and macrofauna at the end of Mondego River continuum. Leaves were exposed in coarse and fine mesh bags for 21 days. Oscillations in water salinity could be observed during the conditioning period (5 – 18 ppt). No differences were found in mass loss between meshes, which suggests a weak or nonexistent influence of macroinvertebrates in the breakdown process of both leaf types. Higher decomposition rates (0.097 vs 0.065 k day-1, poplar vs alder) and respiration (10%) were found in the most recalcitrant leaf, poplar, after 21 days incubation. Microbial communities were dominated by bacteria in both types; fungal biomass was not detected. Meiofauna community was richer and more abundant in poplar. This may suggest that this group has a crucial role in the dynamics of organic matter (particularly the more recalcitrant one) and nutrients in these fluvial-estuarine waters.

Sp7. Oral

Large soil predators and tree husks enhance soil biodiversity and an associated ecosystem process

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Soil fauna play a central role in fundamental ecosystem processes such as leaf-litter decomposition and nutrient turnover, but little is known to date about which are the drivers of soil biodiversity and its role in nutrient turnover. We show intricate and previously unexplored facilitative effects exerted by both predators and trees on the soil food web and associated litter decay. First, although predators may inflict negative effects on prey at the individual level, they can have net positive effects at population and community levels. Indeed, by manipulating large soil predator abundances, we found that lower predator densities led to a decline in the densities of lower trophic levels and to slower decomposition rates. If a well-structured soil community is essential to ensure litter decay, could trees themselves promote the maintenance of such community? In drier years, deciduous forests produce more fruits and hence, second we asked whether this higher cupule density could positively affect soil organisms during droughts, thereby contributing to the maintenance of the soil food web. By experimentally manipulating water and cupule availability in the forest floor, we demonstrate that diverse soil animals are found inside these fruit husks more frequently in drier conditions ('wet refuges'), and that cupule availability is a limiting resource that strongly determines community structure. Thus, decomposers and the associated litter decay are indirectly favoured by large predators and by fruit husks during dry periods. Likewise, by promoting prey survival during droughts, fruit husks also indirectly enhance large predator densities.

Sp7. Oral

Co-dispersal of fungi spores and pollen grains by flower visiting birds in Europe

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(1) MARE, (2) CEF, (3) MARE, (4) ICNF.

European birds are not frequently considered important dispersal vectors of pollen or fungi spores, for wind and insects are generally considered pivotal. However birds may be important dispersals for fungi and pollen since they can travel long distances in short time periods, and mainly by depositing pollen and fungi spores on particularly suitable germination sites, i.e. directed dispersal. We searched for pollen and spores on the peri-mandibular feathers of 894 birds from 34 species mist netted in central Portugal. We found that 229 individuals from 23 species and 131 individuals from 11 species carried pollen and spores, respectively. The most common pollen grains found are from *Eucalyptus globulus*, while the most common and abundant morphological spore type is the Amerosporae, likely from flower growing yeasts. The pollen dispersal is generally more common during the late autumn and winter. Besides the *Eucalyptus* pollen, others economical important plant groups as *Prunus* sp. and Brassicaceae are also commonly transported by birds. We found that the best predictor for the presence of spores on the birds' beak was the presence of pollen – a proxy for flower visitation. This suggests that the spores are likely transported between flowers. Our results indicate that directed co-dispersal of pollen and fungi by birds is a common phenomenon but highly under-appreciated despite its potential ecological, biogeographic and economic outcomes.

Sp7. Poster

Land use pathways strongly drive woody community assembly at landscape scale in Mediterranean scrublands

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(1) CREAF.

The comparative role of niche and historical factors on species assembly has been deeply studied at regional scales, while it remains largely unknown at landscape scales where dispersal constraints might be substantially reduced. We explored the comparative role of historical land use and environmental factors on woody community assembly at landscape scale in Mediterranean scrublands. We analyzed 151 vegetation plots randomly distributed on five historical land use pathways across a scrubland-dominated landscape (9600 ha) in the Garraf massif (Barcelona, NE Spain). For each plot, woody and herbaceous vegetation cover, soil depth, elevation, annual radiation and geographic position were recorded. GLM were used to examine the influence of these factors compared with historical land use pathways in species richness, diversity and evenness. Influence of environmental and geographical distances in floristic patterns were evaluated with a partial Mantel test. Relationships between species composition and environmental and historical variables were studied with Canonical Correspondence Analysis (CCA), including variance partition methods. Woody species richness and diversity were affected by both elevation and historical land use pathways, while woody species evenness was only affected by elevation. We did not found any association between floristic composition and either environmental distances or geographical distances. Variance partition showed that environmental variables and historical land use variables explained, respectively, around 21% and 19% of the variance in the species distribution (both presence and cover). Results indicate that historical land use pathways and environmental factors strongly drive small-scale woody community assembly in Mediterranean shrublands.

Sp7. Poster

Ecosystem services trade-offs associated to the construction of artificial lakes as a climate change adaptation measure in drylands

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Drylands are one of the most susceptible regions to climate change, being water the most limiting factor. One claimed climate change adaptation measure on those regions is the construction of artificial lakes to increase water availability both for drinking and irrigation. These are two obvious ecosystem services that will be enhanced. Besides these, other non-target ones such as carbon sequestration, water purification and sediment retention might change due to lake construction. In this study we aimed to assess the trade-offs on non-target ecosystem services due to lake construction in a real scenario in a dryland region. For that we selected a case-study in SW of Europe where the construction of 11 lakes took place since 2007 and compared the changes for the three ecosystem services between 2006 and 2014, using InVEST modelling tools. Results showed that not all of the studied services were improved by the lake's construction. Carbon sequestration was improved, however this positive balance is dependent on the initial land-use type, which in this case was mostly grassland. Nitrogen availability increased in the same proportion as nitrogen retained by the landscape, causing only a minor increase in nitrogen discharge. Although sediments retained by the landscape increased, the soil loss potential augmented in a higher proportion, meaning an increase in sediments discharge to more than double. The construction of artificial lakes as a climate-change adaptation should thus be considered with caution, taking into account the fragile trade-offs between ecosystem services and measures for soil erosion control should be considered.

Sp7. Oral

The impact of landscape changes on carbon sequestration and storage in the sabor river's upper basin

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The landscape in northeastern Portugal has changed in the past decades mainly driven by depopulation and agriculture abandonment. These changes can have major impacts on the provision of ecosystem services including the climate regulation service. In order to assess the influence of landscape changes in the provision of this ecosystem service we quantified, valued and mapped carbon stored and sequestered in the sabor river's upper basin, Bragança, Portugal, using the invest model. The assessment relied on the interpretation of land use/land cover (lulc) changes between 1990 and 2006 and the estimation of carbon stocks in aboveground, belowground, litter and soil pools for the entire landscape. For the economical valuation we used the social costs of carbon approach. Also, three alternative landscape scenarios (forest expansion, shrubland expansion and agriculture abandonment) have been projected for 2020. The results suggested that between 1990 and 2006 carbon stored in the landscape increased and that the variation of the carbon sequestered and stored in the landscape occurred mainly due to changes in lulc and to the increase of forest tree biomass. Carbon distribution among pools varied depending on lulc types. however, for all lulc types, soil was estimated as the major carbon pool. The scenario that simulates the expansion of forest areas revealed a higher potential for carbon sequestration, which could indicate a higher value for this ecosystem service. In contrast, the expansion of shrubland areas revealed a lower potential for carbon sequestration in the landscape.

Sp7. Oral

The invasion of stream borders by *Acacia longifolia*: consequences for ecosystem functioning

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Acacia longifolia is one of the most prominent plant invaders in Portugal, spreading in all types of ecosystems, from dunes to riparian zones. Most stream ecosystems in temperate zones are heavily dependent on the inputs of terrestrial plant litter, mainly leaves, which constitutes a heterotrophic source of energy for the stream food webs. The replacement of autochthonous riparian vegetation by exotic species may cause drastic effects on stream ecosystems due to the alteration in the amount, type, quality and/or seasonality of litter inputs which in turn may alter the availability of food for stream communities. In this study we determined the decomposition rate and macroinvertebrate colonization of *Acacia longifolia* leaves in a small stream in order to assess if invasion of stream borders by *Acacia longifolia* affects leaf litter processing and thus alters the sources of energy in streams. *Acacia longifolia* was compared with *Alnus glutinosa*, a riparian autochthonous tree which, similarly to *Acacia*, is also a nitrogen fixer. Decomposition rates of acacia were up to 4.9 times slower (k=0.008 day-1 in fine and coarse mesh bags) than alder's (k=0.035 day-1 in fine and k=0.042 in coarse mesh bags). The similar breakdown rates in fine and coarse mesh bags denotes that mass loss was mainly due to microbial degradation in both cases. The slower decomposition of acacia when compared to the autochthonous species, together with the different adaptations (evergreen versus deciduous) may indicate that streams invaded by acacia will be food-limited, especially during autumn when most aquatic invertebrates hatch.

Sp7. Oral

Changes to bee and fly pollinator communities along a landuse intensity gradient in New Zealand

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Habitat degradation and destruction, particularly due to the expansion and intensification of agricultural systems, are the primary drivers of global biodiversity loss, causing the reduction of many ecosystem functions and services. Biodiversity is predicted to enhance ecosystem function and resilience to environmental disturbance. Insect-mediated pollination is a critical ecosystem function and service, and provides a tractable model for investigating biodiversity-ecosystem function relationships. This paper reports on a landscape scale experiment, using targeted mass plantings along a land-use intensity gradient, to assess differences in insect pollinator communities and subsequent variation in pollination services. Pak choi (*Brassica rapa*) was planted in 25x25 m plots at 12 sites throughout the Waikato region, New Zealand in 2014. Insect pollinator communities were measured at each site using floral visitation observations. For all sites, non-*Apis* pollinators accounted for approximately 40% of floral visits and comprised mostly of native solitary bees and flies. Preliminary analyses suggest that insect communities responded to the land-use intensity gradient. The next step will be to determine if these community changes are correlated with seed set rates and thus, pollination services.

Sp7. Oral

Valuing Ecosystem Services in the Montado Landscape: the OPERA's Project Approach

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OPERA's is a European research project (FP7) which aims to bridge the gap between ecosystem science and practice. The project is focused on ecosystem services (ES) and natural capital (NC) science and on enabling stakeholders to apply these concepts in practice. Profiting from existing databases assembled in the frame of research and monitoring activities at the LTSER platform, the Montado ecosystem was selected as a case-study of the OPERA's project. Our main goal within this research is to test decision-support tools and instruments to better capture and represent the concepts of ES and to validate the best practices to maintain their sustainable flow, while preserving biological diversity. The Montado is a unique agro-forestry ecosystem with high ecological and socio-economic relevance, generating a range of ES from provisioning (e.g. cork production, livestock husbandry and hunting) to regulation and maintenance (e.g. climate regulation) and cultural services (e.g. tourism). However, nowadays it is suffering from many pressures and drivers of change including rural abandonment, tree mortality, depreciation of cork market value, overgrazing and climate change. To assess impacts of management options on ES provided, several scenarios were defined (e.g. overgrazing or forest improvement) and their impact at the farm level is being assessed with decision support tools such as TESSA, ToSIA and INVEST. Special attention will be given to socio-cultural and economic valuation using choice-experiments through face-to-face and online surveys among Portuguese citizens. By bringing the ES/NC concept into practice we hope to increase manager awareness and to stimulate more sustainable management.

Simpósio 8. Isótopos estáveis em ecología: atravessando fronteiras entre disciplinas e escalas /Simposio 8. Isótopos estables en ecología: atravesando fronteras entre disciplinas y escalas

Sp8. Oral

Tracing the microbial uptake and trophic transfer of carbon and nitrogen in a Mediterranean forested stream using stable isotopes

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In forested headwaters streams, microbial uptake is the main entry carbon and nitrogen to the food web. Yet, the contribution of diverse stream compartments colonized by microbial biofilms to the dynamics of carbon and nitrogen remains unclear. To address these issues, a 7 days stable isotope tracer addition of 13C-acetate and 15N-ammonium was conducted in a headwater stream during autumn. The 13C and 15N signatures were examined in water column, basal resource compartments and consumers. Biomass and standing stocks were estimated for each compartment. In the water column, a strong decrease in the carbon and nitrogen isotopic values indicated a high and similar uptake efficiency for both elements. Detrital compartments dominated the total carbon and nitrogen standing stock and had the main role in their uptake. In particular, leaf litter had the highest contribution to carbon and nitrogen uptake. Consumers, including predators, also became labelled, with Lymnaeidae as the most labelled family. Overall, our results suggest that leaf litter had an important contribution to the uptake and transfer of carbon and nitrogen from the water column in forested headwater streams.

Sp8. Poster

Fate of atmospheric nitrogen depositions within heathland ecosystems of the Cantabrian Mountains using 15N tracer

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The fate of N atmospheric deposition in Cantabrian heathlands (NW Spain) dominated by *Calluna vulgaris* (L.) Hull remains still uncertain. Therefore, the objective of this paper was to identify and quantify N storage patterns among the different heathland compartments by 15N tracer experiment. Four replicated plots were established to analyze the 15N partitioning among the different compartments analyzed (aboveground biomass of *Calluna*, soil horizons, soil microbial biomass and leaching) using a 15N tracer pulse addition. This study was carried out during two years. Total 15N tracer recovery was 72% in the first year and 5% in the second year. Most of 15N was recovered in the soil in both years, mainly in the O-horizon. All soil horizons changed their behavior from N sinks in the first year to N sources in the second year. 15N losses by leaching were negligible for two years, suggesting that the ecosystem is not saturated in N. Low 15N tracer recovery was found in the new and old shoots of *Calluna*, with no significant differences between the two years. The soil microbial biomass acted as a N sink for the two years, making up 50% of the 15N recovered in the O-horizon in the second year. This study demonstrated that Cantabrian heathlands are able to immobilize N, suggesting that they are not in N saturation phase.

Sp8. Poster

Acorn morphology and isotopic analysis as a tool to integrate the relations between long-term climatic variables and ecological processes influencing plant development and physiology in two *Quercus species* from Montado ecosystems

Costa, C.[1], Oliveira, T.[1], Antunes, C.[1], Silva, A.[1,2], Pinho, P.[1,3], Ramos, A.[3], Pereira, M.[3], Branquinho, C.[1], Santos-Reis, M.[1], Correia, O.[1], Máguas, C.[1]

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Plant responses to climate change highly depend on temporal variability of precipitation and plant specific strategies, ex. drought tolerance and resilience. Within different plant organs, seeds became an important research tool to study plant development and nutrient allocation, given their ability to accumulate nutrient compounds. Light stable isotopes (13C, 15N, 18O) of plant materials are used to study physiological and ecological processes like nutrient uptake, metabolism, nitrogen source and symbiotic associations, providing outcomes from ecology to food traceability. The isotopic fingerprint of seeds yields relevant information on plant eco-physiology and can act as a proxy to understand complex environmental processes, ex. land degradation or climate change. Montados are unique landscapes from the Mediterranean basin dominated by *Quercus suber* or *Q. rotundifolia*. Multiple forest uses and biodiversity richness give these landscapes a high conservation value. Acorns were collected from both oak species in the LTSER Montado platform, accordingly to soil land-use, aridity and desertification indexes. We combined seed morphology and biochemical compounds quantification with isotope ratio mass spectrometry as a "tool" to study changes in plant eco-physiology over time and space. Our results indicate a relationship between seed morphology and both temperature and precipitation, and a correlation between d15N and precipitation - a major climatic variable influencing seed carbon allocation and nitrogen uptake. Moreover, best correlations were found with climatic variables integrated over long-term periods. These results may contribute to mitigation programmes in degraded areas with problematic plant regeneration, and ultimately, to understand the application of stable isotopes approaches in Montados.

Sp8. Oral

Impact of land-use changes on tree physiology: using stable isotopes as proxies in a Montado ecosystem

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Sown, biodiverse, legume-rich improved pastures have been implemented in the understory of Portuguese Mediterranean-type agroforestry systems – the Montados - with evergreen oaks, such as cork oak (*Quercus suber* L.), as the dominant tree species. The recent expansion of these pastures as a consequence of national climate-change policy incentives, calls for a thorough understanding of their impact on the Montado ecosystem, including possible changes in the physiology and productivity of co-occurring cork oak trees. In this case-study, we examined a suite of leaf-level physiological and morphological traits, including 15dN and 13dC signatures, in cork oak trees from a pair of adjacent natural and improved pastures at an LTER site in South-Central Portugal, throughout different seasons. Both 15dN and nitrogen concentration in cork oak leaves were significantly different between pasture types across time. 15dN was consistently higher (less negative) in the improved pasture than in the natural pasture consistent with a higher percentage of legumes - and potential higher nitrogen fixation levels - on the improved side. Foliar nitrogen concentrations were similar across pastures at the beginning of the study with significant differences (levels higher in the improved pasture) arising later on. 13dC signatures, on the other hand, showed marked seasonal variation but were unaffected by pasture type, suggesting no changes in leaf-level water-use-efficiency with land-use conversion. These data will be discussed in the context of other measured variables and environmental parameters.

Sp8. Oral

Temporal uncoupling between soil and xylem water, a widespread phenomenon?

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The analysis of the isotopic composition of oxygen and hydrogen in xylem water presents a great potential to characterize the water flow along the soil-plant-atmosphere continuum. As a general rule, no isotopic fractionation occurs during water uptake and water transport, thus, xylem water is assumed to reflect source water. However, apparent isotopic divergences between xylem and soil water are often found in the field. Here, we present different case studies showing evidence of a temporal uncoupling between soil and xylem water isotopic composition. In some cases, the uncoupling could be clearly linked to higher residence time of water in the xylem and subsequent evaporation in branch and/or fractionation during storage in the stem. This has been observed in dry ecosystems during summer drought, as well as in temperate ecosystems during winter dormancy. In other cases, the existence of a tightly bound water pool in the soil appears as the most likely cause for the apparent uncoupling between soil and xylem water for species showing active transpiration. Funding This study was funded by the Spanish Ministry of Science and Innovation through projects RESILFOR (AGL 2012-40039-C02-02), FENOPIN (AGL 2012-40151-C03-03), and the FPU fellowship for PMG (FPU12/00648), and by the Deutsche Forschungsgemeinschaft (contract numbers GE 1090/8-1 and 9-1).

Sp8. Oral

Tracking nitrogen pollution using d15N in lichens: potentials and limitations

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Biomonitoring methods based on lichen communities' shift, functional diversity and physiology have been used for decades to evaluate environmental quality and monitor environmental changes. Several authors explored the possibility of using isotopic signature in lichens to map atmospheric nitrogen deposition. However, the synergism between climatic and anthropogenic factors and the superimposition of multiple nitrogen sources prevented a clear conclusion on the topic. Different nitrogen's form (NH3, NH4+ or NO3-), distance from the source, time of exposure and deposition type (dry/wet) differently affect lichens. To investigate how these parameters influence lichen's isotopic signature, thalli of the sensitive Evernia prunastri and of the tolerant Xanthoria parietina were exposed for ten weeks to different forms (dry-NH3, wet-NH4+, wet-NO3-) and doses (16, 32 and 64 kg N ha-1 yr-1) of nitrogen under controlled conditions, and physiological parameters, total nitrogen and carbon, d15N and d13C were measured. In parallel, thalli of Cladonia portentosa (moderately sensitive) exposed to the same treatments for 11 years or 6 months were analyzed to investigate the role of time of exposure. Our results showed that: - lichen nitrogen content and d15N were correlated with the nitrogen dose of the N treatments; - lichen d15N tends to become similar to the source's signature; - different species showed different d15N in response to the same treatments, probably due to different cation exchange capacity; - nitrogen content and d15n were well correlated in case of long-term exposure. The potential use of lichen d15N as a surrogate of atmospheric nitrogen isotopic composition is discussed.

Sp8. Poster

Isotopic composition of C (ð13C) and N (ð15N) in leaves, roots and soil underneath of seven afforested tree species in the Guadiamar Green Corridor (SW Spain)

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The use of stable isotope measurements can help in our understanding of relationships between plants and their environment, like the strategies for plant-resource acquisition, plant interactions with other organisms, and influence of plant species on soil functioning. Carbon isotopic ratio (ð 13C) is a useful index for assessing intrinsic water use efficiency (WUE), i.e. the ratio of carbon acquired to water vapor losses via stomatal conductance. Values more negative of ð 13C are associated with a lower WUE. Natural nitrogen isotopic ratio (ð15N) in soils and plants is used for studying the transformation of nitrogen compounds in soils, determining the sources of nitrogen for plants, and assessing the contribution of symbiotic nitrogen fixation to the nitrogen budget of ecosystems. This work aims to analyze the effects of different afforested tree species growing under common environmental conditions in the Guadiamar Green Corridor, after a mine-spill and subsequent soil clean-up and remediation. Seven species with contrasted leaf habit were selected: three deciduous (*Populus alba, Celtis australis, Fraxinus angustifolia*) and four evergreen (*Quercus ilex, Olea europaea, Ceratonia siliqua and Pinus pinea*) The isotopic composition of carbon and nitrogen was analyzed in plant tissues and in the soil underneath at different depths. We tested the differences among tree species as well as the differences among plant tissues and soil depth and their implications on nitrogen and carbon cycles of the ecosystem.

Sp8. Oral

Geoecohydrological mechanisms in semiarid tropical forests: spatial and temporal use of water by coexistent forest species

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Semiarid regions already facing strong water stress is likely to rise as rainfall patterns changes, associated to climate change, are becoming more variable. These changes, are going to cause a general decrease of forests in regions where drought is increasing in duration and severity. In particular sensible species such as pine and oak to environmental variations are going to be jeopardized by these changes. In this study we examined through isotopic ecohydrology, ecophysiology and geophysical exploration techniques, strategies and adaptation mechanisms of *P. cembroides* and *Q. potosina* coexisting tress in a semiarid tropical forest growing on top of very shallow and rocky soils. The semiarid tropical forest also exhibited a strongly coupled hydrology between shallow rocky soils (12 cm) and trees, as well as the coexistence of species in this mixed forest, where oak facilitates water access to pine.

Sp8. Oral

Modulating factors of tree responses to rising atmospheric CO2. Insights from long-term patterns of tree-rings d13C.

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Global atmospheric CO2 increase has been related to enhanced growth and water use efficiency (WUE) in several tree species. Nonetheless, our ability to forecast long-term effects of CO2 rise on forests production is still limited. Despite we have strong evidence about a worldwide increase on tree WUE during the last century, the rate and its relationship with enhanced tree growth are highly variable, suggesting the interacting effect of several modulating factors. This study summarizes long-term changes on tree-rings d13C from different tree species and their relationships with potential modulating factors (climate, land-use, and forest structure). We analyzed tree growth and WUE of *Cedrus atlantica* in Morocco along a latitudinal climate gradient interacting to contrasting land degradation (overgrazing, pollarding, logging, etc.). We compared tree growth and WUE for Abies pinsapo from South Spain and Northern Morocco, illustrating different land-use effects on CO2 responses, as they are two similar ecosystems, related to environmental conditions, but subjected to contrasting land-use changes: management restraint in Spain against traditional land-use and minor perturbation regime in Morocco. Finally, we studied tree growth and WUE in Pinus ponderosa plantations along an aridity gradient in Southern Patagonia (Chile), quantifying the interacting effects of water availability and CO2 rise. Our results support an overall increasing trend in WUE related to global CO2 rise, according to prior observations, but this common response was mainly modulated by land-use, specifically by the effects of forest management on tree age structure and tree-to-tree competition process.

Sp8. Oral

Stable Isotopes as Tracers of Ecosystem Water Management

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Water is a vital resource for the maintenance of our society; we need pure water for human consumption as well as a plentiful supply for agricultural practices. Our management of water resources is critical in virtually any geographical region of the world. In addition, the relationship between ecosystems and their water resources is tightly knitted, with water being the conduit of nutrients as well as a regulator of carbon fixation. The ability to trace water flow and compartmentation in ecosystems would be a great asset in accessing water management practices and ecosystem stability. Fortunately, there are natural isotopologues of water which are found at different concentrations in different ecosystem compartments, and they are ideal tracers for water flow and compartmentation. Here, I demonstrate with 4 examples how stable isotope analysis of water is useful in tracing water management by humans and ecosystems.

Simpósio 9. Genética populacional no contexto ecológico e evolutivo /Simposio 9. La genética de poblaciones en un marco ecológico y evolutivo

Sp9. Oral

Polyploidy as a mechanism of rapid sympatric speciation: understanding the ecological processes in the initial stages after polyploid formation

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Polyploidization has long been recognized as a major mechanism of rapid sympatric speciation. One of the first steps in the study of polyploidy is the knowledge of the diversity and geographical distribution of cytotypes in nature. Significant advances in this field have been fueled by the ability to rapidly and easily screen thousands of individuals using flow cytometry. The spatial arrangement of the cytotypes within species can be characterized as sympatric, parapatric or allopatric depending on whether they grow intermixed, adjacent or disjunct, respectively. The patterns of ploidy distribution in situ reflects, among others, the dynamic of genome duplication and the nature of contact zones, the ecological preferences of different cytotypes and their dispersal abilities. Thus, such information can be used to build ecologically-driven hypotheses aimed at understanding the evolutionary processes involved with polyploidy establishment and spread. During the last two years, we gathered relevant phytogeographical data of cytotype distribution in several polyploid complexes at contact zones of Iberian Peninsula, such as Blackstonia, Gladiolus and Jasione complexes. The obtained results show different contact zones scenarios suggesting that different ecological pressures were involved in each system, including allopatric distributions pointing to niche differentiation, parapatric distributions suggesting minority cytotype exclusion, and sympatric distribution suggesting recurrent polyploidy formation and dynamic contact zones. These distribution patterns are discussed and used as ground for future hypotheses aiming at disentangling the contribution of genome duplications to ecological divergence and, consequently, to the establishment and persistence of new polyploid lineages in nature.

Sp9. Oral

Why ecologists are enjoying NGS

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Community dynamics of species can be better described by using a holistic framework in which functional, ecological, and phylogenetic aspects of biodiversity are studied simultaneously. Next-generation sequencing (NGS) technologies offer unprecedented tools to develop such an approach. However, the challenge of using genomic data can be strenuous for ecologists given that this implies learning new laboratory and bioinformatic methods: the construction of genomic libraries and the interpretation of NGS data. In this talk I will discuss how NGS data can be used to estimate diversity and how genomic tools can be integrated in nature conservation studies. I will review different genomic approaches which are being incorporated into ecology, for example: the performance of genotype-phenotype-demography maps; the combination of macroecological data with phylogenetic methods in community ecology; or the use of macroevolution in conservation research, which can help establishing criteria used to set conservation priorities. To support ecologists in the development of their NGS projects, specialised companies -such as AllGenetics- have become available. Outsourcing this genomic work is an alternative which is gaining followers in the ecological community. In the talk I will also present some examples of projects carried out in our lab to illustrate how you can start enjoying NGS.

Sp9. Oral

Ecological determinants of mating patterns in populations under different landscape contexts

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Good knowledge of plant mating system is fundamental to understand the genetic consequences of habitat fragmentation. In this study we evaluated mating system patterns and its determinants on two Mediterranean shrubs, *Myrtus communis* L. and *Pistacia lentiscus* L., with distinct life history traits. For each species, using microsatellite markers, we estimated mating system parameters in six landscapes with contrasted levels of habitat fragmentation and isolation, and we also considered the impact of the local environment of each individual. Populations of the insect-pollinated and self-compatible species, *M. communis*, displayed low rates of outcrossing (tm = 0.61) and high rates of biparental inbreeding (tm-ts = 0.21), correlated paternity (rp = 0.51). Yet, the wind-pollinated and dioecious species, *P. lentiscus*, presented low values of correlated paternity (rp = 0.10) and relatively high values of biparental inbreeding (tm-ts = 0.21). Moreover, the mating system patterns were also influenced by distinct landscape and ecological factors. While correlated paternity was influenced by conspecific neighbourhood density and flowering phenology in *M. communis*, in *P. lentiscus* we detected the influence of the landscape context, edge effects but also flowering phenology. Conclusively, our study confirmed the complexity of generalizations, the idiosyncratic behaviour of species and the context-dependency of these patterns, highlighting the importance of multi-scale and multi-species investigation of mating system variation.

Sp9. Oral

Habitat fragmentation effects on parental correlations in the seed rain of *Pistacia lentiscus*: implications for the dispersal processes

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The interplay between pollen and seed movement determines the genetic structure of seedling cohorts and, ultimately, genetic variation within and among plant populations. In this study, we use parental correlation analysis (i.e. probabilities of paternal and maternal identity among seed pairs) to investigate how pollen and seed dispersal processes contribute to create fine-scale spatial genetic structure at ecological time scales in the Mediterranean shrub species *Pistacia lentiscus* (Anacardiaceae). In addition, we assessed potential differences in parental correlations associated to anthropogenic habitat fragmentation by comparing the results obtained in connected vs. isolated forest fragments. We found (i) stronger interanual variation in maternal than in paternal contributions to dispersed seeds, which is likely related to masting effects; (ii) consistently lower paternal than maternal correlation (and thus a larger effective number of fathers than mothers) among dispersed seeds across all fragments; (iii) similar numbers of effective mothers in connected and isolated forest fragments; and (iv) higher probabilities of parental identity for seed pairs dispersed under *Pistacia* plants and under tree canopy than in other microhabitats, probably due to the feeding behaviour of bird dispersers, namely fruit ingestion in the maternal plant and subsequent defecation under favourite perches.

Sp9. Oral

Prioritizing populations to conserve the evolutionary potential of *Astragalus edulis* Bunge, an endangered plant species from Western Mediterranean region

Peñas De Giles, J.[1], Barrios De León, S.B.[2], Bobo-Pinilla, J.[2], Lorite, J.[1], Martínez Ortega, M.M.[2]

(1) Universidad de Granada, (2) Universidad de Salamanca.

Astragalus edulis (Fabaceae) is an endangered annual species from the western Mediterranean region that colonized the easternmost Macaronesian islands (SE Iberian Peninsula, NE and SW Morocco, Lanzarote and Fuerteventura). Although in Spain some conservation measures have been adopted, it is still necessary to develop an appropriate management plan to preserve genetic diversity across the entire distribution area of the species. Our main objective was to use population genetics, ecological and phylogeographic data to select Relevant Genetic Units for Conservation (RGUCs) as the first step in the designing of conservation plans for *A. edulis*. We identified six RGUCs for in situ conservation, based on estimations of population genetic structure and probabilities of loss of rare alleles. Additionally, further population parameters, i.e. occupation area, population size, vulnerability, legal status of the population areas, and the historical haplotype distribution, have been considered to establish which populations deserve conservation priority. Three populations from the Iberian Peninsula, two from Morocco and one from the Canary Islands represent the total genetic diversity of the species and the rarest allelic variation. Ex situ conservation is recommended to complement the preservation of A. edulis given that effective in situ population protection is not feasible in all cases. We show that the comprehensive consideration of complementary phylogeographic and ecological data helps to prioritize those populations which better contribute to preserve. The information generated for the species could be adapted to species that have similar types of life history traits in the Western Mediterranean region.

Sp9. Oral

Phylogeography of the palaeoendemic species *Arenaria balearica* L. (Caryophyllaceae): Additional data on the evolutionary history of the flora of the Western Mediterranean continental islands since the Oligocene

Peñas De Giles, J.[1], Bobo-Pinilla, J.[2], Barrios De León, S.B.[2], Seguí Colomar, J.[2], Fenu, G.[3], Bacchetta, G.[4], Martínez-Ortega, M.M.[2]

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Although it has been traditionally accepted that *Arenaria balearica* could be a Tertiary relict plant species, this has never been experimentally tested. Nor have the palaeohistorical reasons underlying the highly disjunct distribution of the species in the Western Mediterranean region been investigated. We have analysed AFLP data and cpDNA sequences from a total of 223 plants from 29 populations sampled along the entire distribution range of the species in Majorca, Corsica, Sardinia, and Tuscan Archipelago. The AFLP data analyses indicate very low geographic structure and population differentiation. The star-like topology of the parsimony network based on cpDNA data suggests that all haplotypes were derived probably in situ from a single ancient one. Altogether, our results point to an Early Oligocene origin of *A. balearica*, the present-day distribution of which is consistent with the fragmentation of the Hercynian massif in the Tyrrhenian area. Further post-Oligocene -either Miocene or Plio-Pleistocene- inter-island contacts in *A. balearica* seem to have been restricted to populations from Corsica and Sardinia. The overall low levels of genetic diversity and cpDNA variation found seem to be in correspondence with the morphological constancy of the species among populations distributed in different continental fragments in locally long-term stable habitats. Our study contributes with additional information about the complex phylogeographic patterns within the Mediterranean region, and allows predicting the potential response of some species in context of climate change.

Sp9. Oral

Evaluating the effects of global climate change on loss of genetic diversity: the case of the annual plant *Arabidopsis thaliana* in the Iberian Peninsula

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It is expected that several species will not be able to keep pace with predicted climatic conditions, experiencing substantial shifts in their geographical patterns and a generalised genetic impoverishment of their populations. The main cause of such a loss of genetic diversity deals with changes in the spatio-temporal distribution of genetic variants. This is important because genetic diversity represents the basis for any adaptive change to new environmental conditions. Thus, efforts to understand the consequences of global climate change on biodiversity must focus on intra-specific genetic diversity. Here, we show how species distribution models adapted to intra-specific genetic units based on different sources (neutral SNPs and evolutionarily important phenotypic traits) represent a powerful tool to better understand the effect of global climate change on loss/changes in genetic diversity. The rationale is that intra-specific genetic units are expected to better capture the heterogeneous demographic and adaptive history of a species across its distribution range. Here, we use a collection of populations of the annual plant *Arabidopsis thaliana* in the Iberian Peninsula including ca. 400 populations. Such a collection has long been characterised with nuclear and chloroplast SNPs, genes from different regulatory genetic pathways accounting for flowering time, and life-history phenotypic traits from greenhouse and natural field settings. Overall, our approach allows the quantification of loss of genetic diversity with global climate change. Furthermore, based on the results, we also hypothesise about the genetic composition of Iberian A. thaliana populations in a future scenario dramatically affected by global climate change.

Sp9. Poster

Demographic and adaptive inference from temporal changes in the genetic and phenotypic composition in populations of the annual plant *Arabidopsis thaliana*: a 10-year study

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The temporal scale in population biology is extremely important to comprehensively understand the performance and dynamics of natural populations. Furthermore, temporal surveys represent essential elements to parameterise demographic and genetic models and obtain realistic outcomes. However, there exists a limited knowledge and empirical evidence on the extent of such temporal variation because temporal data requires time and appropriate experimental designs. Our contribution aims to bridge this gap of knowledge using the Iberian collection of the annual plant Arabidopsis thaliana. This collection was initiated in 2003. Today, the collection includes ca. 400 populations across Portugal, Spain and Morocco. We selected four populations that were fully characterised in 2003/2004 with neutral markers, flowering genes and phenotypic variation for flowering time. These populations were sampled again in 2012/2013. Seeds from individuals from 2003/2004 and 2012/2013 have been grown again and characterised with the same markers (nuclear SSRs, flowering genes) and characters (variation in flowering time). Molecular data will be used to estimate temporal changes in allelic frequencies to compute meaningful demographic parameters. This will allow the understanding of the role of important processes (drift, selection) shaping the genetic composition of populations. Furthermore, we will quantify temporal changes in genes affecting flowering time (FLC and FRI) that will be related to phenotypic changes for the same character. Finally, a common garden experiment is being conducted to assess the magnitude of temporal changes in life-history traits. Overall, the results will help understand the magnitude of temporal changes in demographic parameters and their consequences.

Sp9. Poster

Genetic variation of *Juniperus phoenicea* subsp. *turbinata* across its Western distribution range

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Juniperus phoenicea L. is a small monoecious or dioecious tree with a range covering the whole Mediterranean region, from the Canary Islands, the Atlas mountains in Africa and the Atlantic coast of Portugal in the West, to Jordan and Saudi Arabia in the East. The subsp. turbinata is most widespread in the western part of the Mediterranean Basin. It grows in the Atlas Mountains and coastal sand dunes of Spain and North Africa and it is the only subspecies present in Portugal, Madeira and Canary Islands. Their populations show a variable conservation status, from well-preserved forest (e.g. Essaouira in the Moroccan coast) to highly degraded forests (Canary Islands). We investigated the genetic structure and diversity of eight *J. phoenicea* subsp. *turbinata* populations from the Iberian Peninsula, Canary Islands and Morocco. We examined whether the spatial distribution of the genetic variation respond to an isolation by distance scenario (IBD) or rather is highly influenced by geographic barriers (Isolation by Barriers) or environmental factors (Isolation by Environment). Estimates of genetic diversity were very similar in all populations and inbreeding was detected only in the population from La Gomera (FIS=0.30). Discriminant Analysis of Principal Components (DAPC) showed that the eight sampled populations correspond to five genetic groups, but most populations conserved their integrity. We found evidence of isolation by distance but no spatial autocorrelation when considering all populations. Isolation by Ecology played a role in defining the distribution of genetic diversity in the studied range.

Simpósio 10. Ecologia de espécies exóticas invasoras: processos, impactos e gestão /Simposio 10. Ecología de especies invasoras: procesos, impactos y gestión

Sp10. Oral

The New Zealand mudsnail (*Potamopyrgus antipodarum*): ecological impacts and distribution of this exotic species

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(1) Universidad De Alcalá.

Biological invasions are one of the main causes of biodiversity lost and a relevant economic problem. Given the complexity of the invasion processes, some species have shown invasive behaviour in some ecosystems but not in others. A species with an ambiguous invasive behaviour is the New Zealand mudsnail (*Potamopyrgus antipodarum*). This snail has been reported in Europe, America, Australia and Asia, invading a wide variety of ecosystems. This species has been recently included as an invasive exotic species in Spanish law, which makes necessary the management and the knowledge of its distribution in Spain. In this study we have reviewed the distribution and ecological impacts of this species at worldwide, with especial reference to the Iberian Peninsula. In Spain this species has been cited in 30 out of the 46 provinces, whereas in Portugal it has been cited in 6 out of 18. Most of the affected provinces are in the coast, especially in the provinces with the oldest quotes. Among the most important impacts caused by this species are its ability to change the structure of the invaded invertebrate communities. However, such impacts have not been reported in some case studies. The present review shows a lack of studies on the dispersal mechanisms of mudsnail throughout the Iberian Peninsula. This is an essential point to prevent the spread of this species throughout the aquatic ecosystems of the Iberian Peninsula.

Sp10. Poster

Survival of an invasive aquatic snail to air exposure at different scenarios of overland translocation: implications for spreading

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Invasive species are a threat to aquatic ecosystems worldwide. Aquatic snails have a limited ability for an active dispersal. Therefore, their ability to survive to transport by non-water mediated pathways may help to explain their spread across unconnected habitats. We assessed the ability of New Zealand Mud Snail (NZMS) (*Potamopyrgus antipodarum*) to survive after non-water exposure attached to different materials. Two studies were conducted: 1) a laboratory study to assess the tolerance of a laboratory population of NZMS to air exposure attaching snails to leaf litter, sediment and clay and 2) a field-laboratory study to assess the survival of an invasive natural population after being exposed to air exposure in the laboratory and subsequently transferred to a new river reach. Our results showed that in the laboratory all animals died after 3 days of air exposure in leaf litter, while in the case of sediment and clay all snails died after 5 days. The mortality of the field population was higher than that of the laboratory populations. We conclude that NZMS can be dispersed by non-water-mediated mechanisms, and has a high tolerance to translocation between reaches with contrasting environmental properties.

Sp10. Oral

Can invasibility of Azorean habitats overcome the invasiveness of *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae)?

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Invasion by *Harmonia axyridis* is considered an extreme case of successful adaptation of an alien insect to new areas. This aphidophagous predator is a large generalist species with a high capacity of dispersion, able to survive at low levels of a limiting resource, and producing a strong propagule pressure. Its establishment in new areas has often caused negative impacts in the ecosystems, leading to the displacement and even extinction of native ladybird species. The predator was several times released into the Azores archipelago (Portugal) in the 1980s' but regular samplings indicate that the species did not establish. It is hypothesized that a low diversity of highly fragmented habitats with reduced food resources does not favor the establishment of large sized ladybirds. In São Miguel island, predator and prey species abundances were assessed in 4 habitats corresponding to an increasing gradient of food resources: pasture, woodland, corn crop and coastal prairie. Each habitat was characterized according to the number, area and distance between fragments. Our results showed that more than half of the island area consists of unsuitable habitats for ladybirds (pasture and woodland) whereas the habitat with the highest biodiversity and abundance of predator and prey, the coastal prairie, is composed by a reduced number of small fragments and accounts for less than 1% of the island area. The present Azorean ladybird community seems to mirror the habitat profile of the islands: small species are dominant with medium sized species being rare and large species absent.

Sp10. Poster

Invasion by three non-native trees of Spanish riparian forests

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(1) UAH.

We assessed the invasion of Spanish riparian habitats by *Ailanthus altissima* (Mill.) Swingle, *Robinia pseudoacacia* L. and *Ulmus pumila* L. The banks of the Henares and Oria rivers and a stretch of the middle Ebro River were surveyed to locate all the stands of these three species. Origin (planted/spontaneous), size, density and habitat characteristics (biotic, abiotic and human influence) of every stand were considered to determine the degree of invasion of each zone and species. Data on stand and habitat characteristics were also collected. The degree of invasion was greater in the Henares River banks, where human influence and propagule density were higher. Each species showed a greater degree of invasion in a different study area. All three species coexist in habitats with high light availability, low competition and strong human influence; however, they may also occur in areas with a very dense canopy. Differences in habitat characteristics between planted and spontaneous stands could largely be explained by specific dispersal mechanisms operating at each species.

Sp10. Oral

Changes in reproductive success but no in selfing ability explain the invasive success of *Acacia longifolia* (Fabaceae, Mimosoideae)

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The reproductive biology of exotic species affects their capacity to become naturalized and invasive in non-native areas. Selfing is a common trait in many invasive plants because it provides reproductive assurance under low availability of pollination vectors and sexual partners. Nonetheless, the predominantly self-incompatible Australian *Acacia* species are among the most aggressive plants worldwide. To address if there have been changes in selfing ability and natural reproductive success of *A. longifolia* during invasion we studied floral traits, fruit set and offspring traits, for selfing and open-pollination treatments, in native (Australia) and invaded areas (Portugal). Within each pollination treatment, no differences were found between areas suggesting that the level of self-compatibility has not changed during invasion. However, the number of aborted seeds and seed size were significantly different between pollination treatments in Australia but not in Portugal. There were significant differences in the number of seeds per pod and in seed weight between ranges. A lower number of aborted seeds, a higher number of full-developed seeds and greater seed size were found in the invaded area for both pollination treatments. In spite of the low selfing ability of *A. longifolia* in the invaded area, there were changes in the quantity and size of the seeds produced in the new region, even for self-pollinated fruits, which might contribute to *A. longifolia* invasiveness.

Sp10. Oral

Alteration of nitrogen cycling as a result of invasion

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(1) Universidad de Alcalá.

The invasion of ecosystems by exotic species may alter the nitrogen (N) cycle through different non-exclusive mechanisms. Dramatic alterations occur when the invasive species possesses a new strategy to acquire this nutrient, such as N2 fixation ability. Gradual alterations are due to changes in the utilization of N with respect to dominant natives, e.g. changes in N allocation patterns which affect the chemical composition of tissues and therefore the decomposition and min-eralization processes. Changes in the fire regime mediated by plant invasion may also have a profound effect on the N cycle. Finally, alteration of the trophic struc-ture caused by the invasion of exotic animals is another mechanism of N cycle change. Published syntheses suggest that, altogether, plant invasions tend to in-crease N pools and to accelerate N fluxes of the invaded ecosystems. However, particular impacts are highly dependent on the context and therefore difficult to predict. A critical review of these syntheses shows that the available literature on invaders' impacts is highly biased in the selection of species, impact metrics and ecosystem type. These biases suggest that, in spite of the great advances to under-stand the impacts of invaders on the N cycle, more information is needed for a full understanding of this ecosystem disturbance.

Sp10. Poster

Integration of ecological impacts by invasive exotic plants: a methodological approach

Castro Díez, P.[1], Alonso Fernández, A.[1], Gutiérrez López, M.[2], de las Heras Puñal, P.[2], Medina Villar, S.[1], Pérez Corona, E.[2], Trigo Aza, D.[2], Rodríguez Vazquez de Aldana, B.[3]

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In Spain as in Europe there are too many invasive alien plants to address their management, so it is necessary to give priority to the most harmful species. But this requires the use of quantitative, systematic and comparable impact measures. The information available is uneven in terms of the criteria and variables to measure impacts and, therefore, difficult to integrate. We propose the following method to integrate measures of impacts from different studies: 1) search for case studies, 2) calculation of effect sizes; 3) classification of cases by level of organization, 4) integration of all effect sizes for each species and level of impact with meta-analysis techniques, and 5) estimate a consistency index (based on the heterogeneity among cases) and of reliability (based on the number of cases). We apply this method to estimate the impacts in Spain of three invasive trees (*Ailanthus altissima, Robinia pseudoacacia* and *Ulmus pumila*). We found 50 cases for A. altissima, 39 for R. pseudoacacia and 15 for U. pumila. The impacts at the ecosystem level (fertility) were the most studied, while the community or the individual level are less documented. Robinia pseudoacacia tends to increase fertility, while *A. altissima* does not alter this property. The proposed methodology has the advantage of allowing an impact assessment using data from disparate studies, but its application is limited by the availability of case studies.

Sp10. Poster

Quantifying *Acacia longifolia* flowers through Unmanned Aerial Vehicles

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Invasive Alien Species (IAS) are one of the main causes of biodiversity loss worldwide, costing the EU 12 to 20 billion Euro/ year. *Acacia longifolia*, introduced in Portugal in the end of the 19th century to mitigate dune erosion, is currently the most widespread invasive plant in Portuguese coastal systems. This species produces a prolific long-lasting seed bank which prevents successful control and implies continuous efforts to control plant dispersion. The use of a biocontrol agent (*Trichilogaster acaciaelongifoliae*) that significantly reduces flowering, and consequently seed formation, is currently being investigated in Portugal. The present work aimed to identify and map the distribution of *A. longifolia* in coastal areas using imagery collected with an Unmanned Aerial Vehicle (UAV); additionally, it aimed to quantify plant flowering since flower reduction can be used as a proxy of the establishment of the biocontrol agent. The efficiency of this novel methodological approach was tested in several locations representing different land cover classes/habitats where the invasion by this species is commonly observed. Results showed that while flowering quantification was hindered in forests dominated by Pine trees, in habitats where *A. longifolia* was predominantly uncovered the quantity of flowers could be successfully be estimated. This study outlines the possibility of using UAV's technology to map and quantify the flowering of *A. longifolia* and demonstrates the usefulness of this tool to monitor the establishment of *T. acaciaelongifoliae*.

Sp10. Poster

Phenotypic Plasticity of the invasive grass *Arundo donax* in the Iberian Peninsula

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Phenotypic plasticity is the ability of organism to show different appearances in response to the environment in which it is located. This plasticity allows the plant to adapt to specific circumstances, thus favoring its development and local adaptation to specific environmental conditions. This flexibility is the key to many of the alien species that colonize new ecosystems presenting invasiveness behaviour. In the research presented have been studied different populations of the grass Arundo donax, alien species in the Iberian Peninsula that presents invasive behaviour, especially in Mediterranean river ecosystems where it reproduces clonally. The objective of the experiment was to study the phenotypic plasticity that present the most representative populations of the Iberian Peninsula to determine the relationships that can exist between morphological traits that are expressed and the environmental characteristics of each of the studied environments and to what degree. This allows us to clarify what are the features that allow adapt and optimally to colonize different environmental situations to which the plant is subjected, delving into their evolutionary ecology and biological fitness. The results have shown that the species is able to adapt favorably to a wide range of environmental conditions on the Iberian Peninsula, showing significant differences in the expressed morphological features (height, diameter and density growth), being able to withstand various water stress in its early stages and withstand high concentrations of nutrients.

Sp10. Poster

Invader vs. Invader: potential of *Acacia dealbata* against *Bursaphelenchus xylophilus*

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In 1999, a new invader was detected in Portugal: *Bursaphelenchus xylophilus*, the pine wood nematode, native from the United States of America. Besides all the attempts to control this nematode, it is still destroying the pine forest, specifically the maritime pine, causing economical serious problems. Another alien invasive species present in Portugal is *Acacia dealbata*, the silver wattle. Native from Australia, it is present in Europe since the nineteenth century, causing economic impact on invaded forests, decreasing productivity. Control involve enormous economical costs, mainly because several follow up control actions are needed. On the other hand, the use of a chemical herbicide, glyphosate, is needed, potentially causing environmental and human health negative impacts. Nevertheless, the genus *Acacia* has allelopathic properties, and several uses were reported for their secondary metabolites. Thus, searching for sustainable alternatives to control biological invaders and simultaneously to reduce the impact of synthesized chemical compounds use are important targets. *Acacia dealbata* does not seem to be affected by natural enemies in Portugal and other species of the genus were nematicides. Then, the present study aims to investigate the nematicidal effect of extracts from various parts of the plant on *Bursaphelenchus xylophilus*. To accomplish this goal, in vitro assays will be conducted by transferring twenty nematodes to an excavated glass block with 0.5 mL, for each of the different treatments. Distilled water will served as control. Five replicates will be performed for all treatments and for control. Observations will be made at 24, 48, 96 and 168 hours.

Sp10. Oral

Acacia longifolia and plant-gall networks in Portugal: Evaluating the impacts and planning biocontrol.

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Acacia longifolia is one of the worst invasive plants in Portugal; it is widely distributed along coastal areas where has significantly changed plant communities and soil ecosystem functioning. Its control is mostly based on expensive mechanical methods, which are often unsuccessful due to extensive long-lived seed banks accumulated in the soil. Biocontrol of *A. longifolia* by the gall-wasp *Trichilogaster acaciaelongifoliae* has been successfully used in South Africa for more than 20 years and can be a promising option in Portugal. The agent induces formation of galls in flower buds which in turn significantly reduces flowering and consequently prevents seed production. In Portugal, specificity tests did not predict interactions with non-target plants. However, the indirect non-target effects remains underexplored. For other species, indirect effects on interaction-networks after the introduction of biocontrol agents have been seldom shown; still, the invasive plants themselves have probably changed interaction-networks beforehand and this need to be evaluated. Therefore, our first aim was to evaluate the impacts of the invasive *A. longifolia* on interaction-networks of plant-galls and associated communities. Interaction-networks from low, medium and highly invaded communities were compared. Results showed that *A. longifolia* causes negative bottom-up effects and severely change plant-gall interactions-networks, particularly by reducing species and interaction diversity, and increasing generalism and web asymmetry. These networks will be further used to: 1)characterise the reference situation pre-introduction of biocontrol agent; 2)identify native species (potentially) able to interact with *T. acaciaelongifoliae*, affecting biocontrol success; and 3)evaluate potential indirect non-target effects of the biocontrol agent on interaction-networks pre-release.

Sp10. Poster

European-native species can grow in soils invaded by *Acacia dealbata*: implications for restoration

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The woody legume *Acacia dealbata* Link is a tree native to Australia that has become an environmental problem worldwide forming monocultures and altering ecosystem processes. This invasive species reduces plant cover, richness and diversity in its non-native ranges. *A. dealbata* also increases soil nutrients and modifies the community structure of microbes and functional diversity of bacteria in invaded soils. Soil changes have been suggested to generate a positive feedback that favours this invasive species and, in turn, hamper the restoration of invaded areas. The present study aimed to evaluate the potential ability of European-native plant species for re-colonizing soils invaded by *Acacia dealbata*. We examined the growth of *Trifolium angustifolium, Lavandula stoechas, Cytisus striatus, Pulicaria odora, Cistus crispus* and *Pinus pinaster* in soils from native mixed forests and soils from adjacent sites invaded by *A. dealbata*. Plants were grown in a greenhouse during four months. *P. odora* had significantly higher total biomass in invaded than non-invaded soils, while the opposite trend was found for *C. crispus*. Total biomass of the other native species was not affected by soil type. Our results suggest that all tested native species may potentially colonize invaded soils after removing *A. dealbata*. However, species other than *C. crispus* seem to be more adequate for restoring purposes. No significant differences were found for the content of nutrients between both soils. Further work is needed to evaluate the re-colonization of invaded soils by native species under field conditions.

Sp10. Poster

Experimental study on the effectiveness of eradication methods for the invasive species *Elodea canadensis* at the Torrasa water reservoir

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E. canadensis is a North American invasive species found in the Torrassa water reservoir (Noguera Pallaresa river basin, NE Spain) for more than 20 years. Its presence has led to the alteration of habitats, competition and displacement of native plants (notably Hippuris vulgaris, an endangered species). In order to evaluate the effectiveness of several control methods, a study area was selected with approximately 100% coverage of macrophytes, being E. canadensis the dominant species (> 95%). A total of 29 study plots (area of individual plots: 4-35m2) were set within this area. A combination of mechanical removal of plants and different growth control methods (gravel coating or awnings placed on the reservoir bed, floating awnings and small fenced areas) were tested. Biomass, plant cover percentage data and morphometric measurements of plants were obtained from each plot to estimate the productivity of E. canadensis. Additionally, benthic fauna and substrate particle size were sampled to ensure uniformity across the study area. After verifying the normal distribution of the obtained values, an ANOVA analysis was used to assess significant differences between treatments on the productivity. Preliminary results show that the mechanical trimming and removal of plants is easily compensated by the quickly growing capacity of the species and therefore is only effective for a very short term. Treatments based on reservoir bed coverage had a relative success due to the high rates of sediment input that created a new layer of silt and allowed plant rooting.

Sp10. Oral

Allelopathic effects of invasive and native trees on herbaceous species: the role of soil as modulator.

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Alelochemical compounds released from different tissues of exotic invasive plants may affect germination and growth of native seeds. We aimed to compare the effect of two invasive trees (*Ailanthus altissima* Mill. Swingle and *Robinia pseudoacacia* L.) and two native riparian trees (*Fraxinus angustifolia* L. and *Populus alba* L.) on the germination of target herbaceous species. The role of soil as a modulator of allelopathic effects was also assessed. Leaf litter from the tree species was used to prepare aqueous extracts at different concentrations. The extracts were applied to herbaceous seeds placed on petri dishes with two kinds of substrate: paper and soil. We registered the percentage of seed germination, germination speed and radicle growth of the herbaceous target species. The effect of the different extracts depended on the target species. Invasive trees did not have a clear greater effect than native trees. In general, germination speed and radicle growth were more affected than the percentage of seed germination. The soil showed the capability to reduce the allelopathic effects, likely due to the degradation of allelopathic compounds by soil microorganisms. Our study highlighted the importance of using both, native and invasive species to relativize the effects of invasive species. In addition, under natural conditions the effects of allelopathic compounds would be less severe than under experimental conditions.

Sp10. Oral

Inter-regional hybrids and heritability of increased competitive ability and plasticity of an invasive species

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After introduction to non-native regions, exotic species often experience changes in resource allocation trade-offs ensuing dramatic improvements in competitive ability (EICA), which are often key in invasion success. However, little is known about the heritability of increased competitive ability, or on the role of reinforcement from the native regions in the maintenance of plasticity or competitive ability in the non-native regions. We used *Centaurea solstitialis* from both the European native and the American non-native regions and grew them in common garden conditions, manually crossed them in controlled reproduction experiments, and used the F1 generation of pure and inter-regional hybrid individuals to run one-to-one competition experiments with a generalist competitor grass present both at the native and non-native regions. Our preliminary results suggest that inter-regional hybrids present intermediate competitive ability, with moms being slightly more important in determining competitive success than dads. Our work is pioneer in using inter-regional hybrids to assess the heritability of competitive ability and plasticity, and suggest that reinforcement with new seed from the native region should not result in dramatic decreases in competitive ability of *C. solstitialis* in California, thus resulting in a minor selective force towards the potential development of reproductive barriers between native and non-native regions.

Sp10. Poster

Scenarios of the dispersal and invasion process of *Digitonthophagus gazella* (Coleoptera: Scarabaeinae) in the norther area of the Neotropical region

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The invasion process consists in overcoming certain biotic and abiotic barriers, resulting in negative effects on the biodiversity and functionality of the ecosystem. This is the case of the Indo-African dung beetle *Digitonthophagus gazella*, which was originally introduced in the United States to contribute with cattle excrement removal, a practice that was later adopted by other countries in Central and South America. The geographic distribution of this species has already been documented in North America, but in the Neotropical region the available information is scarce. In the search to understand the beetle's invasion of the Northern area of South America (Venezuelan and Colombian savannas) and evaluate its effect on local species, we collected the available information in zoological collections and bibliography. Five new state records are reported for Venezuela and four invasion scenarios are put forward for this species in the region. Although the amount of records has increased, the number of individuals sampled is still incipient. The possible areas of invasion and the potential negative effects that the presence of this species exerts in these regions are also discussed. Results emphasize the importance of generating models of the invasive process in order to design programs that monitor the effects incurred by the presence of *D. gazella* on native species and propose some specific control and mitigation mechanisms.

Sp10. Oral

Camphor vs. Pine Wood Nematode

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In today's world, evolution goes along with sustainability, looking to problems, such as the use of chemical synthesis pesticides in agriculture and searching for solutions that do not endanger the planet. Since 1999, the Portuguese forest, specifically the maritime pine has been struggling with a serious problem, the Pine Wilt Disease, caused by the Pine Wood Nematode (PWN), *Bursaphelenchus xylophilus*. So far, the control measures have been ineffective in controlling this invader species. Therefore, it is urgent to find effective and environmentally sustainable control methods to prevent the disease spreading to the whole Europe as well as to other potential host tree species. Based on this, the presented work aimed to study the nematicidal activity of *Cinnamomum camphora* on *Bursaphelenchus xylophilus*. In vitro assays were conducted to evaluate nematostatic and nematicidal effects of macerated camphor fresh leaf (1:5 and 1:10) as well as solutions of camphor essential oil (0.1; 0.2, 0.5; 1 and 2%). Control was made with distilled water. A nematicide used in Japan whose active substance is milbemectin was used as pattern. Twenty nematodes were transferred to an excavated glass block with 0.5 mL, for each of the different treatments. Five replicates were performed for all treatments and for control. Observations were made at 24, 48, 96 and 168 hours. The results indicate that, in a general way, camphor has nematicidal and nematostatic effect on Pine Wood Nematode. Thus, more detailed studies should be conducted to better understand this potential nematicide.

Sp10. Poster

The wild-rabbit (*Oryctolagus cuniculus*) as a facilitator of the invasiveness of *Carpobrotus edulis* in dune systems – implications to the conservation of an endemic species (*Corema album*)

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Corema album is an endemic shrub from the west coast of the Iberian Peninsula. It is an endangered species that has suffered a notable decline due to habitat destruction and degradation, as a consequence of urban development, tourism, forestation of the sand dunes and the impact of invasive species. It depends on animals for seed dispersal and seed germination for natural regeneration. Although still being the dominant species in the stabilized dune systems of Costa da Caparica, currently faces regression, a situation even more problematic with the introduction of the invasive *Carpobrotus edulis*. Both species produce fleshy fruits and are dependent on animal vectors for their dispersion, namely the wild-rabbit (*Oryctolagus cuniculus*). In this study we assess how the consumption of C. edulis fruits by wild-rabbits might contribute to a greater recruitment and invasiveness of this species and which are the implications for *C. album*. Our results indicate that both species provide a similar food resource, during the same time period, for the wild-rabbit, but *C. edulis* fruits seem to be preferred. Wild-rabbits are therefore an important key player of the studied dune systems, acting as a disperser and germination facilitator for *C. album*, and as a dispersal agent of *C. edulis*, though it diminished its germination. We propose a hypothetical model for the invasibility of *C. edulis* in dune systems, considering its implications for the management and conservation of these areas, including the conservation of *C. album*.

Sp10. Poster

Potential expansion of the invasive species *Pennisetum setaceum* (Forssk.) Chiov (Poaceae) in Andalusia (Spain)

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Pennisetum setaceum is a C4 plant species from dryer zones of northern and eastern Africa, and southeastern Asia. It has been widely used as ornamental and for soil stabilisation in many zones of the world, escaping from controlled areas, and invading natural habitats along great environmental gradients. Nowadays it's considered one of the plant species with higher invasive potential. In the Iberian Peninsula its introduction in gardens and roundabouts started in the 90'. At present, a large number of wild populations are recorded here, being Andalusia the region with the most populations registered. This could represent a potential threat to natural habitats, particularly in the southeastern driest ones. Our study attempts to estimate the potential distribution of P. setaceum in Andalusia, discussing some climatic and topographic variables which could influence its expansion. For that, we have used the free software Maxent, a technique widely employed due to its strength in predictions. Despite that this work have the difficulty to discern to that extent this species is where "it want to be" or where "it has been planted" (thus, it has not reached the equilibrium), by reducing the overfitting, we can lower this limitation, and then to obtain a coherent but also cautious approximation. Results showed that almost all the Andalusia Mediterranean coastline would be a suitable zone for *P. setaceum*. This species would endure very well severe dryness, and its expansion to the north would be limited to low temperatures. Steep orography would not be a restraint to its propagation.

Sp10. Poster

Filtered out toward opposing trajectories: contrasting functional patterns between indigenous and exotic arthropod assemblages under land-use changes in an oceanic island.

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Land-use change (LUC) has profoundly re-arranged the composition of biotas worldwide by facilitating the introduction of exotic species and causing indigenous extinction. It is now recognized that species respond to LUC according to their traits. Because species' traits influence ecosystem processes, special attention has been given to the consequences of species loss on functional diversity (FD). However, the consequences of exotic species addition on FD are still poorly understood. For instance, it remains unclear to what extent exotic species change the community functional properties and how it may translate in changes of ecosystem functioning. In this contribution, we evaluated how LUC affects the FD of indigenous and exotic arthropod assemblages in the disturbed oceanic island of Terceira (Azores). We selected broad traits related to resources-use that can be assessed throughout different groups of arthropods. We developed a null model approach to test for non-random assembly processes in FD and we examine how traits' composition varies within land-uses between both groups. Within indigenous and exotic assemblages, species were more functionally similar than expected by chance as the degree of disturbance increases. This suggests that similar assembly processes govern the functional structure of both groups. More importantly, we clearly demonstrated that indigenous differ significantly in their functional attributes from co-occurring exotic species indicating that indigenous and exotics adopt different ecological strategies to survive in highly disturbed habitats. These results indicate also that, in some circumstance, exotic species may contribute to maintain FD after the decline of less tolerant indigenous species following human-disturbance.

Sp10. Poster

Increased resistance to a root-knot nematode (*Meloidogyne javanica*) in invasive populations of *Oxalis pes-caprae*

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In the context of plant invasions, rapid evolutionary changes are often acknowledged as important determinants of success. Parasites are central components of biotic communities and may affect the establishment and spread of exotic plants. However, no studies have evaluated evolutionary changes concerning resistance to parasites in plant invaders. *Oxalis pes-caprae*, a geophyte native to South Africa, is a widespread invasive plant in Mediterranean climate regions. It invades mostly disturbed habitats such as agricultural areas, where the root-knot nematode *Meloidogyne javanica*, a major agricultural pest with a wide host range and worldwide distribution, also occurs. The objective of this study was to assess phenotypic differences between native and invasive populations of *O. pes-caprae*, regarding resistance to *M. javanica*. For this, a greenhouse experiment with inoculated and non-inoculated plants from both ranges was conducted. M. javanica was able to infect and reproduce on both native and invasive *O. pes-caprae* plants. However, the number of galls and egg masses, and the reproduction factor of *M. javanica* were significantly higher in South African plants than in those from the invaded region. Aboveground biomass was not affected by infection, regardless of plant's provenance. These results provide strong evidence for genetic differentiation, indicating a change towards greater resistance in invasive populations. Founder events and post-introduction adaptive evolution may have contributed, independently or in concert, to this divergence. Furthermore, this study suggests that *M. javanica* is able to survive on agricultural areas in the absence of crop plants using *O. pes-caprae* as an alternative host.

Sp10. Oral

Is the Meadow Spittlebug *Philaenus spumarius* (Hemiptera: Aphrophoridae) changing their ecological behavior in the presence of the invasive plant *Carpobrotus edulis*?

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Invasive species represent one of the most important threats to biodiversity worldwide, with consequences for ecosystem functioning and the delivery of important ecological services to society. One of the major invaders of Mediterranean coastal dune ecosystems is *Carpobrotus edulis* (L.) N.E.Br., a perennial clone plant native to South Africa. However, there is no information about the interactions between this invasive species with native herbivorous insects, even though it is a crucial aspect for Mediterranean coastal dune ecosystems management of the invasive species. From field observations, we hypothesize that *Philaenus spumarius* (L.) (Hemiptera: Aphrophoridae) have recognized *C. edulis* as a natural host and therefore may be candidate for the management of this invasive plant. Nine populations of *C. edulis* from North (29T 510501 4705353) to South (29T 511296 4619403) were sampled with 25 replicates (0.25 m2) per population. We found an increased number of nymphs from North to South on *C. edulis* (p=0.05) and more nymphs on *C. edulis* than on native plant species (p=0.05). Also, our results show that there is a direct relationship with the Family type of native plant species nearby, like Asteraceae, Plantaginaceae and Fabaceae, which favours a higher presence of *P. spumarius* on *C. edulis*. We conclude that spittlebug nymphs of P. spumarius are favoured by the presence of *C. edulis*. This is the first mention of association of native insect predators on invasive *C. edulis* in Europe. No other herbivores have been reported in the peer reviewed literature as feeding on *C. edulis* in Europe.

Sp10. Oral

Understanding the role of clonal integration in biological invasions.

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One core research question in invasion biology is to explain why some species become invasive while others do not. In spite of the research effort developed in the last years to explain biological invasions, this is a process still not well understood. Some plant characteristics might explain the success of invasive species better than others. In particular, clonal growth has been pointed out as an attribute that could contribute to the invasiveness of plants. However, and although many of the most aggressive invasive plant species show clonal growth, little research has been conducted to determine the role of clonal traits in successful invaders. Clonal plants play important roles in many ecosystem processes and dominate many plant communities. One of the most remarkable traits associated with clonal growth is the capacity for physiological integration (resource sharing between connected members of the clonal system). Recent studies have demonstrated that clonal integration increases survival and growth of aggressive invaders. However, future research should be conducted to determine differences in clonal integration between exotic non-invasive and invasive congeners, and between populations from native and invaded range to determine the presence of adaptive evolution of clonal traits during the invasion process and therefore elucidate the role of clonality in biological invasions.

Sp10. Oral

Ecological models as tools to explore forest ecosystems resilience to invasion in a rapidly changing world

Vicente, J.[1], Honrado, J.[1], Vaz, A.[1], Cabral, J.A.[2], Bastos, R.[2], Richardson, D.[3], Kueffer, C.[4], Verburg, P.H.[5], Bastos Araújo, M.[1,6]

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Biological invasions are a challenge to forest management worldwide, disrupting several functions and processes, which underlie the provision of essential goods and services. Increasing forest resilience has thus become a major target for hampering and mitigating the undesirable impacts of biological invasions. However, empirical evidence and robust analytical frameworks on how forest resilience can be operationalized in space are still lacking for ecological monitoring. In recent years, ecological models have been widely used to address the ecological impacts of climate change, land-use dynamics, biological invasions and other drivers of change on ecosystems, landscapes and their biodiversity. Novel methodological frameworks have been proposed and tested, involving the improvement of predictive algorithms and the use of more causal environmental predictors at their ecologically adequate spatial resolutions. In fact, the potential range of applications of ecological models in biological invasions is still far from fully explored. In this context, we will present recent advances in the use of ecological models in applied ecology and their linkages with resilience thinking, including the anticipation of trends in the patterns of drivers of ecological change, and the early detection of biodiversity responses to on-going and future environmental changes. Among others, examples will be described of the use of models to anticipate biological invasions under current and future conditions of climate and land-use in forest ecosystems, in the context of ecological monitoring initiatives.

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Sp10. Oral

Community scale impact of *A. longifolia* in an oligotrophic system is mediated by increased belowground organic matter input, higher flux rates and its phosphorus use efficiency.

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Invasive leguminous trees, such as *Acacia longifolia* (Acacia), are an increasing problem worldwide and especially transform oligotrophic systems, such as Mediterranean dunes. This is due to their ability to maintain high growth rates even in nutrient poor soils and create large amounts of above and belowground Biomass. Though the long-term effects of Acacia are known to be detrimental to native ecosystems, it was found that on a short-term scale nearby native *Corema album* plants (Corema) seem to benefit from its presence. Corema shows increased growth rates, higher leaf N levels and less depleted d15N signatures closer to the invasive legume but not to co-occurring native Stauracanthus spectabilis legume shrubs (Stauracanthus) (Hellmann et al., 2011). Here, this differential effect on Corema foliage was used as a bio-indicator for soil changes occurring underneath the invasive vs. the native legume. Therefore, foliar Carbon (C), Nitrogen (N) and Phosphorus (P) contents of Corema growing in proximity to Acacia or Stauracanthus were measured, as well as masses, C, N, P contents and potential flux rates of major soil organic matter (SOM) pools underneath each legume (roots, litter, rhizosphere). Using a multivariate approach, the impact of each variable on the foliar nutrient levels of Corema was predicted. This revealed the importance of SOM accumulation underneath the invasive, in conjunction with higher rhizospheric turnover rates and the ability to create tissue with low P content. Thus, higher phosphorus use efficiency and increased microbial turnover might be putative explanations for its success in oligotrophic systems.

Simpósio 11. Toxicologia ambiental e contaminantes emergentes / Simposio 11. Toxicología ambiental y contaminantes emergentes

Sp11. Oral

Side effects of Bionematicides on soil organisms: Ecotoxicological characterization of 1,4-naphthoquinone

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The development of bionematicides for the management of phytoparasitic nematodes is increasing worldwide. Therefore, is important not only to develop environmentally-friendly nematicides but also to assess potential risks for non-target nematodes and other soil inhabitants. This work is a part of an ongoing research project that aims to develop environmentally-friendly nematicides and nematicidal formulations obtained from agricultural residues. The main goal of the present study was to evaluate the ecotoxicological effects of 1,4-naphthoquinone (NTQ), a natural-origin compound presenting nematicidal activity that can be obtained from walnut husk, in plants and soil invertebrates, using standard tests and a novel soil nematode community assay. The battery of ISO tests included emergence and growth of *Zea mays* and *Brassica napus*; avoidance with *Eisenia andrei* and *Folsomia candida*; and reproduction with the previous species plus *Enchytraeus crypticus*. ISO tests and nematode assays were conducted using a natural uncontaminated soil. In case of the nematode community assay, part of the soil was defaunated and the remaining used to extract nematodes (Tray method). A range of NTQ concentrations was prepared to spike the defaunated soil. Toxicity of NTQ was found for all test-species, being *F. candida* and *E. andrei* the most sensitive. After 7 days, nematode abundance decreased along the concentration gradient, having recovered partially after 14 days (NTQ < 48mg/kg soil). The number of nematode families consistently decreased in both periods. Standard tests and soil nematode communities showed to be good indicators of NTQ toxicity to non-target organisms.

Sp11. Poster

Biochar application in agricultural Mediterranean soils: effects on nematode communities

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Biochar is a carbon-rich product, obtained by the thermal decomposition of biomass under a low oxygen atmosphere (pyrolysis) that has been used as a soil amendment. Its high carbon content and its nutrient and water retention capacities contribute to improve soil fertility and soil carbon sequestration. Moreover, biochar production could be a useful management practice to recycle organic wastes and to produce clean energy. However, the effects of the incorporation of biochar in agricultural soils on invertebrate communities and soil quality have been hardly studied. Integrated in a broader research project addressing the physicochemical and biological effects of biochar application in Mediterranean agricultural soils, this study aimed to evaluate its effect on the nematode community. A biochar obtained as a residue from pine chips gasification was added to field plots in 2011 at a rate of 12 and 50 t/ha combined with pig slurry fertilization, and kept under barley cultivation during three years. Nematodes were extracted from soil samples, collected in the field plots in 2013, using the tray method. The identification of the nematode trophic levels (plant-feeders, bacterial-feeders, fungal-feeders, omnivores and predators) was based on the morphology of the head/mouth structures. The application of this biochar did not affect the nematode community since no differences were found among biochar-treated plots and controls.

Sp11. Oral

Effects of microplastics on the predatory performance and efficiency of wild juveniles of the common goby (*Pomatoschistus microps*)

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Microplastics (MP) are considered ubiquitous pollutants of high able to cause physical and chemical adverse effects on the biota. The objectives of the present study were to test the following hypotheses: (H1) early juveniles of the common goby (*Pomatoschistus microps*) ingest MP; (H2) the presence of MP in the water may decrease the fish predatory performance over *Artemia franciscana* nauplii (prey); (H3) the environmental conditions during pre-developmental phases of fish influence the effects of MP on their predatory function. Wild *P. microps* early juveniles were collected in the estuaries of Minho and Lima rivers that have different environmental conditions. After acclimatization, they were exposed individually to clean artificial salt water without food. After 96h of exposure, polyethylene MP spheres (white, red and black) alone and in combination with prey were offered to fish, and the predatory performance and efficiency were assessed. Fish ingested all the MP types, leading to the acceptance of H1. Moreover, under combined exposure to some MP and prey, the predatory performance of Lima estuary fish was significantly reduced, leading to the acceptance of H2. Furthermore, under combined exposures to MP and prey, the predatory performance and efficiency were reduced in Lima estuary fish but not in Minho estuary fish, leading to the acceptance of H3. Overall, the findings of the present study indicate that exposure of *P. microps* early juveniles to MP may result in a reduction of their effectiveness as predators, an effect that can have negative impacts at the ecosystem level.

Sp11. Poster

Influence of temperature on the short-term toxicity of the antibiotic florfenicol to species representative of freshwater phytoplankton (*Chlorella vulgaris*) and zooplankton (*Daphnia magna*)

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The ecotoxicological effects of antibiotics are still poorly understood, especially in relation to climate changes. The goal of this study was to investigate the influence of temperature rise on the short-term toxicity of the veterinary antibiotic florfenicol (FLO) to the microalgae *Chlorella vulgaris* and cladoceran *Daphnia magna*, widely used in Ecotoxicology as representative of freshwater primary producers and primary consumers, respectively. Laboratory bioassays were carried out with the two species independently at 15ºC, 20ºC and 25ºC, by exposing *C. vulgaris* and *D. magna* at different concentrations of FLO (low ppm range) for 96h. The effect criteria were the inhibition of population growth for the microalgae and mortality for the cladoceran. FLO significantly reduced *C. vulgaris* population growth with no significant differences among distinct temperatures (EC50s ranging from 227 to 322 mg/l). In the range of concentrations tested, FLO caused *D. magna* mortality, with 96h-LC50s of 351 mg/l at 15ºC, of 319 mg/l at 20ºC and <300 mg/l at 25ºC. Therefore, temperature rise did not influence the toxicity of FLO to *C. vulgaris*. However, both the lowest and the highest temperatures tested increased the toxicity of FLO to *D. magna* relatively to the toxicity obtained at 20ºC. Overall, these results show that temperature rise was able to influence the toxicity of FLO to the primary consumer but not to the primary producer. They also suggest that in real scenarios temperature is able to modulate the effects of FLO on phytoplankton-zooplankton relationships highlighting the need of more research in this topic.

Sp11. Oral

Microplastics – the invisible threat

Sobral, P.[1]

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In the last years the huge amounts of marine litter reported in many parts of the world alerted the scientific community to this new global problem, and in particular to the effects of plastics, the main material found in marine litter. Plastics readily absorb persistent, bioaccumulative and toxic pollutants (PBT) present in the water, while introducing additives (such as bisphenol A, phthalates, brominated compounds) with are added during production to improve certain characteristics (transparency, flexibility, flame resistance). Though difficult to degrade, plastic in the oceans breaks down slowly into smaller and smaller pieces, due to UV action and abrasion processes, originating the so called microplastics (by definition < 5mm). Microplastics are also introduced in the oceans directly, as in the case of virgin or recycled resin pellets from the industry (typically 3-5mm), and also by the use of personal care products, such as exfoliants (20-300µm). Because of their dimensions microplastics are easily mistaken for food and thus ingested by many marine organisms. Besides the physical risk of obstruction or damage to the digestive tract, and because these particle are contaminated, there is a risk on introduction of PBT compounds in the lower levels of ocean the food chain and their transfer and magnification to higher levels, ultimately affecting the human population through the consumption of fish or shellfish. In this communication a global appraisal of the issue of microplastics and their potential impacts will be made, and selected results from research on the topic performed in Portugal will be presented.

Simpósio 12. Ecologia microbiana / Simposio 12. Ecología microbiana

Sp12. Oral

Importance of aquatic fungal diversity and temperature fluctuations on leaf litter decomposition

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Here we tested if species-rich fungal assemblages are functionally more efficient in leaves degradation under environmental fluctuations than those of species-poor assemblages. We manipulated temperature fluctuations in laboratory microcosms in which oak leaf discs were inoculated with monocultures of aquatic hyphomycetes or random mixtures of three or eight species and subjected to different temperature regimes, including three constant temperatures and temperature fluctuation regimes. Temperature regime and identity of fungal species inoculated in monoculture microcosms significantly affected decomposition rates: decomposition was slowest at the lowest temperature and on single species treatments when compared with mixed assemblages with eight species across all temperature regimes. A functional saturation seems to occur in the presence of a low (three) number of fungal species. Litter decomposition was not inhibited by temperature fluctuating regime when compared with constant temperature conditions. Ecosystem function seems to benefit from the presence of multiple over single assemblages under environmental changes.

Sp12. Poster

Influence of agricultural practices on microbial communities

González Benítez, N.[1], Simarro, R.[1], Molina, M.C.[1], Calero, C.[1], Martín, R.[1]

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In agricultural soils, it has been found that the microbial species and the functional diversity differ between the type of fertilizer used, the species of plants, plow practices or crop type. In this paper a study of microbial communities in two types of crops (vines and olive trees) under conventional and organic farming practices was carried out. A control that has not been subjected to such conduct is also made. In order to study the effect of these practices in microbial communities in terms of functionality of a soil were studied physico-chemical and biological parameters as conductivity, pH, soil texture, field capacity and enzyme activities (phosphatase, glucosidase), bacterial abundance and functional diversity expressed in numbers Hill; (QD), obtained by MicroResp. The results show that plowing and fertilizing techniques using by conventional agriculture significantly influences in physicochemical parameters as field capacity and conductivity by used. In relation to biological parameters, the activity of acid phosphatase and bacterial abundance decreased significantly in agricultural soils, while the functional diversity of order 0D, 1D, 2D showed no significant difference with control. These results suggest functional redundancy and resilient and resistant capacity of microbial communities in response to the various agricultural disruptions. However, Hill numbers for diversities of order 1 and 2 were negatively correlated with the concentration of organic matter in soils. These results suggest that soils dominated by bacterial communities with high functional diversity, are soils with low organic matter as a consequence of high functional activity in general and remineralizing in particular.

Sp12. Oral

Degrading ability of Carbamacepine and Naproxene by a mircroorganism molecularly identified as *Pseudomonas fluorescents*. Assessment of ecotoxicity

González Benítez, N.[1], Molina, M.C.[1], Simarro, R.[1], García-Cambero, P.J.[2], Quijano, M.A.[3], Díaz, E.M.[1]

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A third of the water available on our planet is used with agricultural, industrial and household usage, being these the main polluting activities. There is a very heterogeneous group of pollutants in aquatic systems which appear in trace concentrations known as PPCPs (Pharmaceuticals and Personal Care Products). Some of them, even at very low concentrations, are able to exert toxic effects environmental and public health, especially when they occur in complex mixtures. During recent years have developed efficient physico-chemical laboratory technologies, however in practice, the costs rise much, energy consumption and CO2 emissions, do not allow its implementation on an industrial scale. The main aim of this study is to evaluate the degradation of carbamazepine and naproxen (two PPCs described in effluents from sewage water treatment plants,SWTP) by *Pseudomonas fluorescens* strain. This strain has been isolated from a microbial corsorcio waters from SWTP and molecularly identified. The toxicity of the water is also estimated during the analysis, with particular emphasis on the toxicological effects at initial and final time. The ecotoxicological tests were performed on zebrafish embryos using a variety of criteria, with particular emphasis on those related to neurodevelopment.

Sp12. Oral

Stress responses to copper contamination differ among strains of *Heliscus lugdunensis* isolated from polluted and unpolluted site

Quainoo, S.[1], Sahadevan, S.[2], Graça, M.A.[1]

(1) MARE-Marine and Environmental Sciences centre, (2) Centre of Molecular and Environmental Biology (CBMA).

Aquatic hyphomycetes are the major decomposers of leaf litter and establish a crucial link between riparian plant-litter and macroinvertebrates in streams. Mining and other anthropogenic activities increase the concentrations of heavy metals in freshwaters and are known to affect the ecosystem functioning. Previous research has been focusing on the effects of Cu exposure on interspecies diversity of aquatic hyphomycetes, whereas stress responses at intraspecies level remain largely unexplored. The goal of our study was to investigate the stress responses to Cu exposure in five strains of *Heliscus lugdunensis*, isolated from metal polluted and unpolluted streams in central Portugal. Growth rates in solid media with realistic Cu concentrations (up to 1.5 mg/L), differed significantly between strains. The fungal strains, both individually and in mixture, when treated with Cu solutions (up to 1.5 mg/L) in microcosms with *Alnus glutinosa* leaves, differed in reproductive and metabolic activity as well as in their capability to decompose leaves. We conclude that heavy metal pollution may play a major part in shaping the intraspecies diversity and in ecosystem functioning.

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Sp12. Poster

Copper contamination affects intraspecific variability in tolerance and growth of *Heliscus lugdunensis*

Quainoo, S.[1], Sahadevan, S.[2], Graça, M.A.[1]

(1) MARE-Marine and Environmental Sciences centre, (2) Centre of Molecular and Environmental Biology (CBMA).

Aquatic hyphomycetes play an important role, as they establish the crucial link between riparian plant-litter and invertebrates in streams. Mining and other anthropogenic activities are known to increase the concentrations of heavy metals in freshwaters. Previous research has been mainly focusing at the species level to determine EC50 values for organisms, including aquatic hyphomycetes. However, it is being increasingly recognised that genetic diversity in species is an important component of ecosystem functioning. Our goal was to investigate differences in radial growth between five strains (A, B, C, D, E) of *Heliscus lugdunensis*, isolated from metal polluted and unpolluted streams in central Portugal, in response to copper exposure. Previous work on ITS sequences of the five fungal strains indicated that two (A and E) were genetically different to the others. Fungal plugs of the five strains were grown individually on 2 % malt extract agar and exposed to a series of nine copper concentrations starting at 1.5 mg/L in a logarithmic scale of 2. Radial expansion rates were determined every four days for 20 days. Strain E had the highest growth rate. Fungal growth was suppressed at concentrations of 384 mg/L. Fungal tolerance and EC50 values differed between strains. The results indicate that intraspecific Cu tolerance between strains may be determined by differences in genetic makeup.

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Sp12. Oral

Seasonal profile of aquatic fungal communities along a mine drainage gradient by using illumina MiSeq Next-Generation Sequencing

Sahadevan, S.[1], Sobral, O.[1]

(1) CBMA.

Aquatic hyphomycetes are the important microbial decomposers of leaf litter, and are responsible for the energy and nutrient transfer to higher trophic levels. Traditionally, aquatic hyphomycetes are identified by observing the shape and size of conidia released from plant-litter or conidiogenesis. This method relies heavily on the ability of fungi to sporulate. Molecular tools allow more thorough characterizations of fungal diversity without depending on the fungal reproductive stages. The goal of this study was to use MiSeq Next-Generation Sequencing system to accurately identify aquatic fungal species and to analyse the species diversity of aquatic fungi in heavy metal impacted streams in all seasons of a year. A pollution gradient was established in 3 heavy metal impacted rivers in Central Portugal. Leaf litter decomposition was conducted with *Alnus glutinosa* (Alder) leaves in autumn, winter, summer and spring along a pollution gradient for 20 days. Illumina MiSeq platform was used to generate Internal Transcribed Spacer (ITS) sequence data after extraction of fungal DNA from leaf litter. In general majority of fungi belonged to the Ascomycota followed by Basidiomycota, Chtridomycota and Glomeromycota. The species distribution pattern differed in all the seasons and are impacted by metal pollution. We conclude that metal pollution and seasons are capable of shaping the fungal community.

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Sp12. Poster

Preliminary insights into evolutionary relationships of aquatic and endophytic fungi

Sahadevan, S.[1], Monroy, S.[2]

(1) CBMA, (2) Laboratory of Stream Ecology.

Aquatic hyphomycetes are an ecological group of fungi that play a key role in leaf litter decomposition and are mediators of nutrient and energy flow in freshwater ecosystem. Aquatic hyphomycetes mainly produce sigmoid or tetraradiate spores as a result of convergent evolutionary strategies to adapt to aquatic lifestyle. Molecular studies have earlier shown that some aquatic hyphomycetes are also plant endophytes; however more evidences are needed to know dual ecological abilities. In this study, we examined the phylogenetic relationships and evolutionary divergences of aquatic hyphomycetes, endophytic aquatic hyphomycetes and other fungal endophytes of riparian/terrestrial plants. To that end, 573 fungal sequences of ITS1-5.8S-ITS rRNA retrieved from National Center for Biotechnology Information (NCBI) and neighbor joining tree (NJ) was constructed using the Kimura 2-parameter distance. Whenever an intermingled sub-tree of endophytic aquatic hyphomycetes, aquatic hyphomycetes and endophytes was encountered in the NJ tree, it was regarded as a major phylogenetic group. Eight major groups were identified and explored further. The occurance of aquatic hyphomycetes both as an endophyte and an aquatic fungus suggests an alternating life cycle between the two environments. We conclude that to propel the study of fungal ecology, we need to assign a vast ecological niche for aquatic fungi and further its ecological role has to be thoroughly explored.

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Sp12. Poster

Impacts of gradients of mine pollution on aquatic fungi

Sahadevan, S.[1], Graça, M.A.[2]

(1) CBMA, (2) MARE.

Aquatic hyphomycetes are the key microbial decomposers of leaf litter, establishing a crucial link between riparian plant-litter and higher trophic levels in streams. Heavy metal pollution is known to have an impact on aquatic hyphomycetes and its associated functions. The goal of this study was to assess the effects of mine pollution on the performance metrics of aquatic fungi like litter decomposition rate and biomass production. A pollution gradient was established in 3 heavy metal impacted rivers in Central Portugal: Ribeiro Barroca (4 sites), Ribeira do Castelo (4 sites), and Ribeira de Casinhas/Rio Zêzere (5 sites). The rivers are impacted by Senhora da Guia (Sn, W, inactive, 1970), Quinto do Bispo (U, inactive, 1990) and Panasqueira (W, Sn, Cu, active since 1880) mines respectively. Leaf litter decomposition was conducted with *Alnus glutinosa* (Alder) leaves in autumn and winter along a pollution gradient for 20 days. Metal concentration and other physico-chemical parameters were measured at the beginning and at the end of litter decomposition study. Litter decomposition rate and fungal biomass was estimated from the litter revived in autumn and winter seasons. In this study, fungal biomass and litter decomposition showed a general trend to decrease with increase in metal content in all rivers and seasons. We conclude that heavy metals in the environment are capable of affecting key ecosystem functions.

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Simpósio 13. Ecologia das zonas áridas / Simposio 13. Ecología de zonas áridas

Sp13. Oral

Biocrusts, Environmental Factors and Functional Diversity in Drylands: looking for global patterns

Concostrina Zubiri, L.[1], Bowker, M.[2], Giordani, P.[3], Martínez, I.[4], Matos, P.[1], Cruz de Carvalho, R.[1], Pescador, D.[4], Molla, I.[5], Pinho, P.[1], Nunes, A.[1], Batista, M.[1], Eldridge, D.[6], Mallen-Cooper, M.[6], Zhao, Y.[7], Xu, M.[7], Branquinho, C.[1]

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Drylands comprise an interesting array of ecosystems sharing some peculiarities: i) they shelter very unique biological and cultural ecosystems on earth, ii) their structure and function are mostly defined by the scarcity of water and nutrients, iii) they are highly vulnerable in the face of climate and land-use change, and, iv) they all hold "biocrusts"; i.e. lichen, bryophytes, cyanobacteria and other microorganisms living in topsoil layer. Biocrusts contribute to ecosystem biodiversity but also to ecosystem functioning by fixing carbon and nitrogen, protecting soil surface from erosion, and taking part in biotic interactions. Furthermore, their poikilohydric nature, their diversity (e.g. tens of species and functional groups in 0.5m2) and their suitability for experimentation (e.g. growing techniques) make of them ideal candidates for testing ecological hypothesis, acting as biological indicators or developing effective and innovative ecosystem management and restoration techniques in Drylands. With this idea in mind, the Marie Curie project "BSCES" (Functional diversity of Biocrusts: towards ecosystem services quantification in drylands) is devoted to i) characterize biocrusts distribution, ii) measure critical functional traits (morphological and physiological traits) and functional diversity (RaoQ, CWM), iii) identify main environmental predictors of taxonomic and functional diversity (climate, soil), and finally iv) model and quantify their contribution to ecosystem services. We are studying Drylands in Mediterranean regions, North America, Australia and China along aridity gradients and under different management regimens in order to create a database of biocrust functional traits and find what is common and what is different among sites all over the world.

Sp13. Oral

Plant succession and CO2 emissions in arid environments

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(1) EEZA.

Secondary succession may define the potential of an ecosystem as C source or sink. In scantly vegetated ecosystems, as scrubs, chamber measurement methods can be useful to determine net carbon dioxide (CO2) exchange between soil and atmosphere. Our main objective is to estimate CO2 exchange rate on a secondary succession chronosequence and the potential of carbon sequestration over time. For this purpose, we test the efficiency of a portable chamber to measure gas exchange in shrubs of different size. by measuring CO2 fluxes of the 7 main species and bare soil of 5 community stages after land abandonment, using a portable, closed system chamber (94x94x80 cm) attached to an IRGA EGM-4 (PPSystems), during a growing season (Spring 2014). In addition to plant fluxes, we estimated CO2 fluxes at the community level, using an approximation based on relative cover per species and of bare soil. We found differences among plant species in respiration and photosynthesis. Plant Net Exchange points to an increase of C sequestration in our species. Soil respiration increased with abandonment time. Net gas exchange turned into C source when we included plant and soil fluxes in our estimation. Early successional stages acted also as potential C sources when compared with natural grasslands.

Sp13. Oral

Fragmentation mainly determines how annual species diversity is structured in a gypsum Mediterranean system

López De Luzuriaga Gamboa, A.[1], Sánchez, A.M.[1], López-Angulo, J.[1], Escudero, A.[1]

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Fragmentation associated to habitat loss is a crucial driver of global change for plant diversity. We evaluated the joint effect of two fragmentation drivers –a highway and habitat loss- on community properties of highly diverse annual plant assemblies in a fragmented gypsum landscape in central Spain. 50 fragments were chosen and the presence of every annual plant species, perennials and biological soil crusts were recorded in ten quadrates (900cm2) per fragment. Fragment size, minimum distance to the highway, connectivity and historical shift of fragment size for the last 50 years were measured sunshine and multifunctionality indices were estimated. Distance to the highway showed no significant relationship with any community property, probably due to preadaptation of gypsiferous annual species in order to disperse over unfavourable habitats. Surprisingly, higher connectivity reduced annual species richness and increased the nestedness component of the beta diversity. We propose that a selective extinction process may have occurred resulting in species disappearing in a predictable sequence, leading to nestedness. The most outstanding finding of our study was that regardless of the limited effect of fragmentation on species richness, fragmentation greatly determined how species composition was structured. We detected that fragments that historically have been increasing for the last 50 years showed greater evenness, denoting that in more stable fragments most species were able to coexist achieving more similar abundances than in shrinking ones. Sunshine index exerted a decrease in species richness probably due to some kind of environmental sorting resulting in a nested pattern of beta diversity.

Sp13. Oral

Biological soil crust and rain determine semi-arid annual plant community assembly

López Peralta, A.M.[1], Sánchez, A.M.[1], Luzuriaga, A.[1], Algobia, V.[1], Escudero, A.[1]

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Annual plant communities in semi-arid Mediterranean systems vary dramatically from year to year hypothetically due to shifts in rainfall amount and timing. In addition, biological soil crust (BSC) provides fine-scale spatial heterogeneity, which eventually determines species coexistence. In order to test the effect of rainfall patterns together with the modulating effect of BSCs on annual species assemblage we performed two experimental approaches: 1) water amount and timing were manipulated to establish a factorial design as follows: three rainfall distribution patterns (typical rainfall distribution -data from the last 30 years-, rainy autumn and rainy spring) and two water availability treatments (100% and 75% of the average annual precipitation); 2) rain amount and the presence of the BSC were manipulated by establishing three water availability treatments (100%, 66% and 33% of the average annual precipitation) and two levels of perturbation of the BSC (not altered and mechanically perturbed). These treatments were applied to "microcommunities" (40X40 cm) directly transposed from the field to plastic pots under a nearby rain shelter. In each pot four soil samples (10x10x3 cm) containing the community soil seed bank were placed. Samples were extracted in September without altering soil profile and BSC structure. Seedlings (December) and adult plants (April) were identified to species. Rainfall timing affected seedling abundance, richness and diversity, and its effects remained on spring community composition. The extreme drought treatment reduced species richness and plant abundance and changed community composition. BSC perturbation contributed to a major desiccation of the soil exacerbating drought effects.

Sp13. Oral

Tracking the effects of climate change in drylands using lichen functional diversity

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Drylands will be amongst the most affected areas by climate change. Thus, investigating how these ecosystems composition, structure and functioning will be impacted is a priority. From an ecological indicator perspective, functional diversity has shown to depict better ecosystem functioning or response to environmental factors, than species richness. Lichens, proven ecological indicators, are within the ecosystem components more sensitive to climatic changes. Nonetheless, lichen functional diversity as indicator of climate remains poorly explored. We identified lichen functional traits and functional groups responding to aridity, focusing on easily identifiable traits related to water uptake (photobiont, growth form and reproduction strategy). This was done in a Mediterranean climatic gradient ranging from semi-arid to dry sub-humid. We also pinpointed what essential climate variables should be used to track the effects of climate change on these ecosystems, based on these traits, in an enlarged version of the gradient, covering also temperate zones. Growth form and type of photobiont responded to aridity, with *Trentepohlia* and cyanobacteria photobionts being particularly responsive in contrasting ways to aridity. Surprisingly, temperature related variables and not precipitation, seemed to be the key predictors of lichen functional diversity in these ecosystems, with temperature ranges (annual, diurnal, isothermality) being the most important predictors for the majority of lichen functional groups. Predictions about climate change effects in Mediterranean drylands focus usually on annual precipitation patterns and mean annual temperatures. Our work highlights the ecological importance of temperature ranges, which should also be tracked to properly assess the effects of climate change in drylands.

Sp13. Oral

AdaptForChange project: identifying past good practices to adapt semiarid areas to the future

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The recent aridity increase in Alentejo with the expansion of the semiarid climate to almost the entire region, and the growing impact of climate change demand a local adaptation. The main strategy adopted so far has been reforestation of degraded areas with native forest, aimed at increasing ecosystems' resilience and services provision and decrease susceptibility to desertification. Large areas have been reforested in Alentejo by different stakeholders using native holm-oak and cork-oak trees, often with a low success rate. Yet, no systematic evaluation of the success of such interventions has been made so far in the medium to the long-term. Here we describe the methodological approach to be used in one of the working tasks of AdaptForChange project (AdaPT programme). The task aim is to evaluate the success of reforestation efforts performed in the semiarid region of Alentejo over the last 40-60 years and transfer that knowledge to areas currently affect by increased aridity. For that, we will make a collection of case studies based on information provided by stakeholders, and evaluate the level of success of each intervention through the quantification of current ecosystem services provided by the restored ecosystems. This evaluation will be based on remote sensing data as well as data collected in the field on indicators of vegetation structure and diversity, soil quality and habitat complexity. We will take lessons of good practices to transfer that knowledge to the current semiarid areas and adapt reforestation practices to climate change scenarios.

Sp13. Oral

Effects of long-term climate on woodlands phenology and productivity on drylands

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Current climate change affects ecosystems structure and functioning. To what degree those effects depend on past climate and the ecosystem history is poorly known, especially for Mediterranean woodlands (known as montado/dehesa). To characterize the changes caused by climate on ecosystems structure and functioning, we analyzed several phenology and productivity metrics based on remote-sensing data of Mediterranean evergreen woodlands, measured over a spatial gradient of aridity. These metrics were quantified by satellite for the last 10 years. We tested to what degree did concurrent climate and long-term historic climate influence ecosystem phenology and productivity. We observed that long-term climate influence prevailed over the concurrent one, suggesting that the current spatial patterns of the studied ecosystem metrics are strongly influenced by past climate and that a strong legacy effect, e.g. caused by seed bank, is still observable. This suggests that the future response of these ecosystems to the ongoing climate change may also be affected by historical legacies, which thus must be taken into account when predicting its effects in Mediterranean evergreen woodlands.

Sp13. Oral

Intraspecific functional leaf traits variability of eight algarrobo (*Prosopis pallida*) populations along a climate gradient

Salazar Zarzosa, C.[1], Cruz Alcedo, G.[1], Villar Montero, R.[2], Navarro Cerrillo, R.[3], Grados Quezada, N.[1]

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In a regional spatial scale, functional leaf plasticity might be the result of different environmental factors or a climate gradient, which drives intraspecific variability for one or more traits. In this study, we evaluate some structural (LMA: leaf mass per area, LDMC: leaf dry matter content, stomatal area and density), physiological (Amass: maximum photosynthetic rate per unit leaf mass, E: transpiration rate, gs: stomatal conductance, LRWC: leaf relative water content) and chemical (C and N concentration) leaf traits of eight *Prosopis pallida* populations in north Peru dryland forest under a climatic gradient from the Andes Mountains to the coast. Our results showed that the eight studied populations differed in most of the leaf traits measured. Structural traits were correlated to physiology. LMA was negatively correlated to Amass and N concentration. The instantaneous water use efficiency (WUE) was negatively correlated with LDMC. Surprisingly, mean annual precipitation was not related with the variability in any functional leaf traits but mean annual temperature was correlated with traits related to the water use (negatively to LRWC, and positively correlated to WUE). In summary, there is a wide phenotypic variation in the structural and physiological leaf traits in *Propopis pallida* which were mainly due to variation in mean annual temperature.

Sp13. Oral

Modelling long term natural regeneration of Holm oaks in semi-arid regions: a tool for guiding ecosystem restoration

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Holm oak woodlands occur on semi-arid South-Western Europe, where tree cover is critical in ameliorating the effects of aridity and in preventing desertification and land degradation. Additionally, holm oak regeneration is a major concern, due to seedling high mortality rate and slow growth. We sought to devise a method to predict the natural regeneration potential of woodlands in semi-arid areas, to be used in guiding restoration efforts. We used long-term information on tree regeneration based on historical aerial photography (starting in 1947). Then, using long-term climate and microclimate data, we build and validated a model to predict the natural regeneration of holm oak based on few variables. We found that besides time, microclimate, measured using potential solar radiation (PSR, which depend on local topography) was critical for modelling the natural regeneration of holm oak. The sites with higher PSR attained no more than 20% of tree cover even after 60 years, whereas under lower PSR, tree cover exceeded 90%. We then modelled holm oak cover throughout the years and used it to map the natural regeneration potential in one site where holm oak reforestation efforts had been ineffective. The model developed in this work, considering microclimate, measured using PSR, can successfully predict the holm oak natural regeneration rate, thus allowing the optimization of the cost-benefit of restoration strategies: either to advice active restoration (in the areas with higher PSR) or natural regeneration (in the places with lower PSR).

Simpósio 14. Ecologia e evolução dos sistemas reprodutivos em plantas / Simposio 14. Ecología y evolución de los sistemas reproductivos de plantas

Sp14. Oral

The effect of fruit type, kinship and germination time on the competitive ability of a heterocarpic species

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Heterocarpy is a bet-hedging or mixed strategy in which an individual produces two or more fruit types that may show different dispersal, germination, plant fitness or competitive behaviors. Plant-plant interactions are also known to affect plant performance, and for example, siblings could recognize themselves and thus compete less between them than with strangers. In the heterocarpic *Anaclyclus clavatus* (Asteraceae), when growing alone, winged and larger achenes (fruits) germinate earlier, producing plants with higher biomass and reproductive effort than unwinged and smaller achenes. In this study, we explored whether winged achenes maintain its potentially higher competitive ability under a scenario of competition with other achenes and assessed the effect of germination phenology on plant-plant competition. For that, we investigated how survival, plant biomass, and reproductive effort were influenced by the achene type and germination time, considering also the genetic relationship of the achenes (siblings vs. strangers). Winged achenes outcompeted unwinged ones producing plants with higher biomass and reproductive effort by means of their faster germination. The type of achene influenced biomass of plants under different competition scenarios. In any case, the genetic relationship between competitors did not affect the competition outcome. Although late-germinating achenes were outcompeted by early germinating ones, they produced plants with a high survival probability. In this species, germination time was the key factor that modulated the competitive advantage of different achene types. Late germinating seeds can represent a surplus of plants that could replace the fraction of early germinating plants that may have not survived winter conditions.

Sp14. Oral

Don't count your chickens before they hatch: Pollinator attraction, female reproductive success and fitness consequences of rayed and rayless phenotypes.

Cerca de Oliveira, J.[1], Agudo, A.[2], Álvarez, I.[2], Castro, S.[1], Afonso, A.[1], Torices, R.[1]

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An exceptional model for understanding the selective mechanism underlying the great diversity of floral traits is provided by the floral polymorphism within the sunflower family (Asteraceae). Rayed capitula usually attract a larger number of pollinators, guaranteeing higher outcrossing rates while, on the other hand, rayless plants avoid costs of producing and maintaining rays and, potentially allocate resources for fruit production. To assess the role of these selective forces, we explored the effect of ray presence on pollinator preferences, pollen limitation and plant fitness in a natural hybrid zone where the rayed species *Anacyclus clavatus* and the rayless species *A. valentinus* co-exist and presumably hybridize, forming intermediate phenotypes. In addition, we tested whether ray maintenance entailed a cost on fruit production by means of a ray removal experiment. We found that: 1) rayed plants received a higher number of pollinator visits; 2) rayless plants were pollen-limited while rayed were not; 3) rayed plants have a significantly higher female reproductive success (fruit set), but no significant differences in plant fitness were found between phenotypes; 4) the ray removal experiment did not support that ray maintenance constitute a cost on fruit production. Furthermore, SEM models supported that pollinator visits did not lead to an increase of plant fitness in rayed plants and highlighted the importance of floral display in determining fitness of both phenotypes. In conclusion, although rayless plants were pollen limited and rayed plants received significantly more visits from pollinators, thus producing more fruits, no significant differences in plant fitness were found.

Sp14. Oral

Baker knew a lot: evidences of changes in the mating systems during the invasion process

Costa, J.[1], Ferrero, V.[2], Castro, M.[1], Loureiro, J.[1], Navarro, L.[2], Castro, S.[1]

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Biological invasions are frequently associated with changes in plant reproductive strategies. Thus, comparative studies including both native and invasive populations offer an outstanding opportunity to investigate contemporary changes to the mating systems of hermaphrodite plants. *Oxalis pes-caprae* L. is a South African tristylous species that was introduced to regions with Mediterranean climate, where it became an invasive plant. In this study, we investigated variations in the expression of the incompatibility system in plants from native and invasive populations of this species by performing controlled legitimate (between morphs) and illegitimate (self- and within morph) pollinations. Differences were found in fruit and seed production among pollination treatments and between areas. Native plants had higher fruit and seed set after cross-pollinations than plants from the invaded range. The opposite pattern was found after illegitimate pollinations, with invasive plants having higher fitness after illegitimate pollinations than native ones. Among invasive plants, L- and M-morphs were found to be more self- and morph-compatible than the S-morph, revealing morph-specific differences in the weakening of the incompatibility system. Our results provide evidence for evolutionary changes in the expression of the incompatibility system between native and invasive populations after introduction. They also support the classic idea that selective pressures in the new range, as the lack of compatible mates, may have contributed for the changes to the mating systems during invasion (Baker's Law).

Sp14. Oral

Reproductive biology and pollination ecology of the endemic *Salvia sclareoides* Brot.

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Reproductive success is a key step in species perpetuation. For plants, intrinsic features of the floral biology and breeding system determine their reproductive system. Furthermore, mutualists and antagonists can influence their success. Pollinators are of extreme importance, as they govern who, how and when mating occurs. Plant and surrounding traits are components that can influence the visitation rate and, consequently, the reproductive success. *Salvia sclareoides* is an Iberian endemic species, with conservation interest for which little information is available. This work assessed how diverse features of the floral biology and breeding system affected the outcome of the reproductive system; and how different plant and surrounding traits affected the pollinator's behaviour and female fitness. To achieve that, floral lifespan, display, rewards and sexual functioning were studied, hand pollinations were made to determine the reproductive system, and herbivory of sexual structures, natural reproductive success and pollen limitation were assessed. Moreover, several plant and surrounding traits were to observe if they influenced the visitation rates and female reproductive success; pollinator's assemblage was also studied. *Salvia sclareoides* presents several flowers simultaneously open that are short-lived, nectar rewarding and protandrous, although the peak of sexual organs maturation coincided. Is self-compatible, having some ability of spontaneous selfing. Still, pollinators significantly increased its reproductive success; unlikely herbivores. Also, both quantitative and qualitative pollen limitation was observed. The pollinations were performed mostly by bees (mainly *Anthophora* sp. and *Bombus* sp.), being plant height the trait mostly correlated with visitation rates. However, no effects were detected in reproductive success.

Sp14. Oral

Size-dependent reproductive allocation of an epiphyte changes along a climatic gradient in Southern Europe

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Since many species persist in different environments, intraspecific variation in reproductive traits among populations in heterogeneous environments can be expected. Yet, no studies on reproductive strategies along environmental gradients have targeted primary producers such as lichens. We assessed the reproductive strategy of the threatened epiphytic lichen *Lobarina scrobiculata* among 18 populations along the Iberian Peninsula. We hypothesized that this asexually reproducing species reproduces at larger sizes and more efficiently in the favourable environments (e.g. rainy locations), and vice versa in adverse conditions. Using GLMs and SMA regressions we evaluated the reproductive threshold size and reproductive efficiency (defined by the allometric slope between somatic and reproductive surfaces) among populations. Results showed that reproduction of *L. scrobiculata* (n = 9665) was size-dependent, but the reproductive threshold size differed among populations. Most populations showed positive allometry between somatic and reproductive surface, indicating that *L. scrobiculata* efficiently converts somatic tissue into reproductive structures. As expected, *L. scrobiculata* started to reproduce at larger sizes in rainy locations. However, the allometric slopes were greater in drier locations, suggesting a strategy of increased propagules' pressure to enhance colonization in adverse environments, although at the expense of low genetic diversity. The efficient and flexible reproductive strategy of *L. scrobiculata* may influence its population structure and dynamics, ultimately affecting the community functioning. This study provides novel insights on the variation of reproductive strategies due to environmental heterogeneity in lichens. A broad taxa base is needed to substantially widen our general understanding of the evolution of reproductive strategies.

Sp14. Oral

Disassortative mating in plants: paternity analysis of floral morphs within experimental populations

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Heterostyly enhances disassortative pollination between floral morphs through reciprocal placement of stigmas and anthers, and through a physiological heteromorphic incompatibility system, which impedes within-morph fertilization. Which of these mechanisms is the main driver of disassortative mating in this polymorphism is object of debate. Stylar-dimorphism lacks reciprocal anther placement and hence disassortative mating could be compromised, particularly when there is not intra-morph incompatibility. Variable rates of disassortative mating along with differential female fecundity or siring success among floral morphs could lead to variation in morph ratio in this polymorphism. We investigated mating patterns in *Narcissus papyraceus*, an intra-morph compatible species with dimorphic (long- and short-styled) and monomorphic (long-styled) populations in central and north regions of its range, respectively. We established experimental populations in both regions and exposed them to ambient pollinators. Using paternity analysis, we found high disassortative mating in most populations. Female fecundity of morphs was similar in all populations. Our results provided evidence for the evolutionary stability of stylar dimorphism in N. papyraceus and reveal the central role of morphological reciprocity of sexual organs in promoting disassortative pollination, even when such reciprocity is imperfect. However, it is unclear what forces lead to complete loss of one of the morphs in some natural populations.

Sp14. Oral

Sex specialization within inflorescences

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The evolution of unisexual flowers within inflorescences has been explained as a mechanism of avoiding self-fertilization reducing the negative effects of inbreeding. However, many species with unisexual flowers also have self-incompatibility systems making difficult generalizations of this hypothesis. An alternative hypothesis for this pattern is that flowers within inflorescences compete by resources, and that the sequential development of flowers and architectural constraints might produce a gradient on resource availability. This variation on resource availability leads distinct optima for sex allocation accordingly with the position of the flower within an inflorescence, potentially driving the evolution of sexual specialization on separated flowers. We have explored this hypothesis using as a model the largest family of flowering plants (Asteraceae).

Sp14. Oral

The temporal dimension in individual-plant pollination networks

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Individuals flowering asynchronously within a plant population are exposed to different sets of pollinators when these exhibit a temporal turnover. In these populations, pairwise plant similarities in pollinator fauna are expected to vary. We have explored the temporal dynamics of individual-based plant networks, build on pollinator similarities, when pollinator abundances vary and plant individuals differ in phenology. In addition, we have explored how the idiosyncratic behavior of each pollinator group influences network topology. During two flowering seasons, we surveyed individual phenologies and the pollinator fauna visiting the plants of a population of *Erysimum mediohispanicum* (Brassicaceae) in Sierra Nevada (Spain). Using discrete temporary networks, we described the temporal changes of network topology by means of modularity, weighted clustering, and assortativity by node degree. These metrics were compared with what were expected when pollinators forage randomly among plants. To test the influence of each pollinator on network topology, we compared empirical metrics with null models where only a pollinator type is simulated to behave randomly. We found that the interplay between plant phenology and pollinator turnover influences differences in pollinator composition among plants and shape the topology of the temporary networks. This outcome shows the importance of considering the entire flowering season and highlights the necessity of making comprehensive temporal sampling when trying to build reliable interaction networks.

Simpósio 15. Ecologia Animal: estratégias individuais e padrões populacionais / Simposio 15. Ecología Animal: Estrategias individuales y patrones poblacionales

Sp15. Poster

How anti-predator strategy modulates grouping behaviour in red deer?

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Grouping behaviour is a common phenomenon in animals, which is frequently addressed as an anti-predator strategy. However, the existence of intraspecific variation in grouping behaviour suggests that other aspects like density, availability of resources, habitat heterogeneity and social interactions may also play an important role. We used direct observations of animals to understand the capability of the anti-predator strategy in explaining the grouping behaviour of red deer *Cervus elaphus* in a Mediterranean mountainous environment. We also analysed the influence of local population density and land cover. The results showed temporal variations in group size and composition, as well as an influence of local population density and land cover. A more pronounced increase in the number of groups than in group size was observed in areas with a higher population density. As expected, in open areas red deer forms larger groups. The results suggested that grouping behaviour in red deer is not only a response to the presence of predators but also influenced by density and habitat type. Our results provided support for the anti-predator strategy, indicating that even in populations without or with low levels of predation, the natural anti-predator response continues to modulate the grouping behaviour in red deer.

Sp15. Oral

Ethological diversity: a neglected level in the study of biodiversity

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The concept of biodiversity emerged as a unifying idea in the study of biology, derived from the recognition of threats to species conservation in the mid-1980. The word is a contraction of "biological diversity", but it embraces a multifaceted and hierarchical analysis of the complexity of life, which has implications in many areas of science, but also in philosophy, ethics, politics and even religion. There have been many attempts to define this concept, and most authors emphasize the fact that biological diversity is found at all levels of the hierarchy of life. Three levels are included in the commonly accepted definitions: genetical, species and ecosystem diversity, going from the intraspecific level to the landscape. Here I review the concept of biodiversity and argue that, at least for some groups of animals, a fourth level of biodiversity, never included in biodiversity studies, is of prominent relevance: ethological diversity. There is a growing number of studies showing that animal behaviour is fine-tuned by natural and sexual selection. At the same time, many studies describe alternative behaviours, ethological plasticity and even personality, as characteristics of many animal populations. Behaviour has profound ecological consequences, particularly in species interactions, and models that ignore ethological diversity, treating all individuals as equivalent, are unlikely to have good predictive power. "Ethodiversity" is important at the intraspecific, inter-population, and species level. Furthermore, I expect ethodiversity to show a latitudinal cline, with more diverse and elaborate behaviours in the tropical regions. Quantifying ethodiversity requires the development of new analytical methods.

Sp15. Oral

Human-related factors explain badger occupancy in different topo-climatic areas of Northern Scotland

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1. European badger (*Meles meles*) populations have been widely studied over several biological aspects. The Scottish badger populations, although facing a very particular environment, characterized by high climatic heterogeneity, have been for long overlooked compared to the ecological knowledge available for other badger populations across Europe. 2. Here we aim to understand what environmental factors drive badger occupancy in Northern Scotland. 3. We took advantage of a major camera-trapping effort, conducted throughout Scotland from December 2010 until July 2013, and applied single-season occupancy models to a comprehensive data set of 11 study areas surveyed during Autumn-Winter seasons in Northern Scotland. We searched for ecological variables explaining occupancy variability inter and intra-area. 4. We found that temperature and altitude are the main determinants explaining variability of occupancy probability between study areas. When study areas were clustered into two distinct topo-climatic groups to emphasize the effect of local, intra-area factors, the occupancy likelihood was mainly dependent on agriculture patches in areas characterized by lower temperature and higher altitude, while in areas characterized by higher temperature but lower altitude human disturbance (distance to human settlements and roads) was the key driver of occupancy. 5. Under predictions of increasing temperature and human population density for Scotland during the forthcoming years we suggest that human activities will be an increasing factor determining badger occupancy in Scotland. Research on badger – human interaction and management plans taking into account the topo-climatic characteristics of the target region are recommended.

Sp15. Oral

Sex-biased dispersal and primary sex ratio in relation to father attractiveness in the spotless starling

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Mothers paired with attractive males should benefit more producing sons if they inherit characteristics determining the attractiveness from their father (i.e., the sexy son hypothesis). This hypothesis, however, have received little empirical support and the evidence of adaptive sex-ratio adjustments in relation to paternal attractiveness is equivocal in vertebrates. Another hypothesis relates adaptive variations in primary sex-ratio to natal dispersal strategies of sons and daughters. Thus, mothers are expected to bias the brood sex-ratio towards the most dispersive sex to prevent future local competition. Here, we explored both questions by experimentally increasing the attractiveness of males (i.e., increasing the amount of plants in nests, a trait involved in courtship) during four years in a wild population of spotless starling. Experimental broods produced more males than controls all the years of the experiment. Furthermore, treatment increased natal dispersal distance of sons and reduced that of daughters. Using long-term observational data, we confirmed this sex-specific effect on dispersal distance, and a tendency of having more males those nests with greater amounts of greenery. These results suggest that sex-ratio variations in relation to male attractiveness, which have been commonly interpreted in the light of the sexy son hypothesis, could be closely related to sex-biased changes of natal dispersal. Behavioural strategies of individuals may be modulated by emergent population patterns as well as individual decisions. Therefore, it could be interesting to reinterpret traditional arguments based on individual decisions in the light of emergent population patterns.

Sp15. Oral

Socio-spatial structuration of alternative breeding strategies in a color polymorphic raptor

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It has been proposed that niche and behavioral processes may promote the coexistence of alternative genetically-determined color morphs in discrete areas. Using long-term data on a breeding population of the colonial, color polymorphic Eleonora's falcon (*Falco eleonorae*), we tested the hypothesis that alternative pale and dark phenotypes have different nest-site distributions and breeding performances. We found that different morphs were segregated over suitable habitats by forming permanent same-color clusters, mainly due to social dominance relationships. The pale morph, which was less dominant but more aggressive than the dark morph, settled close to pale conspecifics but far from dark ones. This segregation was also influenced by the settling of dark morph males in less dense areas and at higher altitudes than pale ones. Although the timing of reproduction did not differ between morphs, the dark morph attained higher reproductive output during the study years. Our results suggest that pale and dark falcons adopt different breeding strategies, with pale morphs behaving highly colonially and dark morphs being more territorial, yet their relative advantages depend on environmental conditions. We suggest that balancing selection may act on such competitive asymmetries, likely contributing to the evolutionary stability and long-term maintenance of color polymorphism in wild populations.

Sp15. Oral

Colony size and foraging range in seabirds

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Understanding why group size varies among animals species is an open question in evolutionary ecology. Seabird colonies range from some few breeding pairs up to hundreds of thousands of nests. We have previously reported high colony size variation within species, but consistent median and maximum colony sizes when studying same species in different populations. Seabirds are central place foragers with species-specific foraging distances ranging from some few hundred meters from the colony to hundreds of kilometers to find food for their nestlings. Here we predicted that the foraging range of species imposes a ceiling on their maximum colony sizes; according to the mathematical equation of the area of the circle, we predicted a second-order relationship between (foraging) radius and (foraging) area. Accordingly, on a log-scale, maximum colony size would scale with slope 2 with foraging range. We performed a phylogenetic comparative study of 43 species. Foraging range showed weak relationships with the low percentiles of colony size, but the strength of the association increased for larger percentiles, peaking at the maximum colony sizes. In order to model constraints on the functional relationship between the focal traits, we applied a quantile regression based on maximum colony size, which showed that the slope of the correlation was around 2 for species that have the higher colony sizes given their foraging ranges. Our results provide a mechanistic explanation to seabird colony sizes, and pose strong support to the hypothesis that food availability is an important regulator of seabird populations.

Sp15. Oral

Waterfowl ecology and management at Ria de Aveiro: past, present and future.

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The digging of a pond with about 8 hectares at S. Jacinto Dunes Nature Reserve (from December 1981 until the Summer of 1984), created a refuge area for Ria de Aveiro waterfowl – the Ria was known by having many poachers. Since 1993 we have been studying waterfowl ecology at Ria de Aveiro and their population dynamics. More than 19000 waterfowl were captured and marked (www.pt-ducks.com), migration routes and phenology determined, and was discovered that some teal, wigeons and pintails moulted primaries feathers at the refuge area, being that the pond management was adapted according to this. On 2005 the area was covered by hunting estates and poachers almost disappeared. Hunting estates agreed to manage Mallard hunting effort together, daily bag limit was reduced initially to 3 mallards (10 at national level) and the start of hunting was delayed from 15 August to 6-9 September, since >50% of adult females were doing or still had to do primaries moult after mid-August. Adult female survival rate increased almost 20% during the first hunting month which improved hunting sustainability. Local Nature Conservation gained with the waterfowl hunting management and, for example, nowadays the study area is the Northern limit of the distribution of the Greater Flamingo in the European Atlantic Coast. There is a project to implement a Global Management Plan to the waterfowl populations of Ria de Aveiro and the concepts and limitations will be discussed.

Sp15. Oral

Do fruit type and seed size determine the role of Asian elephants as seed dispersers?

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Asian elephants are important seed dispersers, feeding on a wide array of fruiting species and dispersing their seeds up to several kilometres away from their mother plants. Their ample dietary breath allows for the consumption of broadly different fruit types that contain seeds of very different sizes. To evaluate the effects of fruit type and seed size on the fate of ingested seeds, we carried out an experiment with captive elephants kept on a semi-natural diet in the Millennium Elephant Foundation, Sri Lanka. We fed five elephants a selection of twelve species of fruits known to be part of their diet, chosen to comprise a broad range of seed sizes (from 0.002 to 1.69 g) and two fruit types (pods and fleshy fruits). Following ingestion, elephants were monitored and all droppings collected. Seeds present in faces were recorded to determine gut passage time and sown in outdoor, common-garden conditions to assess their germination and establishment. Information on gut passage time and germination of ingested seeds was combined with data on elephant movements, obtained from radio-collared animals ranging freely in South Sri Lankan forests, to estimate dispersal distances (seed dispersal kernels). Seed dispersal kernels differed broadly among plant species , but this variation was not correlated with seed size and fruit type. As a consequence, median and maximum dispersal distances followed a idiosyncratic, species-specific pattern, which determined the role of elephants as seed dispersers for the different species.

Sp15. Oral

Effect of weaver ants on plant-pollinator interactions

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Weaver ants, *Oecophylla smaragdina*, are keystone predators in the forests of SE Asia and tropical Australia. They use flowers as hunting platforms, waiting on or under the petals for visiting pollinators. This induces changes in the foraging behaviour of pollinators: pollinators susceptible to predation by weaver ants avoid foraging at plants patrolled by ants, while larger pollinators, such as carpenter bees, are immune to ant attacks and preferentially forage at ant-patrolled plants where intra-specific competition for resources is lower. Depending on the pollination effectiveness of large and small bees, flowers experience selective pressures to attract or repel ants. *Xylocopa* bees are the main pollinators of *Melastoma malabathricum*, while smaller bees remove pollen without effecting pollination. Ant-patrolled *M. malabathricum* individuals attain higher reproductive success than ant-free plants, and in this species flowers produce ant-attractant cues. In general, a phylogenetically corrected analysis revealed that flowers are more likely to produce ant repellents if they are pollinated by small bees than if they are pollinated by large bees. Finally, the presence of weaver ants alters the topology of the plant-pollinator network. Communities without weaver ants receive more pollinator species, have more symmetric interactions and are more nested than communities with weaver ants.

Sp15. Poster

Does bird-mediated seed dispersal occurs beyond local and regional scales?

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Long-distance seed dispersal promotes habitat connectivity, particularly in fragmented habitats, thus regulating metapopulation and metacommunity dynamics. At broader spatial scales, it might lead to range expansion and influence biogeographic processes. Birds are often suggested to mediate seed dispersal beyond local and regional scales, yet it is considered a rare and stochastic phenomenon that remains largely unexplored. In this study, we first used mechanistic models to estimate the potential of migratory waterbirds as vectors of long distance dispersal (LDD). Bird size mediated trade-offs between bird movement and seed retention time that determined seed dispersal patterns and the potential of each bird species as a LDD vector. Model estimates indicate that waterbirds have the potential to disperse seeds regularly over tens of kilometres and occasionally over hundreds of kilometres. Second, to empirically demonstrate that migratory birds can mediate seed LDD, we conducted a field study to quantify the frequency of seed transportation during active migration. By examining the gut contents of birds hunted while in migratory flight by Eleonora's falcons, we show for the first time that migratory birds can actually disperse seeds over hundreds of kilometres. These birds were caught over the Atlantic Ocean, in their way between Europe and Africa, after a non-stop flight, and up to 1.2% of them, mostly passerines, carried seeds in their guts. We conclude that migratory birds differ, according to their body size, in their ability to disperse propagules during active migration, but provide continental-scale LDD services to many plant species.

Sp15. Oral

Seed dispersal in anthropogenic landscapes: incorporating the role of individual decisions by animal dispersers

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Anthropogenic changes in natural ecosystems have strong effects of the distribution and movements of animals and animal-dispersed organisms, influencing in turn their potential responses to other components of global change (such as global warming). Unfortunately, incorporating the role of individual choices and decisions by animal dispersers to seed dispersal models remains as one of the major challenges in dispersal ecology. Based on examples from a suite of seed-dispersal systems (dispersal of fleshy-fruited epiphytes by marsupials and birds in Chilean forests; dispersal of fleshy-fruited shrubs by frugivorous lizards in Balearic Islands; and dispersal of Juniper seeds by thrushes in the Cabrera Archipelago), we present a number of approaches and tools to address such challenge. We conclude by discussing current gaps in knowledge and promising research avenues towards the development of integrated models of animal and animal-mediated movement.

Índice de autores