



European Ecological Federation



ASOCIACIÓN ESPAÑOLA
DE ECOLOGÍA TERRESTRE



Sociedade Portuguesa de Ecologia

12th European Ecological Federation Congress

25-29 September 2011, Ávila, Spain

"Responding to Rapid Environmental Change"

10th Annual Conference of the
Spanish Association for Terrestrial Ecology

13th Annual Meeting of the
Portuguese Ecological Society

3rd Iberian Congress of Ecology

ABSTRACT BOOK

12th European Ecological Federation Congress

Jointly with the:

10th Annual Conference of the Spanish Association for Terrestrial Ecology

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3rd Iberian Congress of Ecology

25-29 September 2011, Ávila (Spain)

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Greeting

The 12th European Ecological Federation (EEF) Congress is, in fact, the first EEF 'Congress': many will remember that in previous years EEF meetings have been known as European Ecological Congresses 'EURECO'. From 2011 onwards, EEF meetings will be held once every two years, and we will continue to organize our conferences as joint Congresses with our member organizations as well as with other international ecological societies.

Over the last few years, the EURECO increased in scientific quality and size. Our conferences became important meetings for European ecologists, a place for scientific exchange and symposia demonstrating European-wide scientific projects. We will continue this growth with the EEF Congresses. Our Congresses are a window onto ecological science in Europe but also a place for ecologists to meet with national and European funding organizations, research institutions and representatives of the European Commission as well as non-governmental organizations.

The title of our Congress, "Responding to Rapid Environmental Change", reflects the fact that ecologists are meeting one of the great challenges of the present: how to deal with the impact of global change on ecosystems. The EEF is most grateful to the Spanish and Portuguese associations (AEET and SPECO) for hosting in 2011 what promises to be an excellent meeting, advancing the science of ecology in Europe and bringing the very best scientific minds together to consider how ecology can contribute to tackling many of the challenges faced by society and the environment across the globe.

Prof. Dr. Stefan Klotz. President of EEF

It was with great pleasure that we accepted the invitation to organize the 12th European Ecological Congress to take place in Avila (Spain) from 25th to 29th September 2011. The Spanish Association for Terrestrial Ecology (AEET) and the Portuguese Ecological Society (SPECO) have made a great effort to bring together talented scientists, novel ideas and promising students to tackle ecological issues under the framework of global change. It was a challenge and we think that with the joint effort of many colleagues we have been able to arrange a stimulating scientific program. We are very grateful to the many ecological associations and academic institutions that supported this event and that has profoundly contributed to it. Our venue, Avila, a quiet, small town of medieval feel, was chosen in order to promote scientific discussions in an inspiring and peaceful setting. We are grateful to the local, regional and national authorities and institutions that have also to make the meeting a reality.

We wish you a successful experience both with the scientific and the cultural activities that are programmed.

Prof. Dr. Fernando Valladares. President of AEET

Prof. Dr. Helena Freitas. President of SPECO

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List of sessions and convenors

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- S.02 - **Drivers of pollinator loss in Europe.** Montserrat Vilà, (Doñana Biological Station, CSIC, Spain). Simon Potts, (University of Reading, UK).
- S.03 - **Biodiversity and Ecosystem Functioning in the Context of Environmental Changes.** Hervé Jactel. (UMR BIOGECO-INRA, France).
- Session sponsored and coordinated by Baccara EU project.
- S.04 - **Impacts of climate change mitigation measures on biodiversity and ecosystem services.** Jens Dauber, (vTI, Institute of Biodiversity, Braunschweig, Germany). Jane Stout, (Trinity College Dublin, Ireland). David Bourke, (Trinity College Dublin, Ireland).
- S.05 - **The role of ectomycorrhizal communities in carbon cycling: New perspectives and emerging concepts.** Ken Cullings, (NASA, USA). Pierre-Emmanuel Courty, (University of Basel, Switzerland).
- S.06 - **Cause-Effect Relationships in Food Webs.** Fred Jopp, (University of Miami, USA). Donald L. DeAngelis, (University of Miami; U.S. Geological Survey, USA). Alberto Basset, (University of Salento, Lecce, Italy).
- S.07 - **Theoretical Ecology.** Miguel Angel de Zavala, (INIA-CIFOR, Spain).
- S.08 - **Stable isotopes in ecological processes.** Cristina Aponte (Institute for Natural Resources and Agrobiology, Spain). M^a Paz Esquivias Segura, (University of Sevilla, Spain). Juan Pedro Ferrio, (University of Lleida, Spain). Sara Palacio, (IPE, CSIC, Spain).
- S.09 - **Surveillance and Monitoring of habitats and species.** Rob H.G. Jongman, (Wageningen UR, GEO BON). R.G.H. Bunce, (Wageningen UR, The Netherlands).
- S.10 - **Ecological networks of mutualistic and antagonistic interactions. Implications for conservation and restoration.** Anna Traveset, (IMEDEA, UIB, CSIC Spain). Miguel Verdú, (University of Valencia, Spain).
- Session sponsored by International Union of Biological Sciences.
- S.11 - **Impacts of global environmental change on the structure and functioning of dryland ecosystems.** Fernando T. Maestre, (Rey Juan Carlos University, Madrid, Spain). Roberto Salguero-Gómez, (University of Pennsylvania, USA).
- S.12 - **Evolutionary history, ecosystem function, and conservation biology: new perspectives.** Hélène Morlon, (CMAP Ecole Polytechnique, France). Franck Jabot, (CEMAGREF Clermont-Ferrand, France).
- Session sponsored by the Fondation pour la Recherche sur la Biodiversité.
- S.13 - **Evolutionary Ecology.** Adolfo Cordero, (University of Vigo, Spain). Silvia Matesanz (MNCN, CSIC, Spain)
- S.14 - **Functional Ecology.** Helena Freitas, (University of Coimbra, Portugal).
- S.15 - **Synthesizing community ecology, phylogenetics and macroecology.** David Nogués-Bravo, (University of Copenhagen, Denmark). Nathan Sanders, (University of Tennessee).
- S.16 - **Biodiversity and Ecological Services in Agricultural Systems.** Manuel B. Morales, (Autonomous University of Madrid, Spain). Juan J. Oñate, (Autonomous University of Madrid, Spain).
- S.17 - **Population Ecology and Community Ecology.** Begoña García, (IPE, CSIC, Spain).
- S.18 - **Dryland restoration from ecotechnology to people.** José María Rey Benayas. (Universidad de Alcalá, Spain). Jordi Cortina. (IMEM, University of Alicante, Spain). Jaime Puértolas. (Fundación CEAM, Spain).
- Session sponsored by REMEDINAL-2 project.
- S.19 - **Ecological Models and their applications in forest management.** Juan A. Blanco, (University of British Columbia, Canada). Adam Wei (University of British Columbia, Canada).
- S.20 - **Ecosystems evolution during early successional stages: How can we link pattern and processes for the understanding of ecosystem dynamics?** Maik Veste, (Cottbus, Germany), Siegmund Breckle, (Bielefeld, Germany).

- S.21 - Involving Citizen Scientists in Ecology. Dan Bebber, (Earthwatch Institute / University of Oxford, UK).
- S.22 - Ecological Indicators of environmental change. Cristina Branquinho, (University of Lisbon, Portugal).
- S.23 - Drought-induced forest dieback: causes, scope and implications. Francisco Lloret, (CREAF, Autonomous University of Barcelona, Spain). Jordi Martínez-Vilalta, (CREAF, Autonomous University of Barcelona, Spain).
- S.24 - **Concepts in the center of ecological knowledge? Probing a reflexive tool in biological conservation, ecological model building and data collection.** Kurt Jax, (Helmholtz-Centre for Environmental Research - UFZ, Leipzig, Germany). Astrid Schwarz, (TU Darmstadt, Germany / University of Basel, Switzerland).
- S.25 - Applied Ecology. Josep M^o Espelta, (CREAF, Autonomous University of Barcelona, Spain).
- S.26 - Trophic interactions and ecosystem functioning in real-world landscapes. Daniel García, (Oviedo University, Spain). Jason Tylianakis, (Canterbury University, New Zealand).
- S.27 - Conservation Biology. Mario Díaz Esteban, (Museo Nacional de Ciencias Naturales (MNCN). The Spanish National Research Council (CSIC), Spain)
- S.28 - Population Ecological Genetics and Genomics. Cristina García, (CIBIO, Porto, Portugal). F. Xavier Picó, (Doñana Biological Station, CSIC, Spain)
- S.29 - Sharing and harmonizing long-term ecosystem research and monitoring across Europe: contributions and experiences from the EnvEurope Life + project and the LTER-Europe network in 21 countries. Mark Frenzel, (Helmholtz Centre for Environmental Research - UFZ). Mauro Bastianini, (Institute of Marine Sciences Venezia, Italy).
- Session sponsored by ENVEurope project.
- S.30 - Ecology and evolution of dispersal in a rapidly changing environment: from understanding to conservation strategies. Dries Bonte, (Ghent University, Belgium). Justin Travis, (Aberdeen University, UK).
- S.31 - Applications of ecological models in biodiversity conservation and monitoring in a rapidly changing world. Joana Vicente, (Universidade do Porto, Portugal). Ângela Lomba, CIBIO - (Universidade do Porto, Portugal).
- S.32 - Ecological and ecotoxicological effects of oil spills and plastics in the marine environment. Lúcia Guilhermino, (University of Porto, Portugal). Paula Sobral, (Universidade Nova de Lisboa, Portugal).
- S.33 - Mediterranean forests and global change. Enrique Doblas-Miranda, (CREAF, Autonomous University of Barcelona, Spain). Javier Retana, (CREAF, Autonomous University of Barcelona, Spain). Fernando Valladares, (CCMA-CSIC), Spain.
- S.34 - Stress ecology of soil invertebrates. Péter Nagy, (Szent István University, HUNGARY). Erzsébet Hornung, (Szent István University, HUNGARY). Thomaé Kakouli-Duarte, (Institute of Technology Carlow, IRELAND).
- S.35 - Advances in Eco-hydrology. Juan Puigdefabregas, (EEZA-CSIC, Spain).
- S.36 - Climate change, extreme events and alpine ecosystem responses. Laszlo Nagy. (The National Institute of Amazonian Research, Brazil)

Abstracts of Plenary Lectures

PL.1

Plant-Animal Mutualistic networks: the Architecture of Biodiversity.

Bascompte, Jordi.

Estación Biológica de Doñana, CSIC, Spain.

The mutualistic interactions between plants and the animals that pollinate them or disperse their seeds can form complex networks involving hundreds of species. These coevolutionary networks are highly heterogeneous, nested, and built upon weak and asymmetric links among species. Such general architectural patterns increase network robustness to random extinctions and maximize the number of coexisting species. Therefore, mutualistic networks can be viewed as the architecture of biodiversity. However, because phylogenetically similar species tend to play similar roles in the network, extinction events trigger non-random coextinction cascades. This implies that taxonomic diversity is lost faster than expected if there was no relationship between phylogeny and network structure. I will conclude by exploring the trade-offs between a species' relative contribution to the above patterns of network architecture, and its own survival probability.

PL.2

Earth Stewardship: Sustainability Strategies for a Rapidly Changing Planet.

Chapin III, Francis Stuart.

University of Alaska Fairbanks, USA..

Earth stewardship is an action-oriented framework intended to foster social-ecological sustainability of a rapidly changing planet. Recent developments identify three strategies that make optimal use of current understanding in an environment of inevitable uncertainty and abrupt change: reducing the magnitude of, and exposure and sensitivity to, known stresses; focusing on proactive policies that shape change; and avoiding or escaping unsustainable social-ecological traps. All social-ecological systems are vulnerable to recent and projected changes but have sources of adaptive capacity and resilience that can sustain ecosystem services and human well-being through active ecosystem stewardship. There is urgent need for natural and social scientists to collaborate with practitioners and the public in developing strategies that foster stewardship at all scales. Ecologists can foster earth stewardship at local to global scales through education and outreach that fosters appreciation for and commitment to local and global places, monitoring threats to and progress toward sustainability, improved understanding of threshold behavior of social-ecological systems, and leadership in defining and pursuing sustainability goals. I show from collaborations with Alaska Indigenous residents, who are experiencing substantial climate change, that each of these steps is feasible.

PL.3

Pushing the boundaries of ecological science: emerging topics for the coming decades.

Mace, Georgina.

Centre for Population Biology - Imperial College London, (NERC),UK.

Recently we have seen much interest in the causes and consequences of biodiversity loss and of ecosystem changes. Discussions in the scientific and policy fora focus on the relevance to human societies, their activities and aspirations. Ecological science lies in the core of this debate, yet its role and significance is not yet well defined or understood. Using examples from recent work in conservation biology, climate change science, economic valuation of ecosystems, and human impacts on ecosystem services, I will draw out some key areas for ecological research now emerging in importance and relevance.

PL.4

Ecological Restoration: theory, practice and reality.

Mammott, Jane.

School of Biological Sciences, University of Bristol, UK.

Ecological restoration requires the reinstatement of both community structure and community function if it is to be sustainable in the long term. Constructing ecological networks provides data on community structure and experimentally perturbing networks provides information on community function. Moreover by working on the interactions between species ecologists are dealing in the currency of ecological services. In this talk I will consider restoration at the community level using examples from a range of countries and habitats and I'll discuss what ecologists can do to improve both the science and the success of ecological restoration.

PL.5

Conservation biology: why evolution matters.

Olivieri, Isabelle.

Institut des Sciences de l'Evolution-Montpellier - CNRS. Montpellier, France.

Conservation biology is about slowing down extinction rates. It is traditionally studied by focusing on either habitats or individual species. Within species, populations are usually studied from either a demographic approach (e.g., through population viability analyses), or a population genetic approach (e.g., to infer flow among populations using neutral genetic markers), or more rarely both. Still, species will go extinct anyway, unless they can evolve to avoid extinction and maintain themselves or, even better, diversify into new species. Using examples from our work on mediterranean species (including species from south african fynbos) as well as theoretical work, I will advocate the use of an integrated evolutionary approach. In particular, taking into account the heterogeneity of the habitat might improve the integration of habitat and species management strategies.

PL.6

Spatial point pattern analysis in ecology.

Wiegand, Thorsten.

Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany.

Over the last decade or so, there has been a strongly increasing interest in the study of spatial patterns in ecology. Ecologists study spatial patterns to better understand the processes that may have caused observed patterns, to identify the scale at which they are operating, and to test spatially related ecological theories. Recent advances in mapping techniques and remote sensing provide now large fully mapped plots that record the coordinates and possibly additional information that characterize the ecological objects. In this talk I provide an overview and examples on new developments in spatial point pattern analysis, the technique of choice for this data type. Earlier studies in ecology used a rather limited repertoire of point pattern techniques and explored mostly the question if a pattern was random, regular, or aggregated, or tested the random mortality hypothesis. However, more recent studies employ a much wider range of techniques that allow for deeper insight, especially for multi plant species communities. As an example for univariate analysis I show how application of specific point process models can quantify complex spatial structures of tropical tree species that may involve habitat association and superposition of several critical scales of clustering. Relating critical scales of clustering to species traits helps to formulate hypotheses on the underlying processes. As example for analysis of multi species patterns I show that co-distribution patterns in species rich forests change substantially with life stage from a dominance of positive small-scale associations for recruits to a dominance of neutral or segregation patterns for adults. Finally, I present techniques to quantify spatial structures in diversity. The examples outline the large potential of advanced techniques of point pattern analysis in ecology to precisely describe spatial structures which can help to infer the underlying processes.

Abstracts of Contributions

S.01- Limitations to green house gas assimilation across scales in a warming world

S.01-01-0

CAPACITI: a project on the Carbon dynAmics in Pyreanean grAsslands: a first-time assessment with eCosystem fluxes, Isotopic labelling, and planT guilds.

Altimir, Nuria. Gouriveau, Fabrice. Nogués, Salvador. Sebastià, Maria Teresa.

Forest Sciences Center of Catalonia CTFC. Forest Sciences Center of Catalonia CTFC. Universitat de Barcelona. Forest Sciences Center of Catalonia CTFC and Universitat de Lleida.

Given the vulnerability of mountain ecosystems and their importance as carbon storage systems, there is a pressing need to understand how mountain grassland ecosystems function - with the aim to assess the impact of global change and to determine the management mechanisms that can ameliorate its effects. This work focuses on the study of the annual carbon dynamics of semi-natural grazed grasslands in the Pyrenees. The central question is to resolve how management and climate combine to regulate grassland productivity and carbon storage capacity. This is pursued with a multi-site analysis of ecosystem dynamics from eddy correlation towers data (description of annual cycles and main biotic and abiotic controlling factors, annual carbon balance, partition of ecosystem fluxes), process understanding (compartment functioning through stable isotope analyses and gas-exchange chambers), and evaluation of process-based models of carbon balance for mountain grasslands. Emphasis on the potential role of plant guild distribution as ecosystem regulator is transversal throughout the activity. The study benefits from the infrastructure of the transnational and interdisciplinary project FLUXPYR, which has established an unprecedented multi-site network for the integrated study of the carbon, nitrogen and water cycles in Pyrenean ecosystems. The poster will present the rationale and first results of the CAPACITI project, just started on summer 2011.

S.01-02-0

Above-ground net primary production response to 4 years of nitrogen addition in a tropical lower montane forest.

Baldos, Angelica. Corre, Marife. Sueta, Juvia.

University of Goettingen. University of Goettingen. University of Goettingen.

Nitrogen (N) deposition in tropical areas is projected to increase rapidly in the next decades and little is known on how tropical forest productivity will respond to increase in N availability. We used an N-addition experiment to achieve an N-enriched condition in an old-growth forest growing on an Aluandic Andosol soil at 1200-1300-m elevation in Fortuna Forest Reserve, Panama. Control and N-addition treatments (starting in 2006 at a rate of 125 kg urea-N ha⁻¹ yr⁻¹, split in four applications) were laid out in paired-plots design with four replicate plots (40mx40m each, separated by ≥40-m distance). Here, we report the changes in various components of above-ground net primary production (ANPP) during the 3-4-yr N addition: stem diameter growth (separated by diameter at breast height (DBH) classes of 10-30 cm, 30-50 cm, and >50 cm), woody biomass production (WBP) and fine litterfall. No significant differences were observed between 3-4-yr N addition and the control in stem diameter growth of any DBH classes or all classes combined (control: 1.6±0.2 mm yr⁻¹; N-addition plots: 1.9±0.2 mm yr⁻¹), in WBP (control: 4.3±0.6 Mg ha⁻¹ yr⁻¹; N-addition plots: 4.2±0.5 Mg ha⁻¹ yr⁻¹), in total fine litterfall (control: 7.3±0.4 Mg ha⁻¹ yr⁻¹; N-fertilized: 8.0±0.4 Mg ha⁻¹ yr⁻¹), and in ANPP (control: 11.6±0.8 Mg ha⁻¹ yr⁻¹; N-fertilized: 12.3±0.8 Mg ha⁻¹ yr⁻¹). The first 2 years of N addition showed significant increase in ANPP compared to the control, and this was mainly due to increased leaf-litter production (Adamek et al. 2009). Our results showed interannual variation of ANPP response to N addition.

S.01-03-O

Plants and CO₂: Will rising temperatures trump CO₂ fertilization?

Drake, Bert. Hayek, Lee-Ann.

Smithsonian Institution, Washington, DC. Smithsonian Institution, Washington, DC.

Atmospheric CO₂ has increased more than 40% since 1800 and 15% in past 25 years. Data from a long-term study of elevated CO₂ impacts on Florida Scrub Oak and a Chesapeake Bay wetland in Maryland, USA, shows increased growth of roots and shoots, and gas exchange studies indicate a strong interaction between climate factors and CO₂ fertilization with high inter-annual variation in all factors due to variation in precipitation and soil water. If crops and wild species have responded as happened in this study of the responses of plant physiological processes to increasing CO₂, biomass productivity should have increased, transpiration decreased, the structure of ecosystems shifted, and carbon sequestration increased worldwide. There is some indication that some of this has happened: river discharge has increased, consistent with decline in transpiration and forests have thickened in Africa, Arctic tundra has been invaded by shrubs, and growth of some Tropical trees increased, consistent with stimulation of biomass production as a result of CO₂ fertilization. But analyses of trends in temperature and crop yields suggest that crop production increased only during cool periods and dramatically declined during periods of warming. Prospects for the future suggest that yield of corn, soybeans and wheat, the three major crops in the US, may decline 40-60% during this century due to rising temperatures and increased drought. This talk will describe the long-term study of the effects of elevated CO₂ on two ecosystems and discuss these apparently contradictory, counter-intuitive trends in crop production.

S.01-04-O

Seasonal variation in Q₁₀ and respiration in evergreen Mediterranean maquis species.

Fusaro, Lina. Mereu, Simone. Spano, Donatella. Manes, Fausto.

"La Sapienza" University of Rome. Euro-Mediterranean Center for Climate Change; University of Sassari, Italy. Euro-Mediterranean Center for Climate Change; University of Sassari, Italy. "La Sapienza" University of Rome.

Plant respiration is now accepted as a critical component of the biosphere's response to global climate change, but many models aimed at determining the carbon balance do not consider the weight that the variations in temperature have on short and long term respiration rates (R_d). Models that simulate system behavior in terms of a carbon balance, use a range of assumptions and generalizations that fix the Q₁₀ at or near 2.0, and fix R_d at a reference temperature as a proportion of photosynthesis. This approach doesn't consider the fact that acclimation to temperature may shift the entire temperature response function (shape), nor does it account for the temperature dependence of the Q₁₀ itself. To explore the margin of error of these assumptions, temperature-response curves were determined in different season, on three maquis species in four different sites that differ for drought intensity and mean annual temperature. The obtained dataset was analysed to estimate the seasonal variation in Q₁₀ and basal respiration to explain what kind of seasonal acclimation occurs in the studied species and to quantify the error originated by models with a constant Q₁₀ and R_d. Additionally, in spite of the relative importance of the temperature acclimation process, the influence on respiration of the phenological phase and of drought is discussed.

S.01-05-O

The Carbon Footprint and the role of agriculture practices and soil in the carbon sequestration.

Martins, Helena. Valada, Tatiana. Domingos, Tiago.

Instituto Superior Técnico. Instituto Superior Técnico. Instituto Superior Técnico.

The Global Carbon Footprint measures the area of forest needed to sequester the total dioxide carbon emissions from anthropogenic sources. This is a component of the Ecological Footprint Indicator and the major responsible for the actual conclusion of environmental unsustainability. Using Portugal as a case study, we analyse how the indicator should be calculated by taking into account other land areas that also contribute to the carbon sequestration at the indicator. In Portugal, previous assessments indicate the importance of land management in the ability to sequester carbon, namely through the increase in organic matter. The land management under analysis include the implantation of Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL), the non-use of tillage to control shrubs and to crop seeding, all of them related to an increase in organic matter. SBPPRL have been developed in Portugal and are an example of Biodiversity Engineering applied to carbon sequestration. They are composed of a variety of about 20 species of plants which allow the system to adapt to the particular characteristics of the site. No-tillage at shrub control and crop seeding allow both an increase of the biomass on the field and a decrease of mineralization. Both agriculture practices are thus considered to promote carbon sequestration and are account for in the Portuguese carbon assessment under Article 3.4 of Quoto's Protocol.

S.01-06-O

Precipitation regime exert a stronger control on soil respiration pattern than other biotic or abiotic factors in a Mediterranean mountain ecosystem.

Matías, Luis. Castro, Jorge. Zamora, Regino.

University of Granada. University of Granada. University of Granada.

Soil respiration (RS) plays a critical role in regulating atmospheric CO₂ concentration and climate dynamics at global scale, although a warmer and drier future climate as expected for the coming decades on some areas might imply strong consequences on RS dynamics. In this study, we performed a field experiment to test the effect on temporal variation in RS of three contrasting climate scenarios differing in water availability, as well as to determine the main factors controlling RS. The scenarios were i) current climate conditions, ii) more severe summer drought and iii) heavier summer rainfall simulating eventual rainy years. In addition, we performed the study in the main successional habitats in the area (forest, shrubland and open habitat) and characterized other factors that would be affecting RS as soil C pool and microbial biomass. We found a strong control of precipitation pattern on CO₂ efflux both at seasonal and daily scales, being its effect stronger than the effect of temperature, C availability or microbial biomass. In Mediterranean ecosystems, is only when soil moisture is not the limiting factor when temperature may determine the final result of soil respiration. Thus, the projected changes in precipitation pattern may have much larger effects on RS than the projected increases in temperature. Our experimental approach suggests that the precipitation decrease expected in Mediterranean areas might increase the soil C sequestration on the coming decades by the progressive decrease in soil respiration.

S.01-07-O

Photochemical response of *Cistus monspelliensis* L. to temperature and drought.

Mereu, Simone. Fusaro, Lina. Liberati, Dario. Marzuoli, Riccardo. Cabras, Matteo. Kuusk, Joel. Gerosa, Giacomo. de Dato, Giovanbattista.

Euro-Mediterranean Center for Climate Change; University of Sassari, Italy. "La Sapienza" University of Rome. University of Tuscia. Catholic University of Brescia. University of Sassari, Italy. Tartu Observatory. Catholic University of Brescia. University of Tuscia.

Direct Fluorescence, leaf and canopy level reflectance are used to detect effects of increased temperature and reduced water availability on the photochemistry of *Cistus monspelliensis* L. and its acclimation processes to the new climate conditions. Measurements were performed in an experimental facility in Sardinia (Italy) which is part of the INCREASE infrastructure. INCREASE manipulates the climate in 20 m² plots to simulate the climate change: warming is achieved by drawing reflective curtains at night preventing heat loss, while drought is achieved by covering the plot during rain events. Each treatment has three replicates. Mean annual air temperature is increased by 0.7 °C while precipitations are reduced by approximately 16%. Chl "a" direct fluorescence, leaf level and canopy reflectance were measured in autumn, winter, spring and summer with a Hansatech Handy PEA fluorometer and a ASD FieldSpec spectroradiometer respectively. Leaf level reflectance was measured with the ASD leaf clip. To capture a wider climatic range, measurements on the same species were performed in two other sites characterized one by abundant precipitations and cold temperatures and the other by warmer temperatures compared to the increase site. First, the correlation between OJIP parameters and reflectance indexes (PRI, FRI, Chl "a" content) is discussed. Afterwards it is shown how temperature and drought influence the photochemistry of *Cistus monspelliensis* in terms of photochemical and non-photochemical quenchings.

S.01-08-O

Weakening of CO₂ sinks in the subalpine forest ecosystem.

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The subalpine forest ecosystem in the Rocky Mountains of Colorado, USA, exhibits higher potential for CO₂ uptake during years with higher snowpack and later snow melt, and lower potential for CO₂ uptake during years with lesser snow packs and earlier snow melts. Over the past five decades, the climate trends in this ecosystem have been toward lower snowpacks and earlier snow melt. Thus, we predict a future weakening of this carbon sink as climate warming continues. Using stable isotope studies, we have shown that the mechanisms for this response lie with reduced gross primary productivity during the summer as a result of reduced stored snow melt water during years with warmer winters. Recently, warmer winters have also facilitated large-scale bark beetle attacks on this forest ecosystem. Using natural and manipulated chronosequences of time since beetle attack, we have observed almost immediate reductions in soil respiration rate and gross primary productivity following attack, and this appears to be due to reductions in the autotrophic component of soil respiration. Across the decade following attack, there is a slow increase in soil respiration due to increases in the heterotrophic component of soil respiration, although the total soil respiration rate does not exceed the pre-attack levels. We conclude that the soils of this ecosystem will not become large sources of CO₂ due to high litter production and increased decomposition following beetle attack, at least for the first decade following attack.

S.01-09-O

Chronic N addition to tropical forests: impact on N-oxides fluxes, N₂O sources, and soil-profile N₂O concentrations.

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Georg-August University of Goettingen. Georg-August-University of Goettingen. Georg-August-University of Goettingen.

N deposition is projected to increase in tropical region and emissions of climate-relevant N-oxide (NO and N₂O) gases are expected to rise. However, few studies quantify long-term impact of increased N availability on these gases and on the processes responsible for their production. We used N addition experiments to achieve N-enriched conditions in contrasting montane (3-4-yr N addition) and lowland (11-12-yr N addition) forests in Panama. Control and N-addition (receiving 125 kg urea-N ha⁻¹ yr⁻¹) treatments were represented by four (40 m x 40 m) replicate plots each. We wanted to 1) quantify changes in surface N-oxide fluxes during N addition in tropical montane and lowland forests and 2) assess the contribution of denitrification and nitrification to the surface N₂O fluxes and deduce which process might be dominant at lower depths. In the montane forest, N-oxide fluxes from N-addition plots were higher than the control. During the two-year measurement period (2008-2009), a two-fold increase in annual N₂O fluxes was observed while annual NO fluxes decreased from the N addition plots. Nitrification contributed $\geq 60\%$ to the N₂O flux from both treatment plots while $\leq 40\%$ was attributed to denitrification. In the lowland forest, N-oxide fluxes from N-addition plots were also higher than the control. Annual N₂O and NO fluxes from the N-addition plots remained comparable. Denitrification appeared to be the dominant process producing N₂O in N-addition plots (contributing $\geq 60\%$) during both dry and wet seasons. In the control plots, nitrification accounted for 70% of the total flux during the wet season. At both sites, soil-profile N₂O concentrations in the N-addition plots were significantly higher than the control, starting at about 40-cm depth. High water-filled pore space ($\geq 80\%$) at these depths suggests that denitrification might be the dominant process contributing to the measured N₂O concentrations.

S.02- Drivers of pollinator loss in Europe

S.02-01-P

Effect of woody elements on the diversity and abundance of native bees in agricultural landscapes.

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CEMAGREF Nogent-sur-Vernisson, France. CEMAGREF Nogent-sur-Vernisson, France. CEMAGREF Nogent-sur-Vernisson, France. CEMAGREF Nogent-sur-Vernisson, France. CEMAGREF Nogent-sur-Vernisson, France.

In the present study we try to understand how the proximity to forest affects bee diversity and abundance in French rapeseed fields and apple orchards. Though autopollination or honey bee hives provide the main pollination service for industrial crops, wild bees contribution improves yields and reduces blooming period. Therefore, preserving and enhancing native bee populations offer both economical and conservation interests. In spring 2010, we sampled bees in 8 rapeseed fields using pan traps at three distances from the forest (0m, 50m and 200m) along the blooming period. Our first results show a significant effect of distance from forest on bee assemblages. The 0m distance differs from both 50m and 200m in all the tested variables, i.e. community composition, total bee abundance or DIT (distance intertegula) group abundance. Nonetheless we found no differences between assemblages at the 50m and 200m distances. Forest vicinity seems to affect bee abundance and diversity in rapeseed crops and may affect pollination services. This preliminary study allows us to see how far species using forest edge can go into the field. In spring 2011, we used a similar method to compare bee diversity and abundance between (i) forest edge, (ii) 10 m distance into the contiguous rapeseed field or orchard, (iii) fallow edge as another semi-natural habitat, (iv) cereal field edge as another type of crop and (v) a halfway point between these different edges of the rapeseed field or the orchard. The field experiment includes 10 rapeseed fields and 11 orchards in central France.

S.02-02-O

Drivers and trends of bumble bee community composition.

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Loss of pollinating species richness is increasingly well documented. Less information is available on how the relative commonness of different species in the pollinator communities has changed over time and in different landscapes. Such information is critical if we are to understand the mechanisms leading to extinctions and the capacity of a pollinator community to provide pollination services to wild and crop plants. Here we present information on bumble bee community composition gathered in and around arable fields with red clover (*Trifolium pratense*) cultivated for seed production. Bumble bees are the main pollinators of red clover. We demonstrate drastic changes in bumble bee community composition over the last 70 years in Sweden, with consequences for red clover seed yields. Bumble bee communities have moved from being evenly distributed among species to become totally dominated by two species today. We also show that landscape structure and presence of mass-flowering crops can alter the community composition of bumble bees. These changes in are linked to traits related to the bumble bee species foraging niches and foraging ranges. Our results suggest a need to develop management schemes that promote not only species-rich, but also more evenly composed communities of service providing organisms.

S.02-03-O

Evaluating changes in plant-flower visitor communities through time at different spatial scales.

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Previous studies have used historical records of species to evaluate changes of flowering plants and flower visitors, reporting parallel declines. However, it is still unclear if there is a causality link between the diversity changes of these groups or if they are simply responding similarly to common external drivers (e.g. land use change). To further investigate how plant- flower visitor diversity and composition are changing in Europe we collected records from 1950 until 2010 from four European countries on plants, and on important groups of flower visitors: bees, hoverflies, butterflies and moths. To account for differences in recording effort among the time periods, rarefaction techniques were used to assess changes in species diversity or each grid cell and similarity index were calculated to assess changes in species composition. Changes were evaluated at several spatial scales: 10x10km, 20x20, 40x40, 80x80 & 160x160km. Preliminary results reveal that patterns of change found when using different scales can differ substantially, and that different groups of flower visitors have different patterns of change. While plants changes were more accentuated at smaller spatial scales, flower visitors declines were more accentuated at higher spatial scales, and the increases which were also detected among flower visitors were more accentuated at smaller spatial scales. Our findings reveal important information on the spatial dimension of biodiversity change.

S.02-04-O

Impact of urbanization on flower visitors assessed with a country-wide monitoring program based on citizen science.

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Museum national d'Histoire naturelle. Museum national d'Histoire naturelle. Museum national d'Histoire naturelle.

Pollinators play a key role in ecosystems functioning. Decline in both honey bee and wild pollinators have recently been documented and habitat loss coupled with agricultural intensification have been highlighted as important drivers of this pollination crisis. The effect of urbanization is less documented, and it has been proposed that due to high availability of floral resources and low pesticide level, urban areas may act as refuges for pollinators. We tested this hypothesis using data from a new monitoring program based on citizen science, where observers sample plant-insect interactions following a standardized protocol. By the end of 2010, about 13000 interactions have been sampled in 2200 localities distributed all across France. Our results indicate first that the majority of flower visitors are negatively affected by urbanization. Second, sensitivity to urbanization differs among insect orders, with hymenopterans appearing more tolerant than dipterans and lepidopterans. Third, within insect orders, urbanization's sensitivity seems to be related to the complexity of the insect life cycle, with for example, parasitic hymenopterans that appear to be more sensitive than non-parasitic ones. These results do not support the hypothesis that urban areas are refuges for pollinators. Citizen science seems an appropriate methodology to study pollinator's communities and their responses to large-scale environmental characteristics.

S.02-05-P

Impact of local spatial heterogeneity on the foraging behaviour of bumblebees and on pollination of a floral community.

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Habitat fragmentation and loss of landscape heterogeneity are acknowledged as key drivers in pollinator decline. At the landscape scale, homogenization negatively impacts the diversity and quantity of floral resources available to pollinators. At the local scale, the spatial structure of floral patches modifies the distribution of floral resources that could impact pollinator behaviour and therefore pollination efficiency and the sustainability of the floral community. This study aims to understand the impacts of local spatial heterogeneity on the foraging behaviour of bumblebees (*Bombus terrestris*), and on the reproductive success of a plant community in experimental conditions. Two entomogamous species (*Lotus corniculatus*, *Medicago sativa*) were grown in pollination cages under two spatial configurations: one with a patchy distribution of plants for each species ("low heterogeneity"); and one with a random distribution of plants ("high heterogeneity"). The impact of heterogeneity was tested under two pollinator density treatments: either six bumblebees or two bumblebees were allowed to forage on the community. Following a full-crossed experimental design with 20 replicates for each of the 4 treatment modalities, bee's foraging behaviour and reproductive success of plants were measured. Our results show that bumblebees forage over smaller distances in low heterogeneity conditions, however the number of switches between plants, the number of plants visited and fruit set were significantly higher under low heterogeneity. These results are interpreted within the framework of Optimal Foraging Theory. They underline the importance of plant community heterogeneity on the functioning of plant pollinator networks and the sustainability of a plant community.

S.02-06-0

Landscape composition influences honeybee colony dynamics in an intensive cereal farming system.

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We report the results of a monitoring program initiated in western France three years ago to determine (i) how the composition of an intensive cereal openfield landscape influences honeybee colony development and performance and (ii) whether honeybees may be used as a model species to assess the management efficiency of natural habitat remnants. Fieldwork was undertaken in a 45000-ha long-term biological research facility where the geographical information on land use and farming practices is censused and updated annually. In this system, floral resources available to honeybees peak during oilseed rape (Mars-April) and sunflower (July) blooming periods. Therefore, we expected the long food shortage period spanning from early May to late June would exert strong constraints on colony dynamics, but that the presence of semi-natural habitat remnants in the proximity of apiaries would buffer those constraints by providing bees with alternative, steady-state, flower resources. During the last three years, a total of 150 colonies have been shared out into 30 locations and monitored for a complete season each. Colony dynamics was described using common indicators: brood quantity, population size and honey reserves. Pollen gathered by foraging bees was also analysed for identifying the main plant resources. Most of these biological parameters were strongly influenced by a complex interplay between semi-natural habitats and cropped areas. The results will be presented and discussed in relation with a contemporary research program on sustainable agricultural systems.

S.02-07-0

Impact of habitat fragmentation and invasions on pollinators: A meta-analysis.

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Among the different drivers of the global change, habitat fragmentation and biological invasions are considered in certain regions to be the main causes for the biodiversity crisis (D'Antonio 1992; Dukes and Mooney, 1999; McNeely, 2001) and there is high concern on the impact they pose on pollinators and the pollination service they provide (Buchmann and Nabhan 1996, Biesmejer et al. 2006, Potts et al. 2010). Changes in pollination patterns, due to effects on pollinators' abundance and richness and on their behaviour might also have important consequences for the persistence of many flowering plants. The growing literature addressing the effects of habitat fragmentation and biological invasions on pollination throws different even contradictory results, which makes it timely to synthesize the available information to find out if there is a clear pattern of global pollination decline. Meta-analysis techniques provide a quantitative tool for conducting such synthesis (Rosenberg et al. 2000). The aim of this study was to address the following questions: 1) do habitat fragmentation and biological invasions affect pollinators' abundance, richness and visitation rates similarly?; 2) are there taxonomic differences in pollinator responses to these global change drivers?; 3) which component of habitat fragmentation affects pollinators the most?; and 4) do animal invasions differ from plant invasions in their effect to native pollinators? Habitat fragmentation and invasions affected pollinators similarly and the effect was negative only for visitation rates. Vertebrates in fragmented habitats and other insects but bees and bumblebees in invaded habitats were the taxonomic groups that most altered their visitation rates. The disturbance of the surrounding matrix appeared to be the component of habitat fragmentation that most affected pollinators. On the other hand, the negative impact of invasions on pollinators resulted to be mainly due to invasive animals and not to invasive plants.

S.02-08-O

Pesticides, drivers of pollinators decline in private gardens?

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Private gardens are important refuges for pollinators in urban areas. However, little is known about the effects of gardening practices, in particular the use of pesticides, on this refuge effect. To address this issue, we analyzed data from two citizen science programs on butterflies and bumblebees, monitoring respectively 591 and 130 gardens located in the Parisian region. We assessed the landscape effects as well as local garden organization and gardening practices, including pesticides use (bordeaux mixture, anti-slug, herbicides, insecticides, fungicides), on the abundance and richness of pollinator communities. As already known for agricultural systems, landscape scale effects and the availability of floral resource at the local scale were the strongest predictors of pollinator diversity and abundance. Surprisingly, our results suggested a limited impact of pesticide use on pollinator communities. However, the use of Bordeaux mixture was associated with higher abundance of pollinators and the use of insecticides was associated with a decreased abundance of bumblebees but an increased abundance of butterflies. It seems thus that pesticides are not a key factor in explaining the pollinator decrease in urban areas, and unexpected results could illustrate indirect effect of gardener's spirit. This was confirmed by a punctual study on the plant communities which revealed a great effect of the gardener spirit on the floristic diversity, the food resource for pollinators. "Leisure gardens" showed significantly higher plant diversity than "aesthetic gardens". These results point out that, in urban environments, gardener practices have an impact on how pollinator friendly is a garden but pesticide use alone has a relatively limited impact.

S.02-09-P

Evidences of ecological segregation between wild and managed bees in an intensive cereal farming system.

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Honey bees and wild bees are important pollinators of both crops and wild plants. The last thirty years have witnessed substantial bee population and diversity declines in many European regions. The loss of semi-natural habitats in intensive agricultural systems is considered as one of the main causes responsible for this pervasive decline. Semi-natural habitat remnants provide wild bees with specific nesting opportunities as well as diversified steady state, pollen and nectar resources. By contrast, most cultivated areas are unusable by bees, except mass-flowering crops that offer big-bang, temporarily available floral resources. The objective of this study was to document the relative use of mass flowering crops and wild floral resources by foraging honey bees, bumble bees and solitary bees in an intensive cereal farming system in western France. We counted foraging bees along walking transects within the main flowering crops (oilseed rape and sunflower) as well as in a variety of semi-natural habitats (grasslands, field margins, hedgerows). We found evidence of ecological segregation among bees. Honeybees favoured mass flowering crops when available while solitary bees foraged mostly on wild plants. Bumblebees had an intermediary strategy, with a ubiquitous behaviour. Between periods when mass flowering occurred, all three groups were found foraging in remnants of semi-natural habitats, and so potentially engaged in increased competition for floral resources at this time. This stresses the importance of developing floral enhancements at a landscape scale for promoting bee diversity and sustains their population during periods of food shortage in intensive agricultural areas.

S.02-10-O

Bioenergy crops: drivers of pollinator decline or favourable alternatives to conventional crops?

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Pollinators and the services they provide are increasingly threatened by many human activities including land use change and agricultural intensification. A major shift in agricultural land use is beginning with the widespread promotion and cultivation of bioenergy crops as an alternative fuel source to combat climate change, with potentially major implications for biodiversity. This study focuses on the impact of two bioenergy crops - the annual, high-input, mass-flowering winter oilseed rape (*Brassica napus*) and perennial, low-input, non-flowering *Miscanthus giganteus*, on pollinators and pollination. We use diversity and abundance measures and plant-pollinator networks to examine the impacts of these contrasting energy crops, compared to the crops they replaced, at the community level in Ireland. Transect walks were used to quantify flower-visiting species and their interactions with entomophilous flowering plants, and pan traps were used to measure pollinator abundance and diversity during summer 2009. Bipartite interaction networks were constructed for each site. The potential of mass flowering oilseed rape to influence pollen transfer to native plant species was also examined through a pollen transfer network, and impacts of oilseed rape on colony densities of bumblebees were also investigated. Differences were found between energy crops and they crops they replace in a heterogeneous agricultural landscape at both the species and community level. The findings are discussed in the context of ongoing agricultural impacts on pollination systems, with implications for farmland management to combat pollinator decline. This project is part of the SIMBIOSYS project which is focusing on key sectors in Ireland, and their affects on associated ecosystem services (www.simbiosys.ie).

S.02-11-O

The effect of invasive honeybee (*Apis mellifera*) on plant-animal pollination network in the high mountain scrubland from Tenerife (Canary Islands).

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The mutualistic interactions between flowering plants (17 species) and their floral visitors (including lacertid lizards, passerine birds and insects) were intensively recorded during the springs of 2008 and 2009 in the sub alpine scrubland of the Teide National Park (Tenerife, Canary Islands). The central aim of this study was to determine the structural and functional impacts of the introduced honeybees (\approx 2000 beehives each spring) on the mutualistic native pollination network of this protected area, characterized by a high number of endemic species. The main results indicate that both the structural and functional pollination network parameters were markedly different under the massive presence of the introduced *Apis mellifera* (Apidae). These observed differences were related to significantly reduced diversity of native flower visitors when *A. mellifera* was extremely abundant in this ecosystem and were presumably driven by competitive exclusion of native visitors for trophic resources (nectar and pollen) by *A. mellifera*. Thus, the relatively higher abundance and the dominant behaviour of *A. mellifera* might negatively affect this insular native mutualistic system in which 65% of involved species are endemic taxa from the Canary Islands. Our results also suggest that these structural consequences were translated into functional changes in plant reproductive success. Thus, those plants of *Spartocytisus supranubius* (Fabaceae) being highly visited by *A. mellifera* were characterized by a significantly lower seed-set than those flowers (within the same individual plant) exposed to only native floral visitors. The same negative effect was also found along a decreasing-distance gradient respect to beehives, since the nearest plants of *S. supranubius* to beehives ($<$ 500 m) were characterized by a significantly reduced seed-set than those with a lower (or null) floral visitation by *A. mellifera* ($>$ 1 km). According to these results, we urge and recommend the total suppression of introduced beehives in the Teide National Park.

S.02-12-O

Life history, resource complementarity and the sensitivity of pollinators to landscape change.

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Insect pollinators play a key functional role in natural and managed ecosystems throughout the world, yet in many regions they are threatened by anthropogenic environmental change. Studies from Europe and other regions identify generality in the responses of certain pollinator groups to different anthropogenic changes. Life-history and ecological traits can affect pollinator species sensitivity to different environmental changes and thus determine shifts in biodiversity, community composition, and pollination function. In addition, the distributions of essential resources, such as nesting sites and forage, throughout the landscape may interact with species traits to further determine pollinator sensitivity to environmental change. We report an analysis of studies from throughout the world testing whether bee traits predict the sensitivity of species to different anthropogenic disturbances. We then present a spatially explicit model exploring how nesting and floral resources interact with life history traits to differentially affect bee responses to landscape change. Across studies, nesting location (above- vs. below-ground) consistently affected species' responses to anthropogenic disturbances. Sociality also affected species' responses, but in different ways among disturbances. Trophic specialization was important in determining sensitivity to agricultural intensification. Body size was predictive of bee species' responses to fragmentation, but not to other types of anthropogenic disturbance. Our model indicates that the degree of spatial correlation among essential resources (such as nest sites and forage) interacts with the pattern of habitat loss to influence bee response to landscape change. The result highlights the importance of spatial pattern and scale for understanding bee response to environmental change.

S.03- Biodiversity and Ecosystem Functioning in the Context of Environmental Changes (session sponsored and coordinated by BACCARA EU project)

S.03-01-O

Tree dynamics and coexistence in the montane-subalpine ecotone: the role of different light-induced strategies.

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Pinus uncinata Ram. is the dominant species in the subalpine belt of the Pyrenees. In the present changing context, the rise in temperatures associated to climate change and reduction in logging due to land-abandonment have prompted predictions of encroachment of montane species (e.g. *Pinus sylvestris* L.) into the subalpine belt and establishment of advanced regeneration of shade-tolerant species (*Abies alba* Mill.), respectively. In the absence of water deficit, interspecific differences in performance under contrasting light conditions are expected to drive the dynamics of these transition areas. We evaluated the survival and growth response to variations in light availability for saplings of these three species in mixed-forest ecotones in the Pyrenees. For each species, we selected 100 living and 50 dead saplings, and models relating growth and mortality to light were obtained and the role of morphological plasticity was assessed. Variation in light availability explained more than 50% of variation in growth. Pines and fir developed opposing strategies to face light deprivation: fir employed a conservative strategy based on sacrificing height growth (mortality rate < 0.1), whereas pines enhanced height growth to escape from shade, but at the expense of higher mortality risk (0.2-0.35). Scots pine showed higher plasticity than mountain pine on all architectural and morphological traits analyzed, showing an apparently higher adaptive capacity to a changing environment. Our results support the prediction of future biome changes in the Pyrenean subalpine forests through a progressive upwards shift of the montane-subalpine ecotone.

S.03-02-O

Diversity of ectomycorrhizal fungal communities of two representative European tree species along climatic gradients.

Aurore, Coince. Santamaría-Pérez, Blanca. Rincón, Ana. Marcais, Benoît. Buée, Marc.

INRA. ICA-CSIC. ICA-CSIC. INRA. INRA.

Diversity of ectomycorrhizal fungal communities of two representative European tree species along climatic gradients Coince Aurore¹, Santamaría-Pérez Blanca², Rincón Ana², Marcais Benoît¹, Buée Marc¹ (1) UMR1136 INRA Nancy-Université, Centre INRA-Nancy, IFR110, 54280 Champenoux, France (2) ICA-CSIC, Serrano 115 bis, 28006 Madrid, Spain The relationship between energy gradients and community richness has been well documented in community ecology for numerous groups of organisms. However, little information exists concerning the impact of these gradients on the ectomycorrhizal (EM) fungal communities, a key component of forests. EM fungi are essential for tree nutrition and forest ecosystem stability. Within the global change context, we aimed to check whether EM fungal communities associated to representative European tree species (*Fagus sylvatica* L. and *Pinus sylvestris* L) were structured by climatic factors. Surveys for collecting EM roots and soil samples were performed along different altitudinal gradients in beech and pine forests. Four gradients were studied as independent spatial repetitions across France/Italy (Vosges, Alps and Pyrenees) in the case of beech, and three gradients across France/Spain (Guadarrama, Pyrenees, Vosges) in the case of pine. Total DNA was extracted from roots and soil, and the ITS-1 region amplified by PCR using the primers ITS1F/ITS2 suitably tagged for high-throughput sequencing analyses (454 FLX pyrosequencing). Specific EM community composition of each tree species, diversity indices, and correlations with environmental parameters will be presented to highlight the patterns of EM distribution along these gradients for both types of forests.

S.03-03-P

Contrasted taxonomic and ecological responses of bird assemblages to landscape dynamics.

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The impact of rapid land use changes on biodiversity has become a key challenge in ecology. Particularly, recent changes of agricultural landscapes have been suggested to modify strongly plant and animal assemblages. However, while static relationships between species assemblages and landscape structure have been widely analysed, their joint temporal dynamics have received less explicitly attention. We surveyed birds in 256 point counts in south western France in 1982 and 2007 to examine whether landscape dynamics led to changes in species distributions and in assemblage-level diversity using species richness and habitat specialisation of assemblages as indicators of taxonomic and ecological diversity. Between 1982 and 2007, the diversity of habitats in landscapes decreased and the amount of crop increased sharply at the expense of grassland. Colonisation and extinction events of species were weakly related to changes in landscape composition and structure. Species richness was negatively related to the amount of crop and grassland, and positively associated to the amount of wood and to habitat heterogeneity in both years. In contrast, the level of habitat specialisation of assemblages decreased with habitat heterogeneity. Contrary to species richness, assemblages' habitat specialisation levels were positively related to temporal changes in the amount of crop. In a context of temporal landscape change, we show that taxonomic and ecological diversity respond in contrasted directions. We suggest that taxonomic metrics should be coupled with more trait-based approaches when assessing the impact of environmental changes on species assemblages.

S.03-04-P

Deforestation, Habitat Fragmentation and Threats to Biodiversity within the Temperate.

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Karlsruhe Institute of Technology, Germany. University of Concepción, Chile..

The temperate forests of the coastal range of central Chile are considered a biodiversity hotspot [Myers et al., 2000]. More than 3,400 plant species are found within this region, of which 1,600 are endemic (47%). However, these ecosystems are alarmingly endangered by deforestation and habitat fragmentation. Native forests are increasingly cut down to open spaces for plantations, mainly of Monterrey Pine (*Pinus radiata*) and Eucalyptus (*Eucalyptus* spp.). Of the originally 300,000 ha of primary vegetation, only 90,000 (30%) remain in 2000. The loss rates of up to 8.15% p.a. [Bustamante and Castor, 1998] are among the highest loss rates reported worldwide. Besides deforestation itself, habitat fragmentation threatens biodiversity [Altamirano et al., 2007], [Echeverría et al., 2007]. Within the report, these issues will be exemplified for the region of Biobío river (capital Concepción). Remote sensing datasets provide the data base for an analysis of land use and land cover change (LUCC). An example is given by the community of Penco (10,200 ha) which is close to Concepción. The coverage of native forests has decreased from 43,6% in 1975 to 5,3% in 2000 – an annual loss rate of 1.5%. The coverage of exotic tree plantations has increased from 24,4% in 1975 to 39,7% in 2000. Within the remainder of the paper, an analysis of the entire period between 1975 and 2010 on habitat fragmentation will be provided. Furthermore, a factor analysis which links plantation establishment with topographical factors (like slope, elevation) and accessibility (road networks) will be provided. References [Altamirano et al., 2007] Altamirano, A., Echeverría, C., and Lara, A. (2007). Effect of forest fragmentation on vegetation structure of *Legrandia concinna* (myrtaceae) threatened populations in south-central Chile. *Revista Chilena de la Historia natural*, pages 27-42. [Bustamante and Castor, 1998] Bustamante, R. and Castor, C. (1998). The decline of an endangered temperate ecosystem: the ruiñ (Nothofagus alessandrii) forest in central Chile. *Biodiversity and Conservation*, 7(12):1607-1626. [Echeverría et al., 2007] Echeverría, C., Newton, A., Lara, A., Benayas, J., and Coomes, D. (2007). Impacts of forest fragmentation on species composition and forest structure in the temperate landscape of southern Chile. *Global Ecology and Biogeography*, 16(4):426-439. [Myers et al., 2000] Myers, N., Mittermeier, R., Mittermeier, C., da Fonseca, G., and Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403(6772):853-858.

S.03-05-O

Biological soil crusts and local soil physico-chemical properties: BSC effect along a perturbation gradient.

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Biological soil crusts (BSC) are associations of cyanobacteria, lichens and mosses covering soil surfaces of arid ecosystems. Morphological characteristics and chemical activity of BSC enhance stability and fertility of surface soils. However, the effect of BSC on soil physico-chemical properties may vary among taxa (cyanobacteria, lichen, bryophytes) and species, and be susceptible to soil surface disturbance. We explored the relation between BSC and soil physico-chemical properties along a livestock grazing gradient in a semiarid grassland ecosystem in Central Mexico. We addressed the following question: Do different BSC species create distinct soil microsites characterized by particular physical and chemical properties under the influence of livestock grazing? We examined soil physico-chemical properties (C, N, P, OM, pH, EC, Sand, Silt, Clay, Ca, K, Mg, Na, Cu, Fe, Mn, Zn) associated with five BSC types (cyanobacteria, 1 moss species, 3 lichen species) along a perturbation gradient consisting of four sites with different grazing intensities: a long-term enclosure, and sites with moderate continuous grazing, heavy seasonal grazing and heavy continuous grazing. When comparing BSC cover and bare soil, 13 of the 17 soil variables examined were significantly different (P

S.03-06-P

Historical Ecology. Reconstruction of the terrestrial ecosystems of Doñana for the last three centuries.

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The reconstruction of terrestrial ecosystems in N area of Doñana Parks (SW Spain) for the last three centuries has been carried out combining contemporary data (geomorphology, soils, vegetation survey) with historical evidence. The Kings of Spain owned the N sector of the area (Coto del Rey). To the S, the Coto Doñana belonged to the Dukes of Medina Sidonia. Remaining sectors were ruled by municipalities. Available documents in the National Archives, private and municipal archives, have been analysed to compile historical records on plant species, land uses and environmental events, identifying trends and the introduction of species/uses. Changes in hydrological elements and land use patterns were used as proxy for environmental and resource use changes. Historical maps were projected to a single cartography basis. A detailed comparison with contemporary ecological cartography was performed. The emerging picture reveals a protracted exploitation of every available resource (game, husbandry, agriculture) by Kings, Dukes and towns people. There was a continuing pressure on vegetation to exploit timber, fire-wood, coal, cork and wildfires making the former *Quercus* forests to dwindle. Umbrella pine plantations expanded from XVII C. Mulberry tree and eucalypts were later introduced and vineyards planted. There were three attempts to set up new agricultural colonies in the area which eventually failed. The earliest scientific surveys (vegetation, soils, waters) have been documented early in XIX C. The reconstruction evidences changes at the end of Little Ice Age and the onset of contemporary Climate change period.

S.03-07-O

Forest diversity effects on insect herbivory.

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University of London. University of London.

Mixed forest stands are considered to be less susceptible to herbivory than pure stands, but experimental evidence for this is scarce. We present the results of the research on tree species diversity effects on insect herbivory within the Satakunta forest diversity experiment, SW Finland, which is part of the BACCARA EU project. In this experiment established in 1999, tree species richness and species composition have been manipulated by planting monocultures and 2-, 3 - or 5-species mixtures of silver birch, Scots pine, Norway spruce, Siberian larch and black alder. We found that tree species richness of forest stands significantly affected abundance, species richness and host preference of different types of insect herbivores on birch and alder, but direction of the effect depended on the type of herbivore. In majority of cases mixed stands appear to suffer more herbivory than pure stands, which is in contrast to the predictions and results of studies in agricultural systems. We discuss possible causes and implications of the above findings.

S.03-08-O

Disentangling food web spatial structure: variance components, model selection and path analysis.

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The spatial arrangement of animal communities may be shaped by biotic and abiotic factors, both of which may be decisive for food web structure and dynamics. Actually, biotic interactions may be essential to explain the observed patterns of diversity and abundance. Our study focuses on the spatial distribution of animals living in the leaf litter layer of beech forests in National Parks of Northern Spain, across a pluviometric gradient. Using spatial variance components at different scales, we found that the abundance of three functional groups -saprophagous and microphytophagous mesofauna, saprophagous macrofauna and zoophagous macrofauna- mainly varies among valleys within Parks. We carried out a preliminary correlational study to investigate what factors may control spatial variation in the food web through a model selection approach testing several models including abiotic and biotic factors and searching for the model that best fitted our data. In general, there is greater abundance of fauna in accumulation areas, at the base of slopes, than in drier ones. Our results suggest a bottom-up effect, since annual precipitation only affects the abundance of mesofauna, but not the other groups when including community size as an additional estimate of the productivity of the system, which has a strong effect on the abundance of the three groups, likely reflecting that a greater size of the detritus community is indeed the result of higher productivity. Significant variables were then included in a path analysis to tease apart potential direct and indirect effects on community structure.

S.03-09-O

Depicting the effect of climate change on the relationship between tree diversity and productivity in European temperate forests.

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On-going climate change affects forest functioning processes such as productivity. But climate change will also alter forest biodiversity through shifts in species distribution and community composition, which in turn modifies forest productivity. Understanding the link between biodiversity and productivity and how climate change will affect this link are thus two decisive issues in the current context of global biodiversity loss. The relationship between species richness and productivity has been explored widely through experiments, usually showing a positive relationship, but without being able to explain how this effect will unfold in the long-term, especially in forests. And the impact of climate change on this relationship has been never explored in forests. As a novel approach to explore these questions, we here present results from simulations performed with the forest succession model ForClim. First we show that tree diversity influences productivity in European temperate forests across a wide range of 11 sites with contrasted climate conditions through a strong complementarity effect. Hence, our results confirm the positive diversity-productivity relationship shown in grassland experiments, and the increasing relative importance of complementarity in comparison with selection through time. Second we quantify how climate change affects the relationship between diversity and productivity in our 11 sites, by performing simulations with three Regional Climate Models and one climate scenario. Our study thus provides a new basis to disentangle the role of diversity as a crucial driver for productivity in forests and to make predictions about the impact of climate change on forest ecosystems.

S.03-10-P

Species diversity in mire communities with changed hydrology.

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Drainage is one of the most massive and destructive human activities in wetlands that have long-lasting influence on the whole mire ecosystem. Successful recovery of natural vegetation in drained mires strongly depends on effective rehabilitation of the hydrological regime and species possibilities to regenerate. In 1950 the water table of Lake Endla, which is surrounded with three large mire systems, was lowered about one meter through digging a canal. Although the canal was closed in 1968, the height of the water did not reach the previous level. In this study an overview of species richness registered in 1950 and in 2010 and in addition an earlier community composition on the base of the peat extractions is given. Differences appeared in the vegetation of the quaking mire surrounding the lake, whereas communities farther from the shore were more similar with each other during the time. The vegetation has recovered quite well, no drastic loss of species was detected. The success of wetland recovery might depend on the size and characters of the surrounding landscapes and plant communities occurring there.

S.03-11-P

Structure characteristics of the epigeic invertebrate populations of rocky habitats from Prahova Valley (Romania).

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The rocky habitats are considered terrestrial ecological structures with special characteristics and even extreme conditions in comparison with other terrestrial habitats. We conducted a study on 3 rocky habitats during 2008-2010 with the objectives the identification of the structure characteristics of the epigeic invertebrate populations and the multi-annual variations in relation to major limiting abiotic factors. It was noted that there are obvious differences between the structural elements (numerical abundance, dominance structure, class constant, specific diversity) of epigeic invertebrates on rocky habitats and those of populations from other terrestrial habitats (forests, grasslands) and in terms of structural multi-annual variation patterns. It was also found that local microclimatic factors have an extremely important influence on invertebrates populations, acting as distinctions mark between populations in rocky habitats located in the same climate zone. There are discussed the features of the epigeic invertebrate communities of each study site, types of variations are compared between the studied sites and with those from other terrestrial habitats of the Prahova Valley.

S.03-12-O

Growth patterns of *Pinus sylvestris* along altitudinal gradients in its southern limit of distribution.

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Consejo Superior de Investigaciones Científicas. Consejo Superior de Investigaciones Científicas. CREAM. Universidad de Granada. Universidad de Granada. Consejo Superior de Investigaciones Científicas. Consejo Superior de Investigaciones Científicas. Consejo Superior de Investigaciones Científicas.

Growth of juveniles during its first years of life can determine their ability to cope with extreme events, therefore their survival. It is commonly assumed that increasing temperature, light and water, favours shoot growth. However, in Mediterranean areas, summer drought is the widely recognized bottleneck for seedling establishment and growth. We analysed the factors determining shoot length in seedlings and saplings of Scots pine (*Pinus sylvestris*) throughout its altitudinal gradient in several locations in Spain. We hypothesized that the relationship between climate and growth might be shaped by several factors such as competition, light availability and microhabitat conditions (e.g. cover of herbs and shrubs). We found evidences of different patterns depending on the age of individuals. Local competition seems to be an important factor on growth patterns, while the availability of light could not be so limiting of growth in the Mediterranean ecosystems.

S.03-13-P

Relationship between nutritional status of plant and soil after perturbation and vegetation biodiversity in Heathlands on the Cantabrian Mountains

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The aim of this study is to determinate the effects of variations in nutritional status in *Calluna* and soil on vegetal biodiversity after burning, burning + fertilization and fertilization in heathlands dominated by *Calluna vulgaris* in the Cantabrian Mountain range (NW Spain). Three sites located in the north of Leon province were selected. In each site 4 experimental plots were established: control (C), burnt (B), burnt + fertilized (B+F) and fertilized (F). In June 2005, two plots per site were subjected to an experimental fire. The fertilization treatment was done monthly from May to October. The vegetation development was monitored 3 months, 1, 2, 3 and 4 years after the treatments. At the same time total N and P was analysed in annual *Calluna* shoots. Total N, total P and pH were determined in each soil sample during 3 months, 1 and 2 years after treatments. Main results showed a significant increase on total and herbaceous richness throughout the time in burnt and burnt plus fertilized plots until the 2nd - 3rd year. The N and P content in *Calluna* showed a significant increase from the third year after the treatments. In the soil an increase in the N, P and pH values throughout the time was observed mainly during the first two years after burning. The plant biodiversity was significantly positive correlated with soil nitrogen concentration in fertilized, burnt and burnt + fertilized, also with soil phosphorus concentration in fertilized plot and with soil pH in burnt plot.

S.03-14-P

Larger species pools result in more specialist species in degraded habitats.

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University of Tartu, Institute of Ecology and Earth Sciences. University of Tartu, Institute of Ecology and Earth Sciences. University of Tartu, Institute of Ecology and Earth Sciences. University of Tartu, Institute of Ecology and Earth Sciences. University of Tartu, Institute of Ecology and Earth Sciences.

Calcareous grasslands are characterized by high diversity habitat specialist plant species. The destruction and abandonment of these grasslands, particularly in the last hundred years, has resulted in a decrease in total area and increased fragmentation, which in turn leads to a decline in biodiversity. An understanding of species extinction and colonisation dynamics is essential for developing strategies to mitigate biodiversity loss. We selected 35 Estonian calcareous grasslands that were in relatively good condition. As an examples of deteriorated grassland habitats, we also sampled adjacent overgrown grasslands patches and nearby road verges that had ecologically similar conditions to open grasslands. From each habitat, we counted number of vascular plant species in community level (total number of species i.e. habitat species pool) and in small scale (2x2m). We plotted the proportions of specialist and total grassland species found in small scale as a function of habitat species pool. Small-scale specialist and small scale total species richness were both linearly related to the size of the community species pool in open calcareous communities, indicating that the habitat is not saturated and both more species in total and more specialist species can colonize the habitat. However, in overgrown grasslands and road verges total richness in small scale reaches asymptote, whereas grassland specialist species increases linearly with increasing species pool. Thus, with increasing species pool, degraded communities have relatively more specialists whereas the colonization by non-specialist species is hindered. Our results can be applied to similar grassland systems to predict future changes in biodiversity.

S.03-15-O

Effects of woody species functional diversity on litter decomposition and primary productivity in a southern temperate rainforest.

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Universidad de Concepción.

The knowledge about the relationship between forest biodiversity and ecosystem functioning is extremely rudimentary for temperate rainforests of South America. The aim of this research was to determine the functional diversity effects of woody species assemblages on litter decomposition and primary productivity of two forest stands that differ in floristic composition in a southern evergreen temperate rainforest. To describe functional diversity we quantified interspecific variation of the traits leaf mass area (LMA) and chlorophyll content index (Chl). These parameters were measured in 20 plots in the two forest types: Valdivian (10 plots) and Coihue (10 plots). Primary productivity (litter accumulation rate) and litter decomposition of each species (percentage of dry weight loss) were measured in the same forest stands and plots. Valdivian forest type showed greater species richness than Coihue forest type (25 v/s 18 species respectively). The total variation of LMA and Chl (coefficient of variation, CV = 23.2 % for LMA; 18 % for Chl) was roughly 1.5 fold greater in the Valdivian forest type than in the Coihue type. Additionally, the average decomposition rate was much faster and litter accumulation was higher in the forest type with greater species richness (Valdivian). Pooling all the plots from both forest types, a negative relationship was found between LMA-plot mean and both litter accumulation rate and litter decomposition. These results suggest that variation in ecosystem properties can be predicted by species composition and plant functional traits values that reflect differences in plant strategies. This study was funded by FONDECYT 11090133

S.03-16-O

Relationship between tree diversity and performance at an experimental temperate tree plantation.

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We present performance of 19 temperate tree species planted in 2003/4 at the German tree diversity - ecosystem functioning project BIOTREE. Our aim was to quantify size-asymmetric competition two and five years after planting, and to link growth variation to species-specific shade tolerance. Furthermore we related variation in tree performance to tree diversity. Species diversity was varied at two sites, whereas at the third site, a gradient in functional diversity was created. Tree height was below 150 cm for most of the species, and largest crown projection areas were obtained with highly branched species. Since the upper crown layer was not yet completely closed, we hypothesise that the light regime is still optimal for fast-growing species and suboptimal for slow-growing and shade-tolerant species. This was confirmed by the finding that the relative height growth rate (RGRHeight) decreases with increasing shade tolerance. An indication for size-asymmetric competition was mainly identified for fast-growing and very shade intolerant pioneer species. The negative relationship between RGRHeight and tree height 2005 for very shade intolerant species indicates that tall fast-growing species have a reduced growth rate, possibly due to crown closure and competition for light. We did not find a general effect of tree diversity on tree performance during the initial establishment phase of the experiment, which may be explained by missing interspecific interactions across the small monospecific planting patches. However, we identified positive effect of functional diversity on tree height for fast-growing and very shade intolerant species. We hypothesise that in the future diversity effects will get stronger with complete crown closure, and ongoing analyses on interactions at the patch border will elucidate the presented findings.

S.03-17-P

Island size, plant and arthropod diversity in a changing climate.

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The species-area relationship is one of the few commonly accepted "laws" in ecology. This relationship predicts how strong species loss and habitat loss is connected. Climate change mediated sea-level rise is likely to decrease island size considerably during the next hundred years. According to the species-area relationship, this land loss will be followed by a decrease in species number. In this study we investigated the effect of island size on the species number of plants, beetles and spiders on 42 islands in the Stockholm archipelago, Sweden. We found that the species number of plants and beetles but not spiders increased with island size. The relationship between number of beetle species and island size may be partly caused by increasing habitat heterogeneity due to an increased number of plant species. The absence of relationship between number of spiders and island size might indicate that spiders are less dependent on island size and/or number of plant species for their existence than beetles. Earlier studies do indeed indicate that many of these spider species utilize food with an aquatic origin, why spider diversity might be more depended on aquatic inflow of energy than on terrestrial biodiversity and or/island size.

S.03-18-P

Predicting past, present and future distributions of Atlantic cod (*Gadus morhua*) stocks in Greenlandic waters.

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Historically, the spread and size of cod stock(s) in Greenlandic waters have been highly variable, yet the factors that drive their distributions and abundance patterns in space and time remain poorly understood. This project aims at understanding and predicting the spatial distribution and abundance of Atlantic cod (*Gadus morhua*) stock(s) in Greenlandic waters in response to climate change. This will be achieved through biological, chemical and genetic analysis of unique cod otolith collections (1907-2010), generating historical time series on growth, food composition and genetic population structure. We Genetic analyses of otolith and tissue collections are being conducted to provide a time series of population structure and locations and movements of distinct spawning populations of cod, inside and outside the spawning season. Moreover, stable isotope analyses of cod otoliths are being conducted to identify trophic positions of individuals and the major components of their diet over time. Meanwhile hydrodynamic models are available to inform the spatio-temporal environmental conditions (1948-present). This project unites these elements in a spatial modelling framework to relate cod stock(s) and individual age classes to environmental predictors, and to predict response of the cod stock(s) to changing climate, considering different scenarios of larval recruitment and fisheries activity. The project is expected to generate fundamental insights but will also be able to contribute to proactive management of cod in Greenland.

S.04- Impacts of climate change mitigation measures on biodiversity and ecosystem services

S.04-01-P

Vulnerable insects under climate change: a framework to guide species conservation strategies.

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Universidad de Murcia. Aarhus University. Universidad de Murcia. Universidad de Murcia.

Global warming is expected to have a significant impact on biodiversity, with especially dramatic effects on threatened species. Despite the wide number of studies making predictions and recommending general measures to adapt conservation strategies to climate change, there is an important lack of proposals to guide specific conservation decisions to mitigate global warming effects on species. The vulnerability of a species to global warming will depend on both the capacity of species to maintain their actual populations and the chance to shift their ranges, with different implications for conservation and management. Here we propose the combined use of correlative models and feasible measures of species dispersal capacity and thermal tolerance to evaluate how idiosyncratic species traits could determinate the sensibility type of threatened insects under climate change. On the basis of this information, we developed a decision framework that could be used to outline potential conservation strategies for each insect species depending of their differential persistence capacity and/or chance to shift their ranges in response to global warming. We applied this framework to three threatened species of water beetles, belonging to different families and restricted to the Iberian Peninsula and showed how, despite occurring in similar habitats, having restricted distributions and being threatened in a similar way, they displayed contrasting vulnerability to climate change. Hence, the inclusion of this species information could be a useful and effective tool to refine conservation strategies for insects groups identified as vulnerable under the global warming.

S.04-02-O

Vascular plant species diversity in short rotation coppice plantations (SRCs) of agricultural areas.

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Phytodiversity of twelve willow (*Salix*) and three poplar (*Populus*) short rotation coppice plantations (SRCs) was compared with surrounding arable lands, grasslands and forests in Central Sweden and Northern Germany. Comparing species numbers per 100 m², it became apparent that SRCs exhibit more species than arable lands, coniferous forests and, in Germany, also mixed forests. The same was found using species-area curves as an indicator. The number of species found in only one land use was highest for SRCs and Swedish mixed forests and lowest for arable lands, coniferous forests and marginal grassland strips. Highest cumulative species numbers of SRCs and another land use were found in the combination of SRCs and Swedish mixed forests. Regarding species composition of SRCs and other land uses resulted in highest Soerensen and Bray-Curtis similarities when comparing SRCs with marginal grassland strips, grasslands and Swedish mixed forests and lower similarities of SRCs to arable lands, coniferous forests and German mixed forests. We conclude that SRCs as a structural landscape element with species compositions different from those of the surrounding land uses can contribute positively to phytodiversity in an agricultural landscape. These effects will be greatest in areas dominated by arable lands and coniferous forests as well as in Germany for those dominated by mixed forests.

S.04-03-O

The ABC of Adaptation, Biodiversity and Climate change.

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Climate change is having observed impacts on biodiversity and these will continue and are very likely to increase in the future. Adaptation is an important means of addressing these impacts, especially in the short-term before any mitigation measures can take effect. For biodiversity there are a range of adaptation measures, some of which are additional to existing good conservation practices. Adaptation, however, is being undertaken by many other sectors and their activities can undermine adaptation for biodiversity. Alternatively, they can, through such actions as ecosystem-based adaptation, contribute to the adaptation of biodiversity. Allowing or assisting biodiversity to adapt to climate change is important, as ecosystems play a significant role in climate change mitigation, most noticeably through the storing of carbon, as well as providing a range of ecosystem goods and services. Ecosystems, therefore, can help to address climate change, and thus it is important to ensure that impacts on them are minimized. This talk will examine the complementarity of the relationships between climate change and biodiversity, as well as how adaptation can be effectively implemented in a more holistic manner to ensure that the role of biodiversity in climate mitigation can be strengthened.

S.04-04-O

Ecologically sustainable development of wind energy in Ireland - how to conserve biodiversity and ecosystem services?

Bourke, David. Stout, Jane.

Trinity College Dublin. Trinity College Dublin.

In response to climate change, the EU has set a target to achieve 20% of energy from renewable sources by 2020. Consequently, Ireland has set targets of 40, 10 and 12% of energy coming from renewable sources for electricity, transport and heat, respectively. Wind energy is expected to contribute significantly to achieving these targets given Ireland's large onshore and offshore wind potential. However, the potential impacts of these wind farm developments on Ireland's biodiversity remain largely unquantified. The SIMBIOSYS (www.SIMBIOSYS.ie) project was set up to investigate the impacts of a range of sectors on biodiversity and ecosystem services, with part of the project's focus on those measures that may help mitigate the effects of climate change. In this paper we aim to assess the impacts of wind farms on Ireland's marine and terrestrial biodiversity, highlighting potential conflicts concerning the spatial distribution of our wind and biodiversity resources. To help make these assessments an extensive review of the scientific literature is used to highlight the reported and potential positive and negative impacts of wind farm developments on biodiversity. Spatial analyses reveal the extent to which wind resources and current and future wind farm developments overlap with habitats and species of conservation value. The outputs of these analyses are combined to help make recommendations on the sustainable future planning and management of wind farms in Ireland, helping ensure the direct benefits of green house gas emission reduction are maximised without compromising the protection of biodiversity in Ireland.

S.04-05-O

Interactions between climate change and agricultural intensification on insect pest voltinism.

Dalin, Peter.

Swedish University of Agricultural Sciences.

Climate change can cause shifts in the number of insect generations produced per year (voltinism). Warmer temperature conditions results in advanced phenology and enhanced developmental rates of insects, which can allow for increased voltinism. In this project, I show that also agricultural intensifications, in this case the planting of fast-growing willows in bioenergy plantations, may result in increased insect voltinism. The leaf beetle *Phratora vulgatissima* is a major pest in willow plantations in northern Europe where the beetles normally produce only one generation per year. The beetles do, however, sometimes produce a second generation in plantations consisting of the willow *Salix viminalis*. Studies show that the beetles enter diapause later in plantations than in natural willow stands, which increase the chances for a second generation. Similar to most insects in the temperate region, the induction of diapause in *P. vulgatissima* is determined by seasonal adaptations to photoperiod (day-length). When reared on *S. viminalis*, however, the probability of diapause was much lower than when the beetles were reared on native willows. This suggests that host-plant quality can influence voltinism in *P. vulgatissima*. The planting of high-yielding, fast-growing, plant genotypes can result in enhanced pest problems due to more insect generations produced per year. Improved knowledge about the effects of host-plant quality on insect voltinism could however be used to develop plant resistance to control pest voltinism under future climates.

S.04-06-P

Ecological and environmental implications of bioenergy production from marginal land.

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The increasing demand for both food and non-food biomass is making it increasingly evident that land is a finite resource. In order to avoid the conflict between production of food crops and dedicated bioenergy crops, an easy solution appears to be the spatial segregation of food- and energy-producing areas. Accordingly, there is an array of publications calling for establishment of dedicated bioenergy crops on “surplus” land which is not currently under cultivation or which is “marginal” in terms of agricultural production. Exact definitions of marginal or degraded lands are, however, rarely provided. Assessments of the environmental suitability and agronomic potential of such areas are often lacking. Hence, assessments of bioenergy crop yields and of the extent of land-take for bioenergy production are often not sufficiently substantiated by scientific data. Degraded lands are often considered to be available ‘for free’, while in practice much of this land is in use for local low-input farming or has developed biodiversity conservation values. Competition between bioenergy production and ecosystem services provided in marginal areas are not taken into account. A proper environmental, ecological and socio-economic definition of marginal or degraded areas and of their value in terms of ecosystem service provision is an essential prerequisite to the establishment of bioenergy production. Unrealistic estimations of availability of “surplus” land, due to invalid data sources of land use, agronomic potential or property rights, together with a lack of landscape planning instruments, is impeding the development of sustainable bioenergy crop production.

S.04-07-O

Biodiversity implications of the ‘Climate Matching’ forest management strategy.

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Under scenarios of rapid environmental and climate change it is widely recognised that long lived species, such as trees, will come under increasing pressure the further conditions move away from the past long term average they are adapted to. To date forestry have employed a “local trees for local climate” policy of seed selection for new plantations, however, this may be insufficient to future-proof forests. Under a new management strategy widely referred to as “Climate Matching” seeds might be sourced from areas experiencing today the climate predicted for some target area in the future. To date, however, little attention has been given to the potential impacts that this new management strategy may have on forest biodiversity and ecosystem services. Predictions of possible impacts are strongly affected by the extent of local adaptation tree associated organisms, such as herbivorous insects, might show to local trees. Interactions between trees and their associated species may affect wider forest communities including vertebrate predators, and ultimately the delivery of ecosystem services such as natural pest control and pollination. Using large-scale oak provenance trials of *Quercus petraea*, we are examining phenotypic differences between local and introduced tree genotypes and their impact on local insect herbivores and their natural enemies. We present first data showing species-specific and generation-specific differences in the responses of herbivores to variation in tree phenotypic traits. These data have an applied significance for forest management at a European scale, and we discuss how ‘future proofing’ forests may impact on long-term forest biodiversity.

S.04-08-O

Impact of diverse grass species on nitrous oxide emissions.

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With global climate change and a growing demand for bioenergy, grassland biomass may become an important biomass source, especially in countries such as Ireland, where grassland represents the main agricultural land use. Potentially the use of grass biomass could maintain current grassland composition and associated biodiversity and avoid the risk of introducing new invasive species under new demand for bioenergy production (Barney & DiTomaso 2008). However, the environmental benefits of energy production from grass biomass have to be carefully evaluated in particular with regard to the overall greenhouse gas (GHG) balance. This study examined the impact of three different grass species on nitrous oxide (N₂O) emissions from a grassland site over 1.5 years (June 2008 until December 2009). The site was located at the plant testing station in Crossnacreevy, Northern Ireland. Emissions of N₂O from *Lolium perenne* var. Portstewart, *Phleum pratense* var. Dolina and *Dactylis glomerata* var. Donata, all in combination with *Trifolium repens* var. Chieftain in three replicates, each under two different fertiliser treatments (HighN, 420 kg N ha⁻¹ y⁻¹ in nine applications; LowN, 105 kg N ha⁻¹ y⁻¹ in three applications) were monitored by a closed chamber technique (Hutchinson & Mosier 1981). Significant species related differences (p

S.04-09-O

Biofuels: fuelling climate change mitigation or biodiversity loss?

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The aim of biofuels is to mitigate climate change by replacing fossil fuels in transport and thus reducing transport-related greenhouse gas emissions. To prevent replacement of biologically valuable ecosystems with cultivation of biofuel crops, the EU legislation prohibits establishing biofuel plantations on lands that are high in biodiversity, designated for nature conservation, or host rare or threatened species and ecosystems. However, the indirect land use pressure from allocating agricultural lands into biofuel production is not accounted for in the EU legislation. Allocation of agricultural lands into fuel crop cultivation can increase land use pressure on biodiversity and, in worst case, create even more emissions than fossil fuels. In this study, we build on spatial projections of suitable areas for fuel crop production under various political biofuel targets. With European birds as a case study, we identify conflicts with current protected areas and areas important for biodiversity, as well as opportunities for fuel crop production with minor impacts on biodiversity. We also project the bird distributions into the future, accounting for several climate change scenarios, and quantify the additional pressure directly or indirectly created by biofuel demand. The results will allow identification of policies that will minimize the negative impacts on biodiversity while effectively mitigating climate change.

S.04-10-P

Effect of climate change on the biodiversity and distribution of Phlebotominae (Diptera, Psychodidae) a Vector of Cutaneous Leishmaniasis in the semi arid climate region of Algeria.

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University of Setif. University hospital us Setif. University of Setif.

Leishmaniasis is endemic in 88 countries. The cutaneous form is most common with 50 to 75% of cases of Leishmaniasis disease. Climate change affects the distribution, biological insect and behavior of vector. The main of this work is to provide an inventory of different species of Phlebotominae, their map distribution in the study area taking the climate change which have occurred in the study area within ten years [1999-2009].

S.04-11-P

Landscape generators as tool for integrated regional environmental impact assessment of bioenergy activities.

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Biomass from renewable resources for bioenergy uses offers a great opportunity for the replacement of fossil fuels, especially for future energy demand scenarios. However, modified land use change may lead to new or increased environmental impacts, additionally modulated by climate change. For the assessment of bioenergy impacts on the environment, there is need for regional studies, which integrate a variety of impacts, and which go further than classical Life-cycle-assessments (LCAs), e.g. by including effects on biodiversity, or on river and streams. Especially it is important to include the effects on biodiversity, as such studies are at its beginning. To tackle these questions, we present a landscape generator, which aims to understand the environmental impacts of bioenergy use on the environment including future climate change at the landscape level. This approach will include exemplary studies of bioenergy impacts on biodiversity, aspects of spatial effects of the landscape on populations, and is planned to include the effect of cropping systems on rivers and streams. The landscape generator will vary systematically spatial structures of model-landscapes, e.g. landscape configuration and composition, and relative distribution of cropping systems. It generates a set of model-landscapes, which can be investigated consistently by several collaborating projects with specific questions related to the bioenergy impact on the environment. The use of the same model-landscapes for all collaborating projects ensures a consistent multi-criterial impact analysis. The results of the specific modelling studies will be used for the analysis of the environmental bioenergy impacts at the landscape and the regional scale.

S.04-12-O

Drought alters interactions between root and foliar herbivores: links with plant chemistry.

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Drought can alter the quality of host plants for herbivores and the strength of trophic interactions between groups of herbivores. This study investigated the effects of drought and a root herbivore on the performance of two foliar herbivore species and the relative water content, plant biomass, and concentrations of primary and secondary foliar compounds in a model Brassica system. High drought stress increased the negative effect of root herbivory on the performance of both aphid species, with 30 % decrease in fecundity and 15 % reduction in intrinsic rate of increase. Aphid performance was greatest at medium drought stress in the absence of root herbivory. Foliar nitrogen concentration was greatest in high and moderately drought stressed plants without root herbivores and the moderately drought stressed plants under low root herbivore density. The response of foliar nitrogen to drought and root herbivory thus corresponded to the response of both aphid species. Total glucosinolate concentrations increased 62 % under a combination of drought stress and root herbivory but neither treatment increased glucosinolate concentrations on their own. Root herbivory did not influence relative water content and foliar biomass under normal water regimes. However, relative water content and foliar biomass decreased 24 % and 63 % under high drought stress with high root herbivore density. Root biomass decreased 66 % by high drought stress under high root herbivore density. The present study demonstrates that drought can alter interactions between foliar and root herbivores and that plant chemistry may be key in mediating these interactions.

S.04-13-O

Caught between a rock and a hard place: Tree stumps as a bioenergy resource or biodiversity hotspots? - Case scenarios from Sweden.

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Increasing concern over climate change and limited supplies of fossil fuels have resulted in a growing need for renewable energy sources. In Sweden, 30% of the country's total energy supply is already derived from biomass, of which 80% originate from forest products, primarily brash and tops. It is also the forest that has the greatest potential for delivering more biomass for use as biofuels: Tree stumps and coarse roots may constitute up to 1/3-1/5 of the total amount wood of a tree but under current tree-harvesting practice they remain in the forest. However, there are considerable concerns in relation to the environmental impacts of stump harvesting, in particular the potential threat to forest biodiversity. We present current research from Sweden that examines which stump parameters are important in supporting the high biodiversity of stump-inhabiting organisms. These parameters will be used to form criteria for sustainable stump harvesting. Focus will be given to oribatid mites, which although usually considered as terrestrial soil inhabitants, form species rich communities in woody debris including stumps. Studies will be discussed that examined community composition and diversity of microarthropods on stumps of different tree species, diameters and age. Links between the stump parameters and other organism groups that may shape oribatid mite communities have been drawn. Results show that age since felling is an important factor in determining species richness of all organism groups. Establishing links between stump parameters with a high biodiversity value for several organism groups could allow selective harvesting of stumps.

S.04-14-P

Soil organic carbon under Miscanthus - Assessing the impacts of land-use change from grassland to a perennial bioenergy crop.

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The use of biomass for energy production is considered a promising way to reduce net carbon emissions and mitigate climate change. However, the introduction of bioenergy crops can have a substantial impact on the ecosystem services provided by the land-use they replace. In Ireland the introduction of the perennial grass *Miscanthus x giganteus* has recently been subsidised by the government. It offers a high soil carbon sequestration potential with measurements on experimental plots as well as modelling showing carbon sequestration rates between 0.13 and 3.2 Mg ha⁻¹ yr⁻¹. However, in Ireland it is likely to replace permanent grasslands which are also considered carbon sinks, with average carbon sequestration potentials between 0.33 and 0.52 Mg ha⁻¹ yr⁻¹. Furthermore the plantation of *Miscanthus* on grasslands requires ploughing, leading to an additional soil carbon loss due to disturbance. In this study soil carbon sequestration by *Miscanthus* planted on grassland as well as the potential loss of soil organic carbon due to plantation were measured on eight commercial farms in SE Ireland. A direct comparison between the 2 to 3 year old *Miscanthus* fields and adjacent grasslands showed no significant difference in soil organic carbon contents, indicating no major loss due to planting. Furthermore, an average soil carbon sequestration rate of 0.9 ± 0.53 Mg ha⁻¹ yr⁻¹ was measured. The results suggest that land-use change from grasslands to *Miscanthus* has no negative effects on soil organic carbon contents, the potential to improve soil carbon sequestration when replacing grasslands.

S.05- The role of ectomycorrhizal communities in carbon cycling: New perspectives and emerging concepts

S.05-01-O

Saprotrophy of ECM fungi and interactions with decomposers.

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In temperate forests, fungi play a central role in the circulation of carbon and nutrients through the ecosystem. Saprotrophic fungi are the main decomposers of wood and litter and obtain energy by degrading dead organic matter. However, even if ectomycorrhizal (ECM) fungi obtain energy mainly as photoassimilates provided by symbiotically associated plants, they are also able, as saprotrophic fungi, to mobilize nutrients from organic matter. Since many years, studies clearly demonstrate that ECM fungi possess many of the genes (i.e. laccases, classII peroxidases) shared with their more recent saprophytic common ancestors. ECM fungi could shift between their biotrophic or their saprotrophic behaviour depending on their carbon demand and on the host carbon availability. This discovery is interesting and can potentially shift paradigms in our understanding of mycorrhizal interactions. The previous distinction between ECM and saprotrophic fungi is artificial and now, we should consider that ECM fungi occur along a biotrophy-saprotrophy continuum. This capability is of interest in microbial ecology to understand the role and the contribution of ECM communities in re-circulating carbon, nitrogen and phosphorus from organic matter in forest soils. In this respect, I present here (i) recent advances in our knowledge on the saprotrophic capabilities of ECM fungi, (ii) some strategies which could be applied to address these features in ECM communities in field experiments, and (iii) how ECM and saprotrophic fungi could interact in the recycling of nutrients from organic matter.

S.05-02-O

Where in the soil are the ECM Hyphae?

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Recently, we published papers describing inducement of apparent saprophytic behavior in ECM fungi by both adding organic substrate and reducing host photosynthetic potential. One major criticism of our interpretation of these results was the assertion that hyphae of ECM fungi do not exist in the organic layers, where they would provide access to organic substrates, hence reducing the likelihood of a saprophytic role. In this study, we tested the null hypothesis that in our system, hyphae of ECM fungi do not dominate, or even exist in, the organic soil layer. We sampled 3 cores from each of 3 plots in 3 blocks in 6 pure lodgepole pine stands (total of 162 cores), the dominant forest type in the Yellowstone area. We amplified DNA from soils sifted to remove ECM roots using basidiomycete-specific primers, cloned and sequenced the PCR products, and identified basidiomycete fungi occupying the organic layer using BLAST. Results indicated that the hyphae of ECM basidiomycetes in the Tricholomataceae, the Suilloid group, the Cortinariaceae, and the genera *Russula* and *Piloderma* dominated the organic soils in our system over those of wood rotting fungi by a frequency of nearly 500 to 1. However, a screen of hyphae growing on coarse woody debris demonstrated that these genera were prevalent on that substrate. Thus, our data indicate that ECM hyphae do exist in, and in fact dominate, the organic layer in the soils in our system. Hence, they do indeed have access to organic substrate for saprophytic activity. Because the white rot fungi were rare in organic soils, but prevalent on coarse wood, this role may be via access to downstream breakdown products of delignification of wood rather than to breakdown of the wood itself. Given the ecosystem-wide scale of this access, this alone, would indicate a significant role in carbon cycling in temperate ecosystems.

S.05-03-O

Can trees be mycoheterotrophic? Isotopic evidence of soil carbon acquisition by ectomycorrhizal oak roots during spring reactivation.

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INRA. INRA. INRA. INRA.

Spring reactivation of the European deciduous oaks *Quercus robur* and *Q. petraea* involves active cambial activity and early wood formation before functional new leaves are established. It is thus a critical heterotrophic period when the mobilization of stored carbon plays a major part. In addition, enzymatic studies have suggested that, during the same period, the symbiotic fungi forming ectomycorrhizas with oak roots respond to host-derived carbon shortage by a temporary saprotrophic lifestyle, mobilizing carbon from soil organic matter. Here, using a stable isotope approach with ¹³C-labelled litter, we tested the hypothesis that the fungal symbionts might temporarily transfer part of the carbon thus acquired from the soil to their host. The significant $\delta^{13}\text{C}$ increase in tree tissues around labelled litterbags compared to unlabelled spots indicates the transfer of litter-derived carbon compounds into the fungus-fine root-coarse root- phloem continuum, confirming that oaks are partly heterotrophic for carbon. In addition, the effect of a fungicide treatments reducing fungal activity in the root-litter contact zone strongly suggests the direct effect of ectomycorrhizal fungi in the C transfer. Therefore, it appears that, during the critical spring reactivation period, oak trees behave the same way as mycoheterotrophic or mixotrophic plants that compensate their lack of chlorophyll or their dark forest habitat by deriving carbon from their fungal symbionts.

S.05-04-O

Functional classification of ectomycorrhizal fungi provides new insights into carbon dynamics among soils, fungi, and plants.

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Genetic techniques on ectomycorrhizae and extraradical hyphae applied over the last 20 years have revolutionized our views of the diversity of the ectomycorrhizal community more quickly than our understanding of fungal functioning. One promising approach to assess functional differences among ectomycorrhizal taxa and to link functional and taxonomic information is to correlate a morphological classification system of how ectomycorrhizal fungi explore the soil (termed exploration type) with various functional traits (carbon demand, enzymatic capabilities, insoluble versus soluble nutrient use, and sensitivity to nitrogen deposition). Exploration type appears to be generally consistent within a genus, and can be broadly separated into two categories, based on whether ectomycorrhizae are hydrophobic or hydrophilic. Ectomycorrhizal hydrophobicity in turn correlates with carbon demand, enzymatic capabilities, and the use of insoluble and patchily distributed resources, as nutrient uptake directly by hydrophobic mycorrhizae is not possible, but instead occurs in associated (and hydrophilic) extraradical hyphae. Similarly, hydrophobic rhizomorphs are required to prevent resource loss during long-distance transport. Aspects of fungal functioning such as carbon demand, enzymatic capabilities, ability to access recalcitrant organic nitrogen in soil, priming effects, and production of organic acids should be compared against potential genetic markers of those functionalities, so that we can better judge function from genomic information (e.g., metabolomics). The first ecosystem models that include mycorrhizal fungi have been recently developed, and testing those models will provide important insights into how ectomycorrhizal functioning influences carbon balances of terrestrial ecosystems.

S.05-05-O

Plants that receive carbon from their mycorrhizal fungi: a different story in the tropics vs. temperate regions?

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The evolution of the land flora has provided repeated emergences of the mycoheterotrophic habit, where achlorophyllous plants exploit carbon from mycorrhizal fungi colonizing their roots. This adaptation to forest environments where little light is available was mainly studied through two tools: fungal molecular barcoding allowed identification of the (often uncultivable) fungi from the roots; natural isotopic abundances in mycoheterotrophs were instrumental in supporting that a given fungal guild was providing carbon to the plant. Most classical works investigated temperate and Mediterranean species that proved to have specific basidiomycetes fungal partners, forming the so-called ectomycorrhizae with surrounding trees. Recently, the research interest shifted to tropical forests, where most mycoheterotrophs are growing. First, studies by our team and others have shown that high specificity for mycorrhizal fungi is not the rule among tropical mycoheterotrophs. Although some species are specific, other species associated with basidiomycetes or AM fungi show less specificity, even if they remain selective (i.e. have preferenda among the whole diversity of the targeted fungal guild). Secondly, especially in forest devoid of ectomycorrhizal basidiomycetes, other fungal guilds were targeted: some orchids from unrelated genera receive carbon from saprotrophic, wood- or litter-decaying fungi. At the same time and even in same forests, AM fungi were used by other mycoheterotrophic species, e.g. from the Gentianaceae and Burmanniaceae families. In the later case, the isotopic properties of the continuum between green plant (providing carbon) - AM fungi - mycoheterotrophic plant shows differences as compared to the analogous continuum for mycoheterotrophs associated with basidiomycetes. Moreover, C/N values, that are often low in the later, are unexpectedly higher in AM associated mycoheterotrophs. Thus, beyond apparent similarities, the parallel evolution of mycoheterotrophy in land plants may have followed different evolutionary pathways, linked to the divergent ecology of the respective plant lineages involved. AM-associated mycoheterotrophy may have evolved purely to support carbon need of the mycoheterotrophs, especially in the framework of shaded, but not N-limited tropical forests. At the opposite, basidiomycetes-associated mycoheterotrophs may have evolved for N acquisition in N-limited, but not always dark forests, that often occur in temperate regions.

S.05-06-O

Decomposers in disguise: mycorrhizal fungi as regulators of soil C dynamics under global change?

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Evidence is accumulating that ectomycorrhizal fungi have the potential to contribute to the direct loss of soil carbon (C) by acting as decomposers. In a synthesis of published laboratory studies, we found that the majority of ectomycorrhizal fungi tested were able to break down chitin (73%), protein (91%), and aromatic N compounds like polyphenols (81%). In addition, we found that all ectomycorrhizal fungi tested could utilize at least one form of simple organic N (i.e. amino acids) as a sole N source. However, the proportion of amino acids used by ectomycorrhizal fungi varied significantly by the N content, the aromaticity, and the relative abundance of the amino acid in protein. In addition, less than half of ectomycorrhizal fungi tested were capable of fully decomposing certain plant C compounds, like cellulose, starch, and pectin. If decomposition of organic molecules by ectomycorrhizal fungi occurs in ecosystems, we might expect that mycorrhizal investment in this process will be limited by properties of the organic matter, as well as factors that affect the transfer of C from the host plant to the mycorrhizal fungus. Global changes like pollution, warming, drought, and species invasions are expected to influence these factors and so may have feedbacks to the C cycle that are not currently accounted for in global climate models. The use of new analytical tools to study the function of ectomycorrhizal fungi in the environment can provide tests of these hypotheses and inform predictive models of how they will respond to future disturbance.

S.05-07-P

Ectomycorrhiza as link between trees (*Fagus sylvatica*) and the belowground food web.

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Trophic relationships between soil fauna, plants and mycorrhizal fungi are fundamental to ecosystem functioning. Ectomycorrhizal fungi (EMF) play an important role as regulator of the flux of carbon and nutrients. However, little is known on trophic relationships between EMF species and soil animals and the role of these interactions for carbon cycling and plant nutrient uptake. The flux of carbon from *Fagus sylvatica* into soil biota was investigated in a greenhouse experiment by labelling tree seedlings with ¹³CO₂. In parallel, nitrogen uptake of the trees from ¹⁵NO₃¹⁵NH₄ was studied. The tree seedlings were collected in the Hainich National Park (Thuringia, Germany) and incubated with intact rhizosphere soil in the greenhouse for five months. Thereafter, EMF and soil arthropods were identified to species. The flux of plant C into soil arthropods and the uptake of N by the plants was investigated by analysing stable isotope ratios of meso- and macrofauna species, mycorrhizal root tips and fine roots. A total of 32 EMF and 55 soil animal species were investigated. The results highlight species specific differences in C allocation and N uptake by EMF. Stable isotope ratios demonstrate that EMF functions as control point of plant nitrogen uptake which is mediated by plant carbon. The results further indicate trophic links between EMF, fungivorous soil arthropods and soil arthropod predators.

S.05-08-O

Carbon investment and nutrient return relations of two plants sharing a hyphal network of arbuscular mycorrhizal fungi.

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The majority of plants lives in association with arbuscular mycorrhizal fungi (AMF). Plants invest photosynthates in feeding their obligate fungal partners and obtain, in return, mineral nutrients foraged in the soil by AMF hyphae. Moreover, AMF forms underground hyphal networks interconnecting neighboring plant species. What are the costs and benefits of symbiosis for each plant interconnected by a common mycorrhizal network (CMN)? In a greenhouse experiment, we established microcosms with two adjacent plants (*Linum usitatissimum*, a C3 plant and *Sorghum bicolor*, a C4 plant) connected only by a shared hyphal network formed by *Glomus intraradices* or *G. mosseae*. We used natural discrimination of ¹³C to determine the carbon invested by each plant into the CMN, and ³³P and ¹⁵N to estimate for each plant the phosphorus (P) and nitrogen (N) derived from the CMN. Interestingly, about 70% of the carbon invested into hyphal network derived from *S. bicolor* without receiving corresponding nutrients. In contrast, *L. usitatissimum* received about half of N and P acquired by the hyphal network formed by *G. mosseae* and even 80% of N and 94% of P with *G. intraradices* as fungal partner. To shed light on the large difference between the two plant species in the ability to exploit the hyphal network for nutrients, we related the P uptake patterns to the expression of symbiosis specific plant P transporters. Concluding, such differences in the use of shared mycorrhizal networks help to explain the mechanism of AMF mediated plant coexistence.

S.05-09-P

Ectomycorrhizal fungi associated to phylogenetically isolated trees: Why host should stay with their relatives.

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Ectomycorrhizal fungi (ECMf) are dominant members of soil microbial community in temperate and boreal forests. Structure and diversity of ECM communities has been extensively studied across a wide range of forest types as well as its response to tree phenology, soil chemistry, or environmental disturbances. Among their functions, ECMf mobilize nutrients from organic compounds by secreting oxidative and hydrolytic enzymes. The recent development of new methods for determining the potential enzymatic activity profiles of individual ECMs makes possible to decipher trait diversity of ECM communities. Spatial isolation from conspecific neighbors has been shown to decrease ECMf recruitment. However, isolation of a host from surrounding hosts might not depend on spatial distance only, but also on evolutionary distance, i.e. its phylogenetic isolation. Indeed, spatially adjacent hosts may be separated by millions of years of evolutionary history, and likely share less mutualists than more closely related neighbours. We hypothesize that phylogenetic isolation of host from their local neighbours could decrease diversity and abundance of ECMf, and finally slow down host phenology. We address this question by studying individuals of oak species (*Quercus petraea* or *Quercus robur*) in local host tree communities differing in phylogenetic distance to *Quercus*. We have both studied the taxonomic diversity and measured functional traits (secreted enzymes) of ECMf associated to oak, as well as phenological traits (budbreak index). Our first results indicate that oak trees may benefit from the presence of closely related neighbors, consistent with a common mycorrhizal network shared between closely related neighbors.

S.06- Cause-effect relationships in food webs-aquatic ecosystems as study systems

S.06-01-O

Body size dependent hierarchies in Mediterranean lagoon food webs.

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Biodiversity organisation and spatial scales are major issues in community and conservation ecology. In lagoon ecosystems, the spatial extension of ecosystems, on the one side, and the body size of coloniser species, on the other, pose additional constraints to biodiversity organisation. Here, we have used the Transitional Water Platform (<http://www.circledmednet.unisalento.it/>) data on three trophic levels of Mediterranean lagoon food webs (primary producers, detritus feeders and invertebrate predators) to analyse hierarchical biodiversity organisation and its scaling within food webs. Taxonomic similarity among lagoons and habitat types and morpho-functional similarity have been analysed. Common patterns of biodiversity organisation and scales of organisation have been observed across trophic levels, but also peculiarities of the intermediate level, when compared with both planktonic producers and invertebrate predators. Across all trophic levels, biodiversity is organised primarily at the bio-geographic scale, emphasising very high γ biodiversity contrasting with the commonly very low α biodiversity; secondly, biodiversity is organised at the landscape scale, with high β components; third, body size dependent hierarchical organisation was observed at the local scale. Across all trophic levels, morpho-functional diversity was relatively invariant when compared with the taxonomic one. Comparing trophic levels, higher connectivity within patches and among lagoons was observed at low and high trophic levels than at the intermediate one. The small lagoon species pools when compared with the pools in input marine ecosystems, suggests a relevance of lottery-competition as a mechanism of community organisation at intermediate trophic levels, with increasing importance of niche and body size partitioning at low/high levels.

S.06-02-P

Contributions to knowledge on the causes driving dynamics of benthic macroinvertebrates structure in the Inland Danube Delta.

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University of Bucharest. University of Bucharest. University of Bucharest.

Many internal and external anthropogenic driving forces have been responsible in the last four decades for structural and functional changes in the Lower Danube Wetland System (LDWS), the largest and most diverse wetlands system in Europe which include the coastal Danube Delta (5193 km²), the Inland Danube Delta (2413 km², between km 170 and 365), and other floodplain areas. These changes affected the structure and functioning of the aquatic communities and had a significant negative impact on the amount and quality of the provided resources and services. This paper presents partial results of a research program aimed to contribute to developing knowledge on the causes of changes of the benthic fauna and estimate its role in the bioeconomy of aquatic ecosystems from Inland Danube Delta. The research program was designed for the period 2010-2012 and include 10 sampling stations in Small Island of Braila - Fundu Mare (island area) and 9 sampling stations in the lake Piatra Fetii (riparian area) and results were compared with those obtained from the previous period (1993-2009) in the same area and long-term datasets (1975-2000) from coastal Danube Delta. The dynamics of composition and structure of benthic fauna was described as response to changes in functional regime of the LDWS, mainly hydrological regime and trophic state. Preliminary analysis of samples collected during the first year of investigation confirms the dominance of Oligochaeta and Chironomidae taxonomic groups in the benthic communities from lentic ecosystems and of Oligochaeta and Gastropoda in the adjacent Danube River stretch.

S.06-03-P

Spatial aspects of Food Chain Efficiency –An Individual-based Modeling Approach.

Breckling, Broder. Jopp, Fred. Reuter, Hauke.

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Most of the results gained in classical food chain analysis use averaged interaction intensity values which are implicitly assuming spatial homogeneity of the space in which the interaction occurs. With an individual-based, spatially-explicit modeling approach we developed a predator-prey system which exhibits different forms of spatial and temporal self-organization (e.g. stationary clusters or traveling waves). An extension of the approach to longer food chains allows to assess across scales the relation of spatial structures, behavioural traits and physiological properties of model organisms, synchronously. Different applications show that phase transitions that affect spatial structures and biodiversity of persisting model organisms are linked in a complex way. Finally, conclusions for selection processes are discussed which emphasize the integrated systemic character of adaptation in contrast to plain and linear fitness considerations.

S.06-04-P

Consumptive and non-consumptive removal of temporary pond macrophytes by *Procambarus clarkia*.

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Freshwater crayfish are among the invasive species with most impacts on multiple trophic levels. With the aim to assess the impact of *Procambarus clarkii* on macrophytes of Mediterranean temporary ponds, we performed palatability and preference tests in laboratory, measuring the consumed biomass and the number of pieces into which the samples were fragmented for five macrophyte species. The daily food intake ranged from 4 to 8% of crayfish wet weight (corresponding to 1.17 g plant fresh weight). There were consumption differences between sexes, with females showing higher intakes. There was a clear preference by *Juncus heterophyllus* and a rejection of *Carex divisa* and *Ranunculus peltatus*. The selectivity shown by *P.clarkii* was based on various plant traits, preferring filamentous species with high dry weight and rejecting tough species or species with secondary metabolites. *P. clarkii* may rapidly consume a substantial amount of the selected species and destroy a similar amount of non-preferred species, which may lead to the complete elimination of macrophytes, dramatically changing temporary pond ecosystems.

S.06-05-O

Reciprocal interaction between an aquatic food web and an fish population undergoing rapid evolutionary change.

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The interactions between the optimal life history of a fish species, guppies, under different size-dependent predation regimes and the cascading effects on the food web are studied using a hybrid simulation, which combines state variable equations for the food web components and an individual-based model for the fish population. Starting with 800 phenotypes, the simulation determines the dominant phenotype. Simulations were performed with a sequence of values of size-dependent mortality on the guppies. The predation produced both a direct negative effect on the population size of the guppies and an indirect effect on the food base of their food base. Both of these effects influenced the natural selection acting on the competing phenotypes. Depending on the power (exponent) describing the feeding rate of the guppies on their resources, increased size-dependent predation could cause the optimal weight at maturity to either increase or decrease with increasing predation rate.

S.06-06-P

Understanding complex interactions between cormorants and food webs in the lentic ecosystems of Danube Delta: an integrated approach.

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Most recent studies undertaken upon piscivorous birds species on the European scale revealed the exponential dynamics of the cormorants populations and suggested their increasing impact on fisheries. However, it seems that the other piscivorous birds species maintained or even decrease their populations size and impact. Different attempts to explain the patterns of such changes were mostly based on sectoral and short term approach. This is the case for the studies carried out on cormorants in Danube Delta, too. Under these circumstances it was obvious that there is a need for integration and synthesis of historical data and information and the improvement of knowledge regarding the relationships between food webs in lentic ecosystems and cormorants in Danube Delta. It was assumed that will allow new requirements for management and science. The poster presentation is aiming to show and discuss: i) conceptual and analytical framework adopted and applied for analysis and synthesis; ii) variability of drivers and pressures in Lower Danube River catchment; iii) the patterns of structural and functional changes in the lentic ecosystems food webs, with particular focus on major fish modules - planktivorous, bentivorous and piscivorous species, and iv) the related changes in cormorants population size and their impact on fisheries.

S.06-07-P

Modeling the impact of invasive Dreissenidae on the aquatic food web under competitive conditions.

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Justus Liebig University Giessen. University of Miami. Justus Liebig University Giessen. Justus Liebig University Giessen.

Following the Grand Challenges in Landscape Ecology, the impact of invasiveness on non-native species can be a serious threat to local biodiversity. In this context, invasive Dreissenid mussels (*Bivalvia*, Dreissenidae) like the Zebra mussel (*Dreissena polymorpha*) and the apparently ecologically similarly behaving Quagga mussel (*D. rostriformis bugensis*) represent some of the most important invasive taxa in aquatic ecosystems. While the ecological impact of the former species is under focus since longer times, studies in North America indicate recently that the new invader Quagga mussel might even displace the Zebra mussel from their habitats. Here, a dramatic extension of the new invader seems to take place. First studies from Western Europe show similar trends. The factors, which are responsible for this competitive displacement of the Zebra mussel, are still not evaluated satisfactorily. As several studies reveal that some physiological differences exist in both taxa, different habitats may bring advantages for one of the invasive mussels. We used modeling approaches to understand the principles of this competition process under highly variable ecological conditions. First findings indicate that the reason for the prevalence of the Quagga mussel is a subtle interplay of intrinsic factors, like the species' better adaptation towards colder water temperatures, the ability to cope with lower food quality and with lower levels of oxygen together with a slow velocity in water bodies. We present how this approach can be used to predict abrupt range extensions of a aquatic species under oscillating environmental conditions. Finally, implications for management and conservation are discussed.

S.06-08-O

Analyzing the spatio-temporal dynamics of a tropical marshland small fish community.

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The Everglades ecosystem is a complex subtropical marshland, which is habitat for a large number of endangered or threatened species. This biodiversity is maintained by an underlying food web of small fishes and invertebrates, which are the energy base for much of the higher trophic level production. The ecosystem shows strong seasonality with dry and wet phases, which cause seasonal changes in the distribution of flooded and non-flooded areas. Due to the minimal elevational gradients of the Everglades landscape, small differences in mean water levels can alter the fraction of flooded landscape significantly. We investigate the trophic structure and the biomass dynamics within a spatially-explicit simulation model of the complex aquatic food web, in which we integrated the relevant external drivers (e.g. hydrology, elevation gradients) and internal drivers (e.g. intra- and interspecific competition). We use this approach to describe the resulting aquatic food web under representative ecosystem conditions in which we vary amplitude and duration of the water level fluctuations. We also investigate how important trophic cascades are in the model and what this may imply for the southern Florida fish community. Long-term simulations indicate that the interplay of the different drivers create a diverse local heterogeneity which allows the similar fish species to find and occupy their niches. Finally, implications for management and restoration of the Everglades marshland systems are discussed.

S.06-09-0

Spatial aspects of Food Chain Efficiency – An Individual-based Modelling Approach.

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Centre for Tropical Marine Ecology (ZMT). University of Bremen. University of Miami.

Most of the results gained in classical food chain analysis and respective simulation models use averaged interaction intensity values which implicitly assume spatial homogeneity. This allows general statements on the relation of trophic levels but might hold severe inaccuracies in case of a spatially structured community. With a spatially explicit individual-based modelling approach we developed a predator prey system which exhibits different forms of spatial and temporal self-organisation (e.g. stationary clusters or travelling waves). The simulations demonstrate clearly that temporal population dynamics depend on different movement patterns of the represented organisms. This occurs without any external influences e.g. environmental heterogeneity which might be assumed causal to structure population distribution. An extension of the approach to longer food chains allows to assess the relation of spatial structures, behavioural traits and physiological properties of model organisms synchronously. Different applications show that phase transitions affecting spatial structures and biodiversity of persisting model organisms are linked in a non-trivial way. Conclusions are drawn for selection processes which emphasise the integrated systemic character of adaptation in contrast to plain and linear fitness considerations.

S.06-10-0

Morpho-functional trait adaptations of marine phytoplankton to lagoon conditions: patterns, drivers and potential mechanisms.

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We have used an idealised transect, connecting transitional and coastal waters in the Mediterranean and Black Sea ecoregions, to analyse the patterns of adaptation of phytoplankton optimal body size and other morpho-functional traits. Here, we compare phytoplankton morpho-functional traits along strong gradients of potentially limiting abiotic drivers between and within ecosystem types. We report differences in size spectra, average cell size and surface to volume ratio between marine and transitional water phytoplankton, with marine significantly larger than transitional water ones at three levels of taxonomic hierarchy and across the whole size spectra. These differences are likely to reflect short-term adaptation of marine phytoplankton morpho-functional traits to lagoon conditions. Selection processes in transitional waters seem to favour smaller phytoplankton cell size than in the coastal marine ecosystems, despite the higher nutrient supply and light availability in transitional compared with coastal waters. Contrasting patterns of phytoplankton cell size variation with limiting nutrient concentrations are observed in both ecosystem types and suggested a weak or non-linear influence of nutrient and light limitation on phytoplankton trait adaptations. On the other hand, shallow depth and fully mixed conditions of transitional waters prevent any competitive advantage of large cells over small ones ensured resources exploitation in a deeper column water, due to cell size dependent sinking behaviour. Therefore, the mixed depth layer is likely to be the major driver of phytoplankton adaptation, through energetic and behavioural mechanisms, with the latter more relevant than the former highlighting the importance of spatial resource utilization in marine phytoplankton.

S.06-11-O

Can Food Niche Width ($\Delta^{13}C$) Explain Properties of Detritus-based Food Webs in Aquatic and Terrestrial Contexts? An analysis of food web and trophic niche using stable isotopes.

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A long-standing question in the study of food webs is whether there are similarities in the topological patterns of terrestrial and aquatic webs and how they can be explained. Some food web models have considered the role of the species niche, but field support is limited and, as such, the mechanisms by which consumers regulate web topology remain uncertain. In this study, we explored the influence of species niche width on (i) web structure, particularly the relationship between the number of links and species richness, and (ii) the web robustness to species loss, determined after in-silico removal of rare species. To this purpose, we reconstructed 42 new invertebrate detritus-based food webs and measured the trophic niche width as $\delta^{13}C$ variation of predators and prey from two aquatic and two terrestrial ecosystems. Our results show that the niche width of predators and prey increased in proportion to the number of species at their respective trophic levels, but the rate of niche enlargement was higher in terrestrial than in aquatic webs. Since niche width was also related to linkage density, the different rates in aquatic and terrestrial systems implied different mathematical relationships between the number of links and species richness. Specifically, the linkage density increased with S in terrestrial food webs, whereas it did not change significantly in aquatic ones, which implies S -scaling connectance. The web's robustness to rare species loss increased with the connectance and niche width of predators in both types of web. The results provide a pioneering field demonstration of the central role of species niche width, driven by optimal foraging, in determining food web structure, thus suggesting that optimal foraging and food web theories are just the two sides of the same coin.

S.07- Theoretical Ecology

S.07-01-O

Modelling net primary forest productivity: a machine learning model calibrated with forest inventory data.

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Understanding which factors drive forest productivity and its relationship with main global change drivers is a central issue in ecology. We examine changes in net primary productivity (NPP) for Spanish forests by calibrating a machine learning model from tree growth and recruitment data between 1986 and 2007 measured in 45,069 forest inventory plots along a broad range of climatic, biotic, and anthropogenic drivers. Adding anthropogenic and structural management and biotic variables to environmental ones, is possible to explain up to 64.63% of the aboveground forest net primary productivity (NPP). Namely, structural and management related variables such as tree basal area, tree density, canopy cover percentage and land use are along annual and autumn precipitation the main drivers of Iberian forests NPP. We projected forest productivity into an A2 global warming scenario. Our model predicts an increase in the average aboveground productivity for Mediterranean forests from 0.90 ± 0.75 t/ha·yr⁻¹ (present) to 1.43 ± 0.45 t/ha·yr⁻¹ (2080), and a slight increase in productivity for cool Temperate forests, from 3.32 ± 2.10 t/ha·yr⁻¹ for current conditions to 3.60 ± 1.64 t/ha·yr⁻¹ under global warming scenarios. Our model is more easily parameterized than physiologically-driven models, can be reparameterized and tested periodically - c. 10 years, with new forests inventory - and is based on tree productivity measurements and climatic variables.

S.07-02-P

Complex dynamics induced by seasonality in species competition. A model approach and ecological implications.

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Universidad Rey Juan Carlos. Universidad Rey Juan Carlos. Universidad Rey Juan Carlos.

Competition between species has been a traditional subject of research in theoretical ecology using mathematical models. The model developed by León and Tumpson (1973 in *Journal of Theoretical Biology* 50:185-201) of species competition for abiotic resources has allowed investigations of dynamical behavior in ecological competition. Chaotic induced coexistence in multispecies competition, hypothesis such as the resource-ratio hypothesis or theoretical explanations of the plankton paradox are some of the achievements that yield the study of this model. Chaotic dynamics is currently being applied to this model approaches enriching theoretical ecology with interdisciplinary studies. In the present work we have performed an analytical approach of this model for terrestrial plant competition. Leon & Tumpson's model assumes the total amount of resources to be constant moving between the environment or the species biomass. This conservation principle is not exactly observed in natural systems, so we have implemented a periodic term in the maximum carrying capacity of one of the resources in order to simulate the seasonal behavior that can be found in natural resources such as water availability for terrestrial systems. This change produces an enrichment in dynamical behavior, and chaotic attractors and complex dynamics are observed for the case of two species competing for two resources and studied using nonlinear dynamics tools such as phase space analysis and basins of attraction. Ecological implications including climatic change responses have been tested by varying parameters and their effects in the dynamics of the model are discussed.

S.07-03-O

Dispersal polymorphism and species' invasions.

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University of Leeds. University of Leeds.

The speed at which species' range expansions occur has important consequences for the conservation management of species' experiencing climate change and for the invasion of exotic organisms. Dispersal and population growth rate are known to affect the speed of invasion, however, little is known about what the effect of having a community of dispersal phenotypes is on the rate of range expansion. We use reaction-diffusion equations to model the invasion of a species with two dispersal phenotypes into a previously unoccupied landscape. These phenotypes differ in both their dispersal rate and population growth rate. Using analytical techniques and numerical simulations we find that the presence of both phenotypes can result in faster range expansions than if only a single phenotype is present in the landscape. We show that typically the invasion can occur up to twice as fast as a result of this polymorphism. This has implications for predicting the speed of invasion of species', suggesting that speeds cannot just be predicted from looking at a single phenotype and that the presence of a community of phenotypes needs to be taken into consideration.

S.07-04-O

Random walks, intelligent movement and mental maps: a comparison of search strategies.

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Animal movement strategies that optimize search efficiency have raised considerable interest. This and the availability of detailed movement and dispersal data motivated Nathan and colleagues recently to published their much appreciated call to base movement ecology on a more thorough mechanistic basis. So far, most movement models are based on correlated random walks (CRW). However, even if a random walk might describe real movement patterns acceptably well, there is no reason to assume that animals move randomly. Bayesian foraging strategies based on information and memory use seem to be much more appropriate concepts here. We present a mechanistic movement model of an animal with a limited perceptual range and basic information storage capacities. This “spatially informed forager” constructs a mental map of its environment, i.e. a spatially explicit utility function, by using (evolutionarily acquired) assumptions about the spatial correlation of resources to supplement the environmental information it perceives. We analyse the resulting movement patterns and search efficiencies and compare them to CRWs, biased correlated random walks (BCRW) of omniscient individuals and spatially uninformed strategies. We show that, in spite of their limited perceptual range, spatially informed individuals may perform nearly as well as those following a BCRW. This construction of a mental map results in a highly correlated walk between patches and rather systematic search for resources within resource clusters. Our work highlights the strength of mechanistic modelling approaches and sets the stage for the development of more sophisticated models of Bayesian strategies in foraging and dispersal.

S.07-05-O

Relating topological and dynamical approaches in spatial networks.

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Patchy or fragmented habitats are suitably represented as spatial networks. There are two approaches to spatial networks: topological and dynamical. Topological approaches have used network theory to detect modules, that is, groups of nodes that interact preferentially among themselves than with other nodes in the network. Dynamical approaches, in turn, have identified clusters on the basis of the synchronization of local dynamics. To what degree are these approaches coincident? To answer this question, we first run the dynamics of a metapopulation in a spatial network with modular topology. Then we measure to what extent the clusters formed by patches that have synchronous dynamics are coincident with the topological modules. Our results suggest that there is apparently little resemblance between both partitions in modules. This means that patterns of correlation among patches are difficult to assess from the information on the topology of the network alone. Thus, from a conservation point of view, topological approaches should be complemented with information on the metapopulation dynamics.

S.07-06-O

Species richness patterns of African Acacia: the effect of climate stability and browsers.

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Aarhus University. Universidade de Brasília. University of Copenhagen. Aarhus University. Aarhus University. Aarhus University. Wageningen University. Aarhus University.

What drives species richness patterns has long fascinated biologists. Whilst it has been shown that water and water-energy factors almost consistently best explain richness patterns at higher taxonomic levels (e.g. class level), it has also been established that the factors driving richness patterns of lower taxonomic groups may differ between groups. We used niche models to model the distribution of two widespread genera - *Vachellia* and *Senegalia* (previously two subgenera of *Acacia*) in Africa, and used the resulting maps to compare the two genera's richness patterns and their drivers across the continent. Using variation partitioning, we tested how well factors that have been shown to correlate with species richness - climate and energy factors, soil characteristics and habitat heterogeneity - explain species richness patterns of the two genera. However, because *Acacia* are dominant elements of vast areas of African savannas, and much of their functional biology is characterized by defences against herbivores, we hypothesize that browser diversity may have spurred diversification of the genera. In addition, climate stability is thought to have promoted existence of species over time. Therefore, we also included in the variation partitioning two factors that have been little considered as drivers of species richness patterns: climate stability since the last glacial maximum, and browser diversity. Here we present the results of these analyses.

S.07-07-O

Endemic habitat specialists vs. invasive habitat generalists: Habitat selection and population fluctuations in Island Birds.

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Degradation and habitat loss on oceanic islands are key processes leading to population decline of endemic birds and facilitating the establishment of invasive bird species. In this study, we assessed density and habitat selection of two endemics and two alien landbird species of Robinson Crusoe Island, Chile.

Results show that perturbed habitats contained a low density of the endemics Juan Fernandez firecrown and Juan Fernandez tit-tyrant whereas the invasive green-backed firecrown (and austral thrush) were significantly more abundant in perturbed scrub habitats. Landbird species show different habitat selection patterns, with endemics selecting for native forest and invasive species selecting for perturbed habitats, or using them at random. Landbird species experienced temporal fluctuations in their overall population sizes, with the endemic tit-tyrant suffering a significant decline in its population size of about 63 percent between 1994 and 2009. Only invasive species exhibited temporal changes in habitat use, significantly reducing their densities in the preferred scrub habitats, possibly as a response to decreased habitat quality. Thrushes apparently were able to compensate the population decrease in one non native habitat type by using native forests, a habitat giving them the opportunity of preying on nests of endemic species.

S.07-08-O

Population regulation, relevant information, and the evolution of gender-specific dispersal.

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University of Wuerzburg. University of Darmstadt. University of Wuerzburg.

Sex-biased dispersal is a widespread phenomenon. It is frequently explained as a strategy to avoid inbreeding or traced to differences in gender specific habitat heterogeneity; however, such explanations typically assume random emigration (decisions) in either sex. For a polygynous mating system we explore how males and females could utilize information about their environment to come to gender-specific, conditional emigration decisions. We (i) define information about population attributes (male or female population density, sex ratio) that is relevant to take informed (conditional) emigration decisions under different systems of population regulation and (ii) and how this information must be 'processed' to come to emigration decisions equalizing fitness expectations. We find that in populations with no (weak) density-dependent growth regulation, females should not emigrate or base emigration decisions on habitat quality. For males, on the other hand, emigration should respond to the sex ratio and to absolute male density. In populations with strong regulation (ceiling) both sexes should only respond to the density of their own sex. We discuss conditions favoring either female- or male-biased dispersal; typically higher heterogeneity in fitness relevant attributes should lead to male-biased dispersal.

S.07-09-O

Mechanisms of local adaptations to climatic gradients: lessons from a Physio-Demo-Genetics Model.

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Theoretical models dealing with local adaptation generally use individual fitness as a parameter driving the process of adaptation. This parameter is either directly controlled by the genotype, or indirectly derived from genetically controlled life history traits. Despite benefits of such assumptions and valuable theoretical concepts that emerged, partitioning evolutionary drivers into genotype-phenotype-demography maps is required to account for complex interactions among genes or functional traits regarding selection when environment or demography are unstable. In such frameworks, individual fitness dynamically results from the physiological and demographic processes and environment that can vary in space or in time. Trees can be considered as model organisms for testing such theoretical framework, because tree populations usually experiment a high spatial and temporal heterogeneity due to high longevity, size and dispersal abilities. In the context of increasing interest for short term evolution in non-equilibrium populations, we developed a new hybrid model, based on *Fagus sylvatica* colonisation along an altitudinal gradient in South East of France across 5 generations. The model couples a physical and physiological module simulating the tree response to environmental variations, a demographic module converting tree reserves into seed productions and tree mortality and modelling migration and a quantitative genetics model relating genotype to phenotype for two functional traits: water use efficiency (WUE) and date of budburst. We study the interplay between local adaptation, plasticity and gene flow in the response of tree populations to the altitudinal environmental variation by simulating evolutionary trajectories over five generations under stable climate. First, the model reproduces well variations of tree growth, budburst date, and seed production with elevation and between years. Second, we show that few generations are enough for natural selection to handle genetic and phenotypic differentiations for the WUE and date of budburst across the altitudinal gradient. Third, the simulated patterns of phenotypic and genotypic variations are not linear: (1) population evolve towards increased WUE only at lower elevations; (2) earlier budburst dates are selected for when elevation increases, but above a given elevation, later budburst dates are selected for due to exponential increase in late frost days.

S.07-10-O

Between the devil and the deep blue sea: dispersal under local adaptation and climate change.

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CNRS, Grenoble. CNRS, Grenoble. CNRS, Grenoble. University of Aberdeen.

Dispersal is known to facilitate rapid evolutionary response to changing environmental conditions by increasing genetic variance. At the same time, when individuals are locally adapted, dispersal can reduce population fitness due to gene swamping. In this talk, I present an individual-based, quantitative-genetic model to address conceptual questions on the interactive effects of local adaptation, gene flow and demographic processes on species' responses to climate change. Two polygenic traits - the level of adaptation to the local environment and to global climate - are considered to control population fitness and to evolve under changing environmental conditions. Systematic variation of the model parameters allows evaluating the optimal level of dispersal under scenarios of different selection pressures induced by habitat fragmentation and climatic change.

S.07-11-O

Invariances in macroecology: Are species-abundance, species-area and species-energy relationships universal?

Storch, David.

Charles University.

Looking for invariances proved to be very successful way of scientific inquiry, especially in physics. In ecology, there are many patterns which are implicitly assumed to be invariant in respect to taxonomic resolution or space. For instance, species-abundance distribution or species-area relationship are generally assumed to have particular properties independent of the area or taxon for which these patterns are described. Similarly, trends in species richness are mostly assumed to be quite general regardless of taxonomic level used. However, little effort has been devoted to systematic exploration of these invariances and/or to using these invariances as a criterion to reveal generality of the patterns. I show that several macroecological patterns including species-abundance distribution, species-area and species-temperature relationships either cannot be invariant against changing taxonomic level or scale, or, if they are invariant (i.e. truly general), they must obey quite specific constraints. Moreover, these patterns can be theoretically derived on the basis of their assumed invariance or their particular variation with scale or taxonomic scope.

S.07-12-O

Aridity gradient and annual plants abundance, does exist a global pattern?

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It is described that in a gradient of water availability, annual species will be favored as water becomes less available and pulsed. In Israel and Chile this change along an aridity gradient has been found at a local scales. At this scales it seems that aridity favors annual species, but to a certain threshold from what annuals could not stand with the aridity but perennials can. A similar study was published in California, but studying the change from mainly herbaceous to mainly woody communities with similar results. In contrast, in other Mediterranean/arid habitats (Australia or South Africa) annual plants are a minor components of the ecosystems in terms of species number (7% or 6.4% respectively), and in other Mediterranean habitats, like West Mediterranean basin, there are a lack of data about the relative importance of annual species in ecosystems in relation to aridity. In this study we will compare the proportion among annual and perennial species along an aridity gradients in different arid climates of the world (Mediterranean Basin, South West Africa, Chile and California) in order to test if this pattern is a general trend or depends on local conditions. Preliminary results and bibliographic data indicate that this trend is clear in Chile and in East Mediterranean Basin, but data in other areas needs to be analyzed yet.

S.07-13-P

Size and gender control tree growth in early stages of development in *Juniperus thurifera* forests.

Vizcaíno Palomar, Natalia. García Pavón, Javier. Gómez Aparicio, Lorena. Zavala Gironés, Miguel Ángel.

CIFOR-INIA. Universidad de Alcalá de Henares. IRNAS-CSIC. CIFOR-INIA.

Patterns of growth inequality in crowded woody dioecious plant populations are often considered to be indicative of differences in reproduction costs. It is generally assumed that females invest more resources on reproduction than males, which makes them to be usually smaller than male trees. In this study, we focus on the main factors influencing tree growth in early stages of development of the tree *Juniperus thurifera*, including gender variability and intersexual competition. Specifically we focus on the gender of the trees to understand their role. We used a neighborhood approach to study tree growth as a function of the size and gender of the trees in the site of study. There were significant differences in growth between male trees and female and juvenile trees. Females trees grew faster than males, which contradicts the general assumption about the reproduction cost. Despite the high tree density in the plot, we did not find any evidence of a competitive effect of conspecific neighbors on target tree growth. In the early stages of development of *Juniperus thurifera*, intraspecific competition - including intersexual neighborhood competition- is not yet a relevant determinant of tree growth patterns, and tree growth is mainly determined by individual size and gender.

S.08- Stable isotopes in ecological processes

S.08-01-O

Stable isotopes as a tool for the evaluation of ecological status of groundwater dependent communities.

Antunes, Cristina. Pinho, Pedro. Pinto, Manuel João. Fernandes, Patrícia. Correia, Otília. Máguas, Cristina.

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Groundwater drawdown is of obvious importance to phreatophytic vegetation as reduction of water tables may sever these plants from one of their key water sources. The reports on plant species that are dependent on groundwater in arid ecosystems are scarce and poorly understood. Additionally, few studies had the possibility to use artificial lowering of groundwater at ecosystem scale, and the respective monitoring of plant community response. Anthropogenic alterations may exacerbate groundwater fluctuations and affect vegetation reliant on it. These effects include changes in physiology, structure and community dynamics. Our study site, a Mediterranean pine forest located in Portuguese western coast, which has been affected by artificial lowering of groundwater, is particularly interesting. In order to minimize future impacts of groundwater exploitation, it is crucial to understand specific water requirements, especially in ecological relevant phreatophyte species, such as the case of *Salix repens* in this region of Portugal. Therefore, the aim of this study was to evaluate the physiological response of *Salix repens* to changes in water availability, particularly groundwater, using ecosystem integrative approaches such as stable isotopes. After evaluating its physiological responses (ψ , $\Delta^{13}\text{C}$, $\delta^{18}\text{O}$) to different environmental factors in two contrasting climatic conditions, this study revealed that: (a) the performance of *Salix repens* is dependent of low air salinity and lower dune-slacks area, (b) the species is very susceptible to changes in water availability, being dependent on two water sources (precipitation in spring and groundwater in summer time), (c) the carbon isotope discrimination of leaves ($\Delta^{13}\text{C}$) decreases with stress factors.

S.08-02-O

IADFs in Mediterranean species: a new interpretative model to gain ecological and climatological information.

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The goal of our multidisciplinary approach was to obtain new interpretative models of the dynamics of wood formation in plants growing in Mediterranean ecosystems in relation to climatic factors, especially temperature and water availability. The research was conducted using woody species characterized by different ecological strategies and where density fluctuations (IADFs) in tree rings are easily produced and detectable in responses to climatic changes. Dendro-ecological, quantitative wood anatomy and $\delta^{13}\text{C}$ analyses were performed on *Arbutus unedo* L. and *Erica arborea* L. plants growing in a mesic and xeric site on the Elba island (Italy). Selected rings, with and without IADFs, were analyzed with two approaches: 1) a conventional separation of each ring into 3 sections (earlywood, latewood and IADFs) where the anatomical and isotopic traits were quantified and compared, and 2) a second analysis in continuum of such features along ring width. In this study, we report both methodological and functional results. More specifically, we describe the first systematic comparison between the two methodologies commonly used in the analysis of IADFs of tree rings; moreover, we interpret the effect of climatic variability on different eco-physiological and morpho-functional parameters during wood formation. As final considerations, the study of IADFs seems to be a valuable tool to ease the identification of false rings in the Mediterranean wood and to evaluate how woody species vary their role of carbon sink in different environmental conditions triggered by climate changes or regional modifications of land use.

S.08-03-O

P limitation restrain N retention capacity in N-saturated forests: a test through P fertilization and ¹⁵N labelling in *Abies pinsapo* stands.

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The onset of reduced N retention capacity in forest ecosystems under chronic N deposition might arise from a shift from N limitation to limitation by another nutrient such as P. To test this hypothesis, we carried out a ¹⁵N soil labelling field-experiment, using non-fertilized and P-fertilized plots at two elevations in a N-saturated Mediterranean-fir (*Abies pinsapo*) forest showing P limitation symptoms. We expected N retention capacity to be higher in P-fertilized plots as a consequence of the alleviation of P limitation. The inclusion of root-exclusion treatments allowed us to disentangle the relative contribution of roots plus ectomycorrhizas (ECM) uptake and heterotrophic microbial immobilisation to N retention. Overall ¹⁵N recovery from the litter, soil (0-15 cm) and plant uptake components was 96 % in P-fertilized plots and 61 % in non-fertilized plots at low elevation; 59 % and 38 %, respectively, at high elevation. Estimates of root+ECM uptake in P-fertilized plots represented sink similar to that of microbial immobilisation, accounting for 43.5 % of total ¹⁵N recovery at low- and 34.4 % at high-elevation. In contrast, soil was by far the biggest sink for added ¹⁵N in non-fertilized plots. P addition increased N immobilization in the litter plus surface soil layers only when roots had been excluded. It suggests that reduced N retention capacity and dominance of soil microbial over autotrophic immobilization in a N-saturated forest results from a shift from N to P limitation of trees, while alleviation of P limitation makes tree roots competitive for N against soil microbes.

S.08-04-P

Effect of lipid content in stable isotope analysis in bumblebees (*Bombus* sp).

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Stable isotopes of carbon and nitrogen are widely used to address resource use in animals. However, the technique is not free from caveats or methodological issues. For instance, lipids stored in tissues are depleted on $\delta^{13}\text{C}$, thus potentially introducing a bias in the results, i.e., yielding isotopic values that deviate from those expected from the use of certain resources. There are two ways of addressing this lipid issue, which is important when the lipid content is high or variable among samples to compare: 1) lipid extraction, which produces uniformly low lipid content of the samples but may cause artefacts in $\delta^{15}\text{N}$; 2) mathematical normalization, based in the relationship between C:N ratio, lipid content (%) and $\delta^{13}\text{C}$, preserves the integrity of samples, but relies on the strength of these relationships, which should not necessarily be constant among organisms. We examined the effect of lipid extraction on $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ and evaluate the mathematical normalisation technique in 4 species of bumblebees (*Bombus* sp.), using both workers and queens. Although our samples showed low lipid content, there was a significant effect of lipid extraction on $\delta^{13}\text{C}$ in all the species, regardless of caste. In addition, we found no effect of lipid extraction on $\delta^{15}\text{N}$. Relationships between C:N ratio, lipid content (%) and $\delta^{13}\text{C}$ were weak or non significant in all the species or castes considered. We conclude that mathematical normalisation would not be a reliable technique when dealing with terrestrial insects samples.

S.08-05-O

An isotopic approach of the use of fish farm effluents by benthic communities: different sources and pathways.

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Freshwater trout farming discharges significant inputs of organic matter into rivers, resulting from faeces, unconsumed feed pellets and various excretions. Although substantial modifications of aquatic ecosystem are expected, study cases on perturbation downstream trout farm effluents are missing. The composition and origin of feed pellets, including marine fish meal and oil, offer the possibility to trace the fate of organic matter in freshwater benthic food webs thanks to stable isotopes analysis. Our study was performed at the vicinity of 3 trout farm located on the 3 different geological and hydrochemical contexts in France: Brittany, Normandy and Aquitaine. Different samples were collected in autumn and at the end of spring : Particular Organic Matter (POM) and Sediment Organic Matter (SOM), epilithic biofilms, primary producers (algae, macrophytes including bryophytes), benthic invertebrates belonging to different trophic guilds (grazers, shredders, deposit feeders, filter feeders and predators), and benthivorous fish. Samples collected immediately upstream, in the effluent channel, 100 and 1000 meters downstream the fish farm, were prepared and analysed for stable C and N isotope analyses. We also tested on some samples Deuterium analyses, in order to distinguish different sources of energy for these food webs. Feed pellets were significantly ¹³C-enriched compared with isotopic background of the river. In spring and autumn, $\delta^{13}\text{C}$ values in benthic food web significantly increased downstream the effluent, indicating assimilation of organic matter from the fish farm via the decomposer pathway and transfer to benthivorous fish. However, grazers were substantially ¹⁵N-depleted in spring, suggesting enhancement of the algal-grazer pathway by dissolved N from the farm. Our results give evidence that organic matter from fish farming is assimilated by freshwater ecosystems, and highlight the role of benthic organisms in this process. Dissolved nutrients also affect benthic food webs modifying their isotopic signature.

S.08-06-P

Effects of season and nitrogen supply on soil CO₂ efflux of understory vegetation in a boreal forest using a ¹³C pulse labeling technique.

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Vegetation research in boreal forests has traditionally been focused on trees, with little attention given to understory vegetation. However, the productivity of understory vegetation could be comparable to that of the trees and therefore may play a key role in the amount of carbon (C) that is entering and leaving these forested ecosystems. We conducted a ¹³C pulse labeling experiment to determine the allocation of new C to different pathways in the early and late growing seasons for two understory communities dominated by either *Vaccinium myrtillus* (bilberry) or *Vaccinium vitis-idaea* (lingonberry) in a boreal forest in northern Sweden. Additionally, this study was replicated across a nitrogen (N) fertilization treatment to examine the effects of nitrogen availability on belowground C allocation. This poster presents data on the amount of ¹³C label that was measured from CO₂ respired from soil. Seasonal variation in respired ¹³C exceeded differences in ¹³C respired between the two plant communities. Plant communities dominated by *V. myrtillus* respired 44% and 22%, whereas plant communities dominated by *V. vitis-idaea* respired 30% and 16% of the ¹³C label in early and late growing seasons, respectively. Across seasons, 21% of the ¹³C label was respired in plots with no added N, 32% in the low N treatment, and 31% in the high N treatment. Results from this study suggest potential seasonal differences in the utilization of belowground C by understory vegetation in boreal forests. Moreover, N addition appeared to increase the amount of new C respired from soils, which is in contrast to a previous ¹³C pulse labeling experiment on young *Pinus sylvestris* trees.

S.08-07-O

Tree-ring $\delta^{13}\text{C}$ analysis of dead and surviving Scots pines in two populations affected by drought-induced mortality.

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Stable isotopes record physiological responses to climate during a tree's lifespan and therefore can be used as tools for retrospective analyses in tree rings. In this study we determined $^{13}\text{C}/^{12}\text{C}$ ratios of annual tree rings of Scots pine (*Pinus sylvestris* L.) individuals from two populations in Spain (Prades and Arcalís), where high mortality rates following particularly dry years have been recorded in the last decades. Recent investigations conducted at these two locations show a direct connection between Scots pine mortality and severe drought periods defined by exceptionally dry summers. At the same time, a slow process of growth decline that started 15-40 years before the time of death was evident for the now-dead trees. Here we use $\delta^{13}\text{C}$ aiming at understanding ecophysiological differences, in terms of water-use efficiency and a possible predisposition to later mortality, between the now-dead Scots pine trees and the ones that survived the severe drought events. Our hypothesis is that the trees that are about to die experience greater drought stress, either because they are intrinsically more vulnerable or because they occupy drier microenvironments, resulting in higher water-use efficiency and lower growth compared to surviving individuals. A total of 30 Scots pines including now-dead and living individuals sampled along a humidity gradient were analyzed for $\delta^{13}\text{C}$ with annual resolution for a 34-year period. The implications of our results are discussed in terms of the impact of climate warming on future mortality dynamics for this species.

S.08-08-O

 d^{13}C and d^{18}O isotopes to trace plant integrated processes: the case study of Mediterranean plant communities under drought stress.

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During photosynthesis, transpiration, heterotrophic respiration and evaporation, isotopic fractionation between $^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$ leaves an isotopic imprint on the soil, plant and atmospheric carbon and water pools and associated fluxes which can be traced through the plant-soil-atmosphere continuum. The possibility to use a multiple-isotope approach, i.e. the simultaneous measurements of d^{18}O and d^{13}C , provides a unique opportunity to investigate water and carbon, which has markedly advanced our understanding on the underlying processes at various temporal and spatial scales. Here, we present how the use of carbon and oxygen isotope fractionation improved our knowledge about water and carbon cycling in Mediterranean ecosystems (oak woodland "montado" and pine forests), in particular when considering the highly temporal dynamics and spatial heterogeneity. In particular, we discuss: 1) the use of isotope information of pine phloem sap to trace plant integrated canopy response to drought stress; 2) the utilization of isotope tracers at the community scale that allows the distinction between plant functional types based on simple measurement of mean bulk leaf D^{13}C and water source partitioning; 3) the partitioning of isotopic compositions ($\text{d}^{13}\text{C}_{\text{res}}$) fluxes at ecosystem level.

S.08-09-0

The long-term vulnerability of *Pinus halepensis* trees to drought stress is strongly modulated by stand structure in a semiarid Mediterranean ecosystem.

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Plant community structure influences the relative weight of facilitative or competitive plant-plant interactions and can thus affect the resistance and resilience of semiarid Mediterranean woodlands to the predicted increase in climatic stress. In order to compare the long term performance of *Pinus halepensis* between open woodland stands and dense afforested stands, we measured tree ring growth and the carbon and oxygen stable isotope composition of latewood ($\delta^{13}\text{CLW}$ and $\delta^{18}\text{OLW}$, respectively) from 1967 to 2007. Across stand types, annual precipitation amount was strongly correlated with radial growth (positive), $\delta^{13}\text{CLW}$ and $\delta^{18}\text{OLW}$ (negative), thus indicating that tree physiology and growth are largely determined by interannual changes in water availability. Pines in afforested stands had consistently more enriched $\delta^{18}\text{OLW}$ values, lower radial growth, and showed greater sensitivity to climatic variability than pines in open woodlands. By contrast, there was no difference in $\delta^{13}\text{CLW}$ between stand types, indicating that both stomatal conductance and photosynthetic rate were lower in afforested than in open woodland stands, with no significant differences in water use efficiency between them. Trees in afforested stands were more vulnerable to drought stress than those in neighbouring open woodland stands due to much heavier inter-tree competition for soil water in the former.

S.08-10-0

Usefulness and limitations of stable isotope analysis ($^{15}\text{N}/^{14}\text{N}$ and $^{13}\text{C}/^{12}\text{C}$) to establish trophic guilds in arthropod-dominated terrestrial food webs.

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Ascribing species to trophic guilds is a difficult task in arthropod-dominated terrestrial communities, where generalist predators and omnivores are commonplace and plant-based and detrital-based food webs are intermixed. Originally, the position of species within food webs was generally based on time-consuming techniques like direct observation of feeding events or in the analysis of predator gut contents. The measurement of naturally occurring stable isotopes of N and C provides an alternative approach. In short, the N isotopic composition gives an idea of the trophic level of the species and the C isotopic composition of their ultimate C source (i.e. terrestrial vs. aquatic or detrital vs. plant material). Here we present some preliminary results (on ants, spiders and aphids) of an ongoing community-wide attempt to establish trophic guilds among 500+ arthropod species in an organic citrus grove of Tarragona, NE Spain. The three taxonomic groups showed a variable degree in the usefulness of isotopic analysis to establish trophic guilds among species. Isotopic content of ants reflected most of the previous knowledge on both the trophic level and the predaceous vs. plant feeding habits of the species. Isotopic analysis of canopy spiders did not differentiate discrete trophic levels, but showed a continuum on both C and N axes, maybe due to the extreme generalist feeding habits of most spiders. Finally, $\delta^{15}\text{N}$ values of aphids varied 8 per mil among species, when all of them are phloem feeders, reflecting the high heterogeneity of different plant resources in the grove

S.08-11-O

15N stable isotope as a tool to investigate the effects of herbivores on plant N uptake.

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Reindeer have a strong direct effect on arctic ecosystems by consuming palatable plants. However, reindeer indirectly affect arctic plant communities, via altering the nutrient cycling. Reindeer populations increase nitrogen (N) cycling via a range of different pathways: they provide nutrient rich urine and faeces, change the species composition towards plants with a higher litter quality and increase soil temperatures. The increased N cycling could have large effects on tundra plant communities, since they are strongly nitrogen limited. We will explore how ¹⁵N stable isotope can be used to investigate the effects of herbivores on plant nutrient uptake. The influence of reindeer is studied across 50-years-old reindeer fences, with highly contrasting grazing pressure in northern Norway. Our preliminary results show that $\delta^{15}\text{N}$ values tend to be higher in shrubs in heavily grazed areas compared to shrubs in ungrazed areas. However, the opposing pattern was found for graminoids with lower $\delta^{15}\text{N}$ values in the grazed plants. We hypothesize that the higher $\delta^{15}\text{N}$ values in grazed shrubs reflect a reduced N uptake via mycorrhiza, while the lower values for graminoids in the grazed treatments reflect an alteration of the isotopic composition of plant available N in the soil. We will test these hypotheses and explore the major ways in which herbivores influence plant nutrition via a series of experiments including grazing simulation, reindeer dropping addition and fertilization with trace amounts of ¹⁵N labeled substances.

S.08-12-P

Stable hydrogen isotopes in bone collagen as an indicator of trophic level.

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Organic deuterium/hydrogen stable isotope ratios (D/H or 2H/1H, expressed as δD value in ‰) in faunal tissues are related to D/H ratios in diet and ingested water. Bone collagen preserves the biochemical D/H signal in the δDn value of collagen's non-exchangeable, carbon-bound hydrogen. δDn can potentially be used to constrain environmental and trophic conditions, which are of interest to studies of modern and fossil vertebrates. Based on over 120 individuals from more than 30 marine and terrestrial vertebrate species, it is shown that D/H of environmental water and trophic level are major factors influencing collagen δDn . In south central Indiana where local meteoric water averages $\delta\text{D}_{\text{water}} = -47\text{‰}$, collagen δDn from terrestrial species ranged from -100‰ to $+100\text{‰}$. Herbivores tend to have the lowest δDn , omnivores have intermediate values, and carnivores have the highest values. Body size and metabolic rate may be additional factors. Part of our study focuses on marine and terrestrial carnivores to investigate D-enrichment and variability at the top of trophic chains. The observed variability within populations of California sea lions and northern elephant seals may arise from individual dietary differences such as pre-weaned infants vs. adults. Bone collagens of terrestrial and marine carnivores can be comparably D-enriched and express similar variance of δDn . D-enrichment of seawater and reduced evapotranspiration in some marine mammals yield comparable results like D-depleted terrestrial water sources and strong evapotranspiration in land mammals. This in turn may suggest a stronger effect of trophic level than metabolic rate on δDn values in animals.

S.08-13-P

Mediterranean evergreen woody species use differently carbon and nitrogen reserves for leaf and root growth.

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New growth is essential for seedling establishment in forest plantations. Reserves contribute 50 to 80% of new organ N. Stored C is basic for early growth in deciduous species but currently fixed photosynthates seems to be more important in evergreen conifers. However, little is known about how Mediterranean evergreen species use reserves for organ growth. We determined the relative importance of N and C reserves on early growth of roots and shoots in four Mediterranean evergreen woody species *Quercus ilex*, *Q. coccifera*, *Pinus halepensis* and *Olea europaea*. We labeled plant C reserves and soil N with ¹³C and ¹⁵N, respectively, to distinguish the contribution of stored and currently fixed C and uptaken N. Overall the use of N and C reserves in all species followed the same pattern but it differed depending on the organ. New shoots were made up of more C and N reserves than roots in all species. *Q. coccifera* was the specie that relied less on reserves for both root and shoot growth (< 25%). *Q. ilex* and *O. europaea* roughly used similar amounts of both stored nutrients and recently uptaken N or fixed C in root and shoot growth. In contrast, *P. halepensis* had a very different pattern of use of stored nutrients. While less than 20% of C and N in roots came from the reserves, more than 60% of C and N in new shoots came from reserves. Results suggest that nursery culture should promote large reserves but also high capacity to acquire external resources, especially in *Q. coccifera*

S.08-14-O

Climatic sensitivity of stable isotopes in co-occurring *Quercus* species: analysis of spatial and temporal gradients under Mediterranean conditions.

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Stable isotopes records provide information on temporal and spatial interactions between plant communities and environmental factors. In the Mediterranean region, fully adapted vegetation coexists with temperate species that are either on their driest distribution extreme or remain as relict populations in relatively wet environments. As climate warming may produce wholesale relocation of tree species, this study aims at understanding how co-existing species with different climate optima will respond as climate warms, and what climatic factors will most likely limit their performance. We analyzed $\Delta^{13}\text{C}$ and $d^{18}\text{O}$ of α -cellulose from 21 sampling points along a rainfall gradient (range 385 mm - 1018 mm) in Northern Spain where the evergreen *Q. ilex* is accompanied by different deciduous oaks: the mesomediterranean *Q. faginea*, the submediterranean *Q. humilis*, and the temperate *Q. petraea*. Tree rings (1989-2008) were pooled for isotopic analysis. For three points (one representing each pair of oaks), we also analyzed tree rings with annual resolution. The relative strength of the common variance signal at temporal and spatial levels was evaluated using mixed modeling. Deciduous oaks (considered together) and *Q. ilex* had different patterns of intra-annual and inter-site variation for $\Delta^{13}\text{C}$, but exhibited similar fluctuations for $d^{18}\text{O}$ at the temporal level. The most contrasting sensitivities to climate factors between co-occurring species involved *Q. ilex* and *Q. faginea*, at the driest distribution extreme of deciduous oaks in the region. Based on their performance in dry sites, potential implications of global warming for oaks currently growing in wetter and colder areas will be discussed.

S.08-15-O

Facilitative effects of legumes on the performance of four different grassland species.

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Positive effects of legumes on performance & N dynamics of neighbouring grassland species are well known in agricultural settings, but little is known about how N facilitation in diverse grasslands is affected by the functional identity of the interacting players. We investigated how species identity & ecological traits affect interactions between legumes and their non-fixing forb neighbours. We grew either *Lotus corniculatus* or *Medicago lupulina* (legumes) in combination with three different forbs (*Achillea millefolium*, *Dianthus deltoides*, *Ranunculus repens*) representing different functional traits and specialization to different environmental conditions in order to test whether N facilitation occurred and to evaluate how important N transfer versus nitrate sparing are as mechanisms for N facilitation. Using both pots and rhizotrons we measured not only plant biomass, N and $\delta^{15}\text{N}$ but also sampled soil from underneath the plants to evaluate how interactions affected soil nutrients and indirectly N facilitation. We found that the non-legume forbs profited in varying ways from having a legume neighbor and the identity of species affected interactions considerably. Both legume species derived a similar and high fraction of their N from the atmosphere (ca. 85%), and in general $\delta^{15}\text{N}$ -values of legume neighbours (compared with increases in leaf N) suggest that N transfer occurred. The main evidence for N transfer of legume-fixed N to the neighbors was with *D. deltoides* growing with *Lotus* rather than near *Medicago*. We found higher soil nitrate concentrations under *D. deltoides* and an accumulation of ammonium under *R. repens* growing with *Lotus*.

S.08-16-P

Water sources used in Mediterranean and tropical coastal sand dune vegetation: stable oxygen isotopic composition (d^{18}O).

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The aim of this study was to compare two foredune plant communities (Mediterranean and tropical) from the point of view of water source exploitation, addressing variations in spatial (zonal distribution across the dune) and seasonal (wet and dry) patterns. Two coastal dune systems were studied: Flecha de El Rompido (37°12'N, 7°04'W) in Huelva, Spain and La Mancha (19°35'N, 96°22'W) in Veracruz, Mexico. The mean annual rainfall of the Spanish site is 583 mm while in the Mexican dune system it is 1260 mm. Both sites experience one yearly seasonal dry period. Stable isotopes ($^{18}\text{O}/^{16}\text{O}$) were used to identify water sources used by the vegetation (rain, ground and ocean water). In each study site, stem samples were collected for xylem water extraction during the wet and dry seasons at four points along a transect (30 and 40 m length) across the dune: High beach proximal to the embryo dune, top of embryo dune, interdune depression and seaward face of foredune. The samples of rain, ground and ocean water were collected at the same time than plant samples. The results showed isotopic evidence that, independently of the geographical location, dune plant species display different use of water sources along their zonal distribution. The patterns of water use were related to the type of radical system of the species. Some species in the Mediterranean site changed the main water source used from the wet to the dry season, whilst those species with deepest root systems kept using groundwater along the year. Opposedly, tropical species used the same water source both in wet and in dry season. We hypothesized that differences may be due to the more pronounced seasonal drought effect in the Mediterranean dunes.

S.09- Surveillance and Monitoring of habitats and species

S.09-01-P

A GIS Model of Range Suitability Assessment for Sheep Grazing.

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Introduction: Range suitability has been defined as the adaptability of an area to grazing by (Ibrahim, 1975). Each land utilization type required certain environmental conditions. Adequate forage in the dry season and access to stock watering points are examples of land use requirements for extensive grazing. Understanding the most important factors affecting range suitability, recognizing limiting factors and introducing criteria's for assessment of suitability for sheep grazing were objectives of this work. Those maps have been used in this study were vegetation, soil and land capability, property border, water resources, location of villages, land use, geology and geomorphology. Method introduced by FAO (1991) used for producing range suitability classification map using ILWIS as a GIS software. Two orders of range suitability were considered: suitable (S) and not suitable (N). Three classes of suitability were determined including high (S1), moderate (S2), and marginally suitable (S3). For range suitability classification, three sub-models of; sensitivity to erosion, water and forage were created and their output were integrated. Limiting factor of potable water in the mountainous areas in semi-arid region was slope. In terms of forage production rangeland with less than 150, 100 and 50 kg/ha dry matter were not suitable for grazing in humid, semi-arid and arid areas respectively. GIS facilitated integration of information layers within and between models. As FAO (1991) cited requirements and limitations for a type of utilization is the base of decision making for range suitability classification. Range suitability in each region differed depends on climate, vegetation, soil, current land utilization condition and topography. The most important factor that reduced forage production suitability was amount of proper use factor because of sensitivity of soil to erosion. No grazing is recommended for sloppy areas by domestic animals. These areas can be considered just for wildlife and tourism as also was recommended by Holechck et al. (1998). Generally determination of range suitability is the most difficult aspect of range assessment. Precision of suitability assessment can be increased by GIS for integration of various information layers.

S.09-02-P

Wintering White-headed Duck (*Oxyura leucocephala*) in Garaet Hadj-Tahar (Skikda, Northeast Algeria).

atoussi, sadek. metallaoui, sophia. merzoug, abdelghani. houhamdi, moussa.

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Garaet Tahar Hadj is one of the main sites frequented by White-headed Duc in Algeria. The maximum observed in winter (251 birds) is the highest recorded for all Algerian wetlands. This number is however composed of two populations, a sedentary and breeding one made up of 6 to 7 pairs, the other one only wintering and more numerous. The latter prefers free space at the center of the garaet while the breeding population is dispersed throughout the western area rich in *Nymphaea alba*. The daytime behavior is dominated by sleep (38.98%), followed by swimming (35.6%), preening (18.18%), feeding (4.76%, among which 3.16% diving and 1.6% surface picking), other activities (flight, parade and antagonism) accounts for a minimal budget in this time.

S.09-03-P

Successful wildlife introductions: the case of Alpine marmots in the Pyrenees.

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Introductions of species occur when species are released in areas where they have not been present in historic times. They may pursue conservation, recreational, hunting or other goals and have different outcomes or potential impacts on the hosting habitat. According to the IUCN guidelines a monitoring should always follow these interventions, but this is seldom the case. For example, Alpine marmots *Marmota marmota* were released into the French side of the Pyrenees between 1950 and 1980, from where they quickly expanded and colonized the sunnier southern slopes in Spain and Andorra. Similar habitat conditions in the Pyrenees to those in their native range in the Alps, coupled to low interspecific competition and scarce initial impact of predation, might be the main reasons behind their successful colonization. However, an assessment of their introduction and its potential impacts on Pyrenean alpine ecosystems is still lacking. In the present study we review the status of introduced Pyrenean marmot populations based on different indices and life history traits, and compare them to other populations within their native range, to evaluate the success of their introduction. Pyrenean marmot populations may represent an example of successful introduction with similar population parameters as in their native range, although the indirect consequences of their introduction have not yet been evaluated. In addition, given that the Pyrenees would represent the southern and westernmost part of Alpine marmots' distribution range, studying these populations will provide useful insights into the management and conservation of the species under likely global change scenarios.

S.09-04-O

Towards Spatial and Topical Priorities in Biodiversity Monitoring in Europe.

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To efficiently allocate resources in biodiversity monitoring priorities need to be identified. Here we define our understanding of the setting of topical and spatial priorities for the monitoring of habitats and species in Europe and what kind of consequences this understanding has for the selection of biodiversity components for monitoring. While many different approaches for determining conservation priorities have been suggested in the literature, we focus on two main criteria: 1) priorities set by European and other international policies and 2) the potential of existing monitoring schemes and their integration for a spatially and topically prioritized biodiversity monitoring in Europe to estimate status and trends of species and habitats. We gave preference to these two criteria because a topically and spatially prioritized biodiversity monitoring system in Europe will remain academic unless it obtains political legitimacy and builds on existing approaches. Based on existing policy priorities we recommend four levels of priorities for biodiversity monitoring in Europe. These levels comprise species and habitats of the Annexes of the EU Birds- and Habitats Directives, the Bern Convention, SEBI indicators, Annexes of CITES and the Convention on Migratory Species as well as invasive species. Most of these policies focus on vertebrates. Plants, invertebrates and habitats are covered to a lesser extent. Other taxonomic groups are only rarely included in priority lists at the European level. This bias is reflected in our results which indicate that the potential for integration of monitoring schemes is highest for species groups like birds, mammals, butterflies and plants.

S.09-05-P

Assessing quality and usefulness of different taxonomic groups inventories in a semiarid Mediterranean region.

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Extensive biological databases are valuable tools in ecological research and the basis for biodiversity studies, needing, especially for non-charismatic groups, a previous assessment of the inventories completeness to their use in ecological and conservational research. Using four exhaustive databases compiled for four poorly related taxonomical groups (aquatic beetles, aquatic bugs, bryophytes and orchids) in a semiarid Mediterranean region, we aim to estimate the degree of completeness for the inventory of each taxonomic group, identifying those spatial units that can be considered as well surveyed (UTM 10 x 10 Km squares). Then, we assessed the degree of environmental representativeness of these databases; identifying also the factors that biased sampling effort. Lastly we discuss the usefulness of each database for conservational purposes. Our results highlight the lack of complete and extensive inventory data since the best sampled group does not even reach a 25% of well surveyed cells in the territory (in the case of aquatic bugs) and none of the cells present reliable inventories in the case of bryophytes. Although our results suggest that recording was skewed by relatively simple climatic variables, the well-surveyed cells are evenly distributed across physioclimatic subregions, enabling their use in further ecological studies. We emphasize the potential of these procedures to locate areas needed of further sampling as well as to help in the design of more effective regional conservation schemes.

S.09-06-P

What changes 6 years after? The fish community of Cávado Estuary (NW Portugal).

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The Cávado estuary is a nursery for several fish species, some of them important as commercial species, other as part of the food web. The knowledge of estuarine biodiversity and its dynamics is an important tool for the proper management of these resources and their habitat, which is included in the Natural Park of the North Coast. The fish community of Cávado estuary was followed in one sampling station, in 2003/2004 and six years later, 2009/2010 using a purse seine net. During the first sampling period we found 62 individuals weighing 70.174 g per sampling effort distributed by 19 taxa and in the second sampling period we found 139 individuals weighing 255.682 g per sampling effort distributed by 17 taxa. In 2003/2004 *Pomatoschistus microps* dominated in abundance with 74% of total, followed by *Atherina boyeri* (8%) and *Liza aurata* (5%). *P. microps* represents 38% of biomass, followed by *A. boyeri* (18%) and *Gobius niger* (12%). In 2009/2010 *A. boyeri* dominated in abundance (45%) followed by *L. aurata* (25%) and *P. microps* (19%). In biomass *A. boyeri* represents 39%, followed by *L. aurata* (31%) and *Platichthys flesus* (12%). Grouping fish by their ecological characteristics we found a decrease of sedentary species (89% to 68%) and an increase of migratory cyclical species (10% to 32%). Anadromous or occasional freshwater species were not registered during the study. The Shannon diversity index is almost the same six years after (1.5 and 1.6) despite the reduction in the number of species caught. Catadromous and occasional marine species occurs only in the warmer months (June to September) while the sedentary and cyclical migratory species inhabit the estuary throughout the year. Shannon diversity index is lower in winter, increases in spring and is higher in summer.

S.09-07-P

Unravelling plant-animals diversity relationships: a meta-regression analysis.

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The unprecedented loss of biodiversity has become a major environmental concern. Apart from concerns for the conservation of endangered species, this loss may have dramatic detrimental effects on ecosystem functioning. There is therefore an urgent need to estimate the number of species living in a given area, to better identify habitats of highest conservation value or ecosystems at highest risk of dysfunction. Cross taxa correlates have been proposed to provide quantitative estimates of biodiversity. However the strength of correlation may considerably vary with trophic links between taxa and environmental filters. To decipher these relationships we report the outcome of a meta-analysis of 411 correlation studies between plant and animal species richness. Arthropod, herpet, bird and mammal diversity did increase with plant diversity. However the diversity metric and the trophic level emerged as two important factors influencing both the accuracy and the magnitude of correlations between plant and animal diversity. Overall correlations were stronger when plant and animal species richness were compared across different habitats (gamma diversity) than within habitats (alpha diversity) and for primary consumers. These findings may contribute to the improvement of biodiversity indicators.

S.09-08-P

A multilevel approach for assessing plant taxa as indicators of biodiversity and habitat quality in Mediterranean psammophilous vegetation.

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Human activities are responsible for the decrease of biodiversity through the loss and deterioration of natural habitat. Evaluation of habitat quality is thus an important component of conservation planning. We present a project aiming to assess the utility of several plant taxa as indicators for habitat quality, functional structure and conservation status of Mediterranean psammophilous vegetation in South-Western Portugal. Achieving this objective needs a good knowledge of the ecological dynamics of the studied habitats, as well as on their ecological role and physiological adaptations of the studied taxa. Therefore, we will characterise plant structure and ecological dynamics of Mediterranean psammophilous vegetation under different levels of human disturbance, analysing also several physiological traits, adaptations and ecological role of the target species. Several combinations of taxa and environmental parameters will be used to formulate indicators of the habitat quality and overall plant biodiversity of the studied habitats. We will also develop predictive models of both the potential distribution of these indicators and the impacts relevant to these systems, in order to assess the conservation status of habitats in the study area. These models will be used to assess the conservation status of the studied habitats in South-Western Portugal and their coverage by the EU Natura 2000 Network.

S.09-09-O

Monitoring Landscape Indicators in Spain between 1956 and 2008.

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Changes in landscape pattern, both configuration and composition, convey important information about overall shifts in biodiversity. This is recognized by the inclusion of connectivity in the list of indicators of biodiversity. Whilst some regional studies of connectivity have been carried out, their stock changes in a major country are not yet available. The present paper presents results for the whole Spain over a 50 year period. The database used for the determination of the landscape indicators was produced from Sispare, a stratified random network of samples based on main environmental gradients throughout Spain. Sample analysis was carried out using aerial photos from 1956, 1984, 1998 and 2008, in a series of 215, 4x4 Km(16 Km²) Sispare units, The scale of photos was 1:30.000 with a minimum interpreted patch size of 1 ha. Ten land covers were delineated on the photos, with changes being annotated at each date. Various well tested connectivity indexes were calculated using Conefor Sensinode at each of the four dates. Although landscape composition has been relatively stable the landscape configuration has been changing, especially in terms of fragmentation. The paper will predict these changes and discuss their implication for biodiversity in Spain.

S.09-10-O

Is camera trapping a suitable method to evaluate the permeability of a main road?

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Linear infrastructures, such as roads, generate several impacts on fauna and one of the most important is the barrier effect. This impact is frequently mitigated by fauna passages, which can restore wildlife corridors and maintain landscape permeability. To evaluate efficacy and adjustment of this mitigation measures is crucial to establish survey programs. On February of 2010, we started a survey program in a main road (IP4), on Northeast region of Portugal, to evaluate its permeability and the main impacts on the mammals' community. We surveyed 20 sampling stations, along the road stretch, using camera trapping. Each sampling station was constituted by a fauna passage and 2 control points, on the north and south sides of the road. To analyze the resulting photographs, we developed a Photo Trapping Data Manager which classifies and organizes automatically the data into an Access database. In the first year, we identified 12 species, registered 622 detections (278 on the north side, 215 on the south side and 129 on the passages) and obtained an index of relative abundance of 11%. In the passages we identified 10 species and registered a crossing rate of 25%. Comparing the results of control points, we conclude that there're no significant differences between mammal communities on the north and south sides. Attending on the crossing rate the road is permeable and ensures the exchange of individuals.

S.09-11-O

Habitat monitoring and change detection using different thematic and spatial resolution.

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In this paper we assess 1) potential of the EBONE monitoring methodology for identification and evaluation of changes in habitats, management regime and other parameters recorded and 2) consequences of different spatial and thematic resolution of EBONE and remote sensing (CORINE Land Cover /CLC/ with improved spatial resolution = BIOPRESS approach) data for habitat monitoring. The EBONE methodology uses minimal polygon size 400 m² and 160 classes (59 General habitat categories and 101 their combinations) while BIOPRESS has minimal polygon size 0,5 ha (=5.000 m²) and 44 classes (CLC lev. 3). We developed the case studies in test sites in Slovakia (size 1x1 km each) and compared 2 time layers: 1949 and 2010. Because the field data mapped by the EBONE methodology do not exist for 1949, we simulated them. The results indicate that the EBONE approach produces more detailed maps (more classes mapped, more patches) than BIOPRESS approach. The EBONE approach identifies also more types of habitat changes. However, some changes identified by BIOPRESS approach does not represent change when using EBONE approach - e.g change from category 242 (complex cultivation patterns) to 211 (non-irrigated arable land). As this type of land cover change is quite common in Slovakia, in agricultural landscape the BIOPRESS approach can indicate more area changed than EBONE approach.

S.09-12-P

Evaluation of calcareous grasslands restoration success: density and reproductive success of key species.

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ULG, Gembloux Agro Bio Tech. ULG, Gembloux Agro Bio Tech. ULG, Gembloux Agro Bio Tech.

Calcareous grasslands are biodiversity « hotspots » at local scale. Unfortunately, those exceptional ecosystems have undergone a drastic fragmentation due to the abandonment of the traditional agro pastoral practices. Consequently, many - often rare - calcareous grassland species are now in danger. In Belgium, many hectares of these habitats have been restored from 1990 until nowadays, in order to reassemble remaining fragments of calcareous grasslands. The main goal of this work is to participate at the scientific evaluation of calcareous grasslands restoration which took place in the Viroin valley (Namur, Belgium). Informations about global and local densities of four species (*Helianthemum nummularium*, *Hippocrepis comosa*, *Potentilla neumanniana* and *Sanguisorba minor*) have been measured on 6 working zones (2 reference plots, 2 restored in 1990 and 2 restored in 2006) situated on 2 different sites. Reproductive success traits have been observed on 120 individuals for each species. Moreover, information about individual's size and some environmental data (soil depth and vegetation structure) have been collected. Results show that global and local densities are lower on recently restored grasslands. On the other hand, older restorations and reference grasslands are not significantly different. With regards to the reproductive success of species, individuals of the populations that have been restored in 2006 have the best results. They produce more flowers or inflorescences and more seeds. Among explicative variables, only the vegetation structure could explain the differences observed for individual's reproductive success. The vegetation of the zones that have been restored more recently is shorter; the shrubs and trees layer is lower.

S.09-13-O

ChangeHabitats 2 - Habitat Monitoring by Airborne Laser Scanning and Hyperspectral Imaging Supported Field Work.

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Habitat monitoring is compulsory for the EU member states due to the Habitat Directive (NATURA2000). Present state of the art in EU habitat monitoring is time-consuming field work. Aerial imagery presently supporting field work does not replace field work due to its very rough interpretation. Satellite images are used as well, but they are less detailed and cannot depict information from below the plant foliage, such as the horizontal and vertical vegetation structure or the terrain. Due to the enormous effort of field work, any method to pre-select habitats would result in considerable time efficiency. Thus, the EU funded project "ChangeHabitats 2" aims at developing a cost- and time-efficient habitat assessment technique by using modern earth observation methods. Airborne laser scanning and hyperspectral imaging will be used to assess information on complex land cover, for the creation of new digital surface models such as digital canopy height models for vegetation under the top most canopy structure, e.g. in forests, and semi-automated object oriented classification procedures for habitats. Airborne data acquisition is paralleled by field survey and followed by a deduction of habitat parameters via a comparison of airborne and field data as well as correlation analysis of habitat features and structural parameters from aerial survey. First results from this year's aerial and field data acquisition campaigns in Germany and Hungary will be presented.

S.09-14-O

Agrobiodiversity indicators in diverse farming systems across Europe.

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There has been rapid development of environmental indicators for monitoring. This is particularly true for indicators of environmental effects of agricultural policy because much of the wider countryside in Europe is under agricultural land use. Agroecosystems host about 75% of the European biodiversity, and due to its complexity, biodiversity cannot be measured as such, in the broadest sense of the Rio Convention. It is thus accepted that a single indicator for biodiversity cannot be devised. Ideally indicators should be selected that express or represent both the biodiversity as a whole AND that are sensitive to environmental conditions resulting from, for instance, land use and agricultural management practices. Following a standardised design and common methods, 28 candidate indicators for genetic, species and habitat diversity as well as 14 indicators for agricultural management practices that relate to biodiversity were selected and assessed in 12 case study regions across Europe. Each case study region represents a typical production system (i.e. specialist field crops, horticulture and permanent crops; specialist grazing with cattle and other livestock types; mixed crop and livestock farming). The presentation will focus on the search for the best surrogates for biodiversity across the various production systems investigated, using preliminary results. In particular, the validity of agricultural management indicators for biodiversity monitoring will be discussed in the light of information delivered, methodological simplification and costs. Part of this research was funded by the EU FP7 contract KBBE-2B-227161. For more information consult www.biobio-indicator.org

S.09-15-P

Plant diversity along spatial and temporal gradients of the rapidly changing dry Mediterranean-climate landscapes of SE Attica, Central Greece.

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Attica region is the district where Athens metropolis is found. The south-eastern part of this region resembles a long peninsula jutting into the Aegean Sea. The climate is dry-Mediterranean and until the 70's the population was predominately agricultural. Across the hilly and low mountainous ranges a diversity of ecosystems such as *Pinus halepensis* forests, maquis and phrygic shrublands and *Juniperus phoenicea* arborescent matorral were found. Since the 70's, a great deal of urbanization across SE Attica has taken place, initially near the coastline with the creation of summer resorts and over the last decade along the recently developed road-network. This high rate of land use change together with an increase of wildfire event frequency and area burned threatens the overall biodiversity of the area, which despite its proximity to Athens metropolis is quite high, as the presence of a National Park and three Natura 2000 sites indicate. A new sampling protocol has been applied in order to record plant diversity across a network of sampling sites forming spatial and temporal (i.e. post-fire age) gradients. All available ecosystem types have been regarded for sampling. The applied protocol combines species-area sampling and species abundance recording in order to obtain quantitative data suitable for reliable classification and ordination techniques. As a result, several approaches of plant diversity across the studied gradients have been achieved, producing a vegetation database that may act as a reference material towards the monitoring and evaluation of any future direct or indirect disturbance.

S.09-16-O

Bees as indicators of habitat and management in extensive Hungarian farms.

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The large scale monitoring of the influence of farmland management on biodiversity requires a proper set of indicators. We studied 9 organic and 9 low-input farms in Central-Hungary; here we evaluate the effects one of the indicator groups, bees. Bees were sampled in herbaceous, tree/shrub habitats, crop fields and different kind of linear habitat elements in each farm. Bees were caught along 100m long transects in 15min, three times during the season (May, June, August) of 2010 and were identified to species level. We surveyed the main flowering plant species and estimated the cover of available flowers. In total 1295 individuals of 106 bee species were sampled. The most abundant species (958 individuals) was the honey bee (*Apis mellifera*). No significant difference was found between the organic and low-input farms neither in the species richness nor in the abundance of bees. More species were found in May and June than in August. The number of bee species was higher in the grasslands and along the shrub and tree lines compared to the other habitat types. The abundance of bees was highest during June and in the herbaceous and shrub habitats. The species richness and cover of flowering plants enhanced both the species richness and abundance of bees. We conclude that bees are appropriate indicators mainly on herbaceous habitats, however, display less information about the ecological value of several other habitats due to their strong preference to flowering plants. This study was conducted as part of the Biobio FP7 EU project.

S.09-17-P

Odonata in Algarve, Portugal. Improving our knowledge on habitats and on species distribution.

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Fifty species of Odonata (31 Anisoptera and 19 Zygoptera), or dragonflies and damselflies, occur in the Algarve. Fourteen species are widely distributed, 23 have a limited distribution, and 13 species were found only on a very reduced number of places. A regional classification for the Odonata habitats is described: three traditional categories are considered on the first hierarchical level. However, lotic (or flowing-water) and lentic (or standing-water) systems are strongly conditioned by the characteristic mediterranean climate of the region, causing a noticeable seasonal change on the characteristics of the water-bodies. Consequently, to a detailed regional habitats classification, at least nine categories need to be clearly distinguished. Mean air temperature, annual rainfall and lithology were additional parameters used to carry out the Algarve's Odonata habitats cartography. A distribution map for each one of the above mentioned 50 species was produced, including all the published records together with our personal observations. Species occurrences are compared with the habitats cartography, allowing a better understand of regional Odonata habitat characteristics and of regional species present time and potential distribution. Running out of research on the subject, a digital field guide was edited and available from www.iDescobrir.pt. We hope that we will contribute to build a new network of volunteers interested in the Algarve's Odonata, that will contribute with new records as well as with conservation of freshwater habitats.

S.09-18-O

Surveying steep bird populations in the main pseudosteep area in Portugal.

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Castro Verde, located in Portugal's southern region, is the major pseudosteppe area in this country. It's classified as Special Protected Area, due to the national and international importance to steppe bird species populations. Since 1995 the area has specific agri-environmental management programmes for farmers, witch allows agricultural practices compatible with bird conservation to be carried out. Some flag species populations have been systematically monitored during this last years and some ecological indicators for agri-environmental programmes were established. Even so, for some species there was missing information, such as population size, local spatial distribution and population tendencies. In the period between 2010 spring and 2011 winter, we performed an intensive bird survey, in order to fill some of the existing gaps and to complement data from other monitoring schemes. Different methodological surveys were established, depending on the species or group: (1) point counts for most of passerines and other singing birds (as *Melanocorypha calandra*, *Calandrella brachydactyla*, *Oenanthe hispanica*, *Cisticola juncidis*, *Emberiza calandra*, *Coturnix coturnix*); (2) line transects for raptors (as *Circus pygargus*, *Buteo buteo*) and (3) identification and counting colonial nestling birds (*Glareola pratincola*) or night roosting birds (*Milvus milvus*). Data collected in (1) and (2) were analysed with Distance software, in order to estimate population size. Results sustain the importance of Castro Verde SPA for different species, revealing that *Circus pygargus* and *Melanocorypha calandra* populations are much larger than expected. On the other hand, results indicate that several threatening factors on the *Glareola pratincola* population are occurring in the area. Therefore we suggest further investigation and conservation actions for this species.

S.09-19-O

Environmental stratifications as the basis for biodiversity monitoring.

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There is growing urgency for integration and coordination of global environmental and biodiversity data required to respond to the 'grand challenges' the planet is facing, including climate change and biodiversity decline. A consistent stratification of land into relatively homogenous strata provides a valuable spatial framework for comparison and analysis of ecological and environmental data across large heterogeneous areas. We discuss how statistical stratification can be used to design national, European and global biodiversity observation networks. We will draw on insights from the ongoing European Biodiversity Observation Network (EBONE) project, which will provide methodologies and recommendations for biodiversity monitoring in Europe. Furthermore, we will discuss ways of extending these approaches globally supported by the recently developed Global Environmental Stratification (GENS). This dataset distinguishes 125 strata and eighteen zones with a 30 arcsec resolution (approximately 1km²). It provides a robust spatial analytical framework for the aggregation of local observations, identification of gaps in current monitoring efforts, and systematic design of complementary and new monitoring and research. The GENS has potential to support global biodiversity monitoring, and has been identified as a focal geospatial data resource for tasks of the recently launched Group on Earth Observation Biodiversity Observation Network (GEO BON).

S.09-20-O

Mapping and monitoring landscapes, habitats and species distributions in Israel using the EBONE approach.

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The Israel Nature and Parks Authority often practices conservation management by manipulating habitat. We are therefore interested in habitat mapping and monitoring methods that are affordable and effective for conservation management both on the national scale and within parks and nature reserves. During the last three years as a partner in the EBONE project, we tested methodology for mapping and monitoring habitats and species distribution on the landscape level in both mediterranean and desert regions of Israel. We compared correspondence of classified habitats with classification by remote sensing methods (LiDAR and thematic images at different scales of resolution). We mapped habitats in the LTER desert site Avdat and the LTER mediterranean site Ramat HaNadiv. We sampled vascular plant, bird, reptile and invertebrate populations in mapped habitats in order to determine correlations of species distribution with habitat categories. Our results suggest that correlation of species assemblages with habitat are quite good, although species richness patterns are not. More common species correlate with habitat better than rare species. The correspondence of habitat categories with remote sensing classes seems better with thematic images than with LiDAR, but in most cases more than one habitat category will match a given remote sensing category. We were able to study changes in time in one wetland nature reserve, where classic phytosociological methods were compared to EBONE classification of habitats. The EBONE methods compare favorably to the phytosociological methods, and take only a quarter of the field work time, which is an important consideration in conservation management.

S.09-21-P

Relation between forestation and the woodpecker community.

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This conference material is based on a research done in Hungary, near Budapest (Ócsa, 47°29' N 19°20') in a postglacial relic bog between 1983-2010. Secunder succession of vegetation begun in the area after the peat mining: a mosaical, wooded association evolved consisting of several tree species. Eight of the ten woodpecker species occurring in Hungary live in the studied area. The most common is the Great spotted woodpecker. The Lesser spotted, Green and Black woodpeckers are also often observed however less frequently, the Syrian and Middle-spotted woodpeckers are rarely found species. The authors used the data of mistnetted birds in Ócsa Bird Ringing Station. The change in the vegetation succession is based on the aerial photos made between 1979-2010. The aims of this work were to detect the changes of the abundance of woodpecker species related to the forestation; to examine the seasonal patterns of different species' abundances, and to reveal the correlation between the population changes. The growth rates of each species were characterized by linear regression. Spearman analysis was used on pairs of tendencies of the species. All of the studied species exhibited population growth in correlation with the forestation, although in varying degrees. The population growth of the Great spotted woodpecker and the Lesser spotted woodpecker were the most significant. Most of the other species appeared only in the dispersal period. The value of the Spearman rank correlation was highest between the population increase of the Great and Lesser spotted woodpecker.

S.09-22-O

Surveillance of habitats and biodiversity in the Iberian Peninsula: preliminary results, key challenges, and the way forward.

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Located in the westernmost end of the Mediterranean biodiversity hotspot, the Iberian Peninsula is a challenging territory for designing and implementing observation systems for habitats, landscapes and their biodiversity. In the framework of harmonisation and standardisation of the surveillance of habitats and species across Europe, using the EBONE protocol for field survey, results from eleven pilot areas located in Portugal and Spain are presented and compared. These areas represent different types of typical Iberian landscapes stratified-randomly selected in Madrid province (Spain) and in the North of Portugal. Species and habitat richness and diversity (as well as their components) are compared in the wider context of global and regional data in order to test the effectiveness of the methodology in terms of time and cost. Results from spatial analyses of landscape heterogeneity are also presented and discussed in their connection to the pertinent SEBI indicators. A potential integration of this type of information, using techniques for up-scaling between sites and networks of sites, and from habitat mapping and recording to remotely sensed data, is explored and potential caveats are discussed. Perspectives for integration with complementary monitoring schemes targeted at key species, habitat types or landscapes is also discussed in order to optimise the power of these observation networks for detecting and interpreting changes in key biodiversity indicators as well as their link to ecosystems and their services.

S.09-23-P

Role of the tamarisk grove in the contamination by the Pb fallout of the Kebir-Rhumel wadi bank soils (Algerian east).

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In order to know the role of the tamarisk grove in the soil contamination by lead fallout (Pb), ten sites were randomly selected along the Kebir-Rhumel wadi which skirts a heavy traffic road. In each site, the sampling stations were chosen so as to comprise a vegetation plot nearby a bare plot. All the stations are localized on the road side. Two soil's samples were taken in the middle, in the road side and the wadi side of each plot. Tamarisk leaves were the object of an average sampling. Pb was measured, by Inductively Coupled Plasma Optical Emission Spectrometry (ICPOES) in washed and unwashed leaves, and in total extracts of soils, which were also the object of organic matter (OM), pH, electrical conductivity (EC), total CaCO₃, cation exchange capacity (CEC) and particle sizes analysis. Significant differences were noted between washed and unwashed Pb leaves contents, suggesting an atmospheric contamination source, apparently from the road traffic. Pearson correlation coefficients indicate that total Pb soil contents are significantly and positively related to OM and clay in vegetation plots, and to pH, CEC and silt in the bare plots. Analyses of variance (ANOVA) and Sheffer's test reveal Pb, OM and clay contents in vegetation plots (especially in the middle of tamarisk grove) are significantly greater than in bare plots. The results show that the tamarisk grove, through the generated OM rates and the clay catching, would allow the retention of Pb in the soils, thus its mobility will decrease towards the stream water.

S.09-24-P

Does type of habitat influence the population dynamics of *lobaria pilmonaria*? Is it endangered?

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The aim of this study is to detect potential differences in *Lobaria pulmonaria* populations due to type of habitat in Mediterranean Spain. For this purpose we define environmental, demographic and physiological variables to determine the population dynamics of the species in two different habitats. Four plots were established in the Sistema Central, 2 of them in oak forests (*Quercus pyrenaica*), 2 in beech forests (one 1 ha plot, three 0.25 ha plots). All trees in each plot were georeferenced and marked. Location, size, status, and presence of sexual and/or asexual reproductive structures of all *L. pulmonaria* individuals were registered. 200 individuals were randomly selected and marked within each population. Semiannually, pictures of every individual will be taken in order to estimate potential reproductive changes and / or size variation. We will monthly record the physiological variable Fv/Fm, as a stress indicator. Besides, 360 sampling squares (20x20cm) were also set to find out establishment rate. Environmental factors determining presence, abundance, size and reproductive capability will be analyzed using Generalized Lineal Models and Generalized Lineal Mixed Models. Currently, 11580 *L.pulmonaria* individuals have been described. Trees that show *L.pulmonaria* individuals are thicker and have a rougher bark. *Lobaria pulmonaria* shows different patterns between the 2 studied forest types. Differences were found on height distribution pattern (individuals on beech grove grouped in the lower).

S.09-25-P

The study of the pastoral potential in relation with the wild herbivores pressure in the National Park of Bouhedma (Tunisia).

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The National Park of Bouhedma in Tunisia is part of the UNESCO World Network of Biosphere Reserves since 1977. This park is one of the last steppes with dispersed trees (steppes arborées) of North Africa, which provide home for many protected plant and animal species as last specimens of their kind in the whole country. The fauna and flora richness of Bouhedma Park is characterized by the presence of a number of plant and animal species such as; Acacia Totillis, Dorcas gazelle and Barbary sheep, species only found in this park. The role of fauna and flora protection played by the Bouhedma Park depends on the state of equilibrium between the availability of pastoral resources, composed by nine phytoecological groups, and the stocking rate. However, in years of low rainfall and drought, it was observed that the wild herbivores pressure exerted on pastoral resources exceeds the carrying capacity of the park. This work was carried out inside the integral protection zone (n° 1) of Bouhedma Park in order to determine the pastoral potential in relation with the pressure exerted by the wild herbivores. Indeed, when climate conditions are favorable, as it is the case of our study year, the park vegetation production is largely sufficient. The potential carrying capacity of the park is about (1.53 Livestock Unit (LSU)/ha), which is six times larger than the carrying capacity of equilibrium (0.24 LSU/ha). Nevertheless, when conditions are unfavorable, events of overgrazing are observed at the same way as in absence of pastoral fencing.

S.09-26-P

Is thermal imaging a useful tool for the early detection of Pine Wilt Disease in maritime pine (Pinus pinaster)?

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Thermal imaging to detect the occurrence of stress has encountered rising interest in recent years, in the perspective of its application for irrigation scheduling and ecosystems monitoring. Thermography is based on the principle that leaf temperature rise when stomata conductance is low because the cooling effect, resulting from water lost by stomata, is reduced. Thermography by infrared images (thermal images) was found correlated with stomatal conductance in leaves and canopies of several species. The objective of this study was to evaluate the possibility of applying thermal imaging for the early detection of the Pine Wilt Disease (PWD) caused by the pinewood nematode (PWN), *Bursaphelenchus xylophilus*. The earlier expression of the infection is a reduction in water transport and transpiration, due to the invasion of the PWN on conductive tissues of the tree. Thus, the detection of higher temperatures in the canopy of maritime pine, *Pinus pinaster*, can be associated with a symptom of PWD. As a preliminary study, maritime pine seedlings were grown in a growth chamber under controlled conditions of Temperature (15°C/25°C, day/night), PAR (860mmolm⁻²s⁻¹) and Relative Humidity (50%/60%, day/night). The experiment included two treatments, well watered (W) and not watered (N) plants. After 5, 9, 11 and 17 days, stomatal conductance was measured by an open path IRGA (Li-Cor 6400, LiCor Inc., NE, USA) and pictures of the canopies were taken with an infrared camera (Thermacam SC640, FLYR Systems Inc., Sweden). In the field, air temperature and relative humidity were measured with an eclogger (Mezão Lda., Cascais, Portugal) and canopy temperature (Tc) of adult maritime pine trees was also registered through thermal images. The temperatures of wet (Tw) and dry branches (Td) were used to calculate the index CWSI (Crop Water Stress Index). $CWSI = (Tc - Tw) / (Td - Tw)$ All the images were analyzed with Thermacam Researcher (FLIR Systems Inc., Sweden) software. In order to assess the presence of PWN on maritime pines, wood samples (approximately 60 g) were collected at 1.5 m from the base of the trunk, using a low-speed drill, nematodes extracted by the tray method and the identification of *B. xylophilus* was based on diagnostic morphological characters. Water stress resulted in a decrease of stomatal conductance, which was linearly correlated with the increase in canopy temperature. A good relationship was found between CWSI and the presence of the PWN. Globally, our results clearly indicate that thermal imaging can be a useful tool to detect stomatal closure in maritime pine, a symptom of plant stress, caused by drought or PWD.

S.09-27-O

On the presence of *Aedes (Stegomyia) aegypti* Linnaeus, 1762 (Insecta, Diptera, Culicidae) in the Island of Madeira (Portugal).

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Since October 2005 the population of the yellow fever mosquito *Aedes (Stegomyia) aegypti* LINNAEUS, 1762 has expanded in the city of Funchal. In 2008, the mosquito was found in the neighbouring municipalities of Câmara de Lobos and Santa Cruz. During 2009, the ovitraps network was rearranged in Funchal and expanded to the neighbouring eastern and western municipalities, thereby covering all of the south coast of Madeira. Two sentinel ovitraps were deployed in the north coast of the island.

S.09-28-P

Effects of forest composition and vertical structure on the abundance of *Ixodes ricinus* ticks in northern Belgium.

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The sheep tick (*Ixodes ricinus*) is a tick of considerable significance as vector of both livestock and human diseases. In Europe, the sheep tick is the principal vector of Lyme disease, a potentially serious illness caused by the bacterium *Borrelia burgdorferi*, which has emerged as a major public health problem over the past twenty years. Because this tick species is vulnerable to extremes of temperature and humidity, forests generally support higher tick densities than non-forested habitats. However, high variability in tick abundance is observed when comparing different forest types. Considering the threat of this tick to human health, it is important to better understand the main factors regulating tick abundance in forests. The present study was carried out in 21 forests in the Campine ecoregion (northern Belgium). The area is characterized by secondary pine plantations on nutrient poor and acid sandy soils, interspersed with deciduous forest stands. Ticks were sampled by the blanket-dragging method in four distinct forest stand types: oak and pine stands, both with and without substantial shrub cover. Abundance of larvae, nymphs, and adults was significantly higher in oak stands compared to pine stands. In addition, tick abundance increased significantly with increasing shrub cover. Thus, both forest composition and vertical structure are important indicators of favourable conditions for tick occurrence. This insight is especially relevant in the Campine region, where forest conversion (i.e. change in the dominant tree species from coniferous to deciduous and increase in forest structure) will take place over the next decennia.

S.09-29-O

Using LiDAR data to monitor General Habitat Categories

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Compared to aerial photographs the LiDAR point cloud can provide information under the tree tops, creating a 3D data for the measured object. We have used LiDAR data with combination of RGB values from aerial images and also intensity information that is recorded for each point to extract different types of objects that are useful for GHC (General Habitat Categories) mapping. Two different flying altitudes were compared: specially ordered 1200 m flight and nationwide LiDAR data from 2400 m for the selected test area in Central-Estonia. Using the echo information we isolated the points that represent forest or bushes, since there are usually multiple returns from those areas. The boundaries, which represent the forested area, can be drawn around these points and these areas were compared to the field measurements made in the test site. The results were close to the field measurements, but the level of detail is much higher with LiDAR data. Also, the vertical structure of the forest can be drawn from LiDAR data and forest can be classified based on the height of the vegetation. For extracting roads, a different solution was used: the RGB values from aerial images were assigned to LiDAR points. Sample measurements were taken from roads and HSV (Hue Saturation Value) and intensity numbers were used to extract other points with similar properties. The results showed that almost all the points that were extracted with this method represented the road, except stone piles near the road which has the same physical properties as the asphalt road.

S.10- Ecological networks of mutualistic and antagonistic interactions. Implications for conservation and restoration

S.10-01-O

Aliens in the community: consequences of plant invasions on compartmentalization and species' roles in plant-pollinator networks.

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Compartmentalization - the organization of ecological networks into subgroups of species that are not connected by interaction links with other groups (compartments) or have a higher probability of interacting with one another than with other species (modules) - has been identified as a key property for the stability, functioning and evolution of multitrophic communities. Invasions of often highly generalized alien species may lead to the fusion of compartments or modules and alter the functional architecture of networks through shifts in the distribution of distinct topological roles a species can play in the network. We tested these hypotheses for alien plant invasions of plant-pollinator networks using a dataset of 44 paired networks from seven published studies, each pair consisting of an invaded and a control network lacking alien plant invaders. The number of compartments was indeed lower in invaded compared to networks without alien plants, but not the number of modules detected by simulated annealing. The effect of invasion on modularity (estimating between-module differentiation) was contingent on the study system. However, module size, i.e. the mean number of species forming a module, increased following invasion, also after accounting for variation in network size. Moreover, plant invasions altered the composition of species' topological roles; in particular, the average number of species acting as module hubs, i.e. species highly linked within but not among modules, almost doubled following invasion. We discuss the implications of our findings for the conservation and restoration of plant-pollinator communities in the face of biological invasions.

S.10-02-O

Network structure analysis gives new insights on resprouting shrub community composition in a semi-arid area.

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Studies on the composition of plant communities are frequently based on null model analysis of species co-occurrence. But this approach fails to capture the complexity of ecological networks of interactions. Network analysis considers an ecological community as a network of linked elements, and provides useful information on relevant aspects of community structure and function (e.g., nestedness or vulnerability to disturbance) and the role of individual species within the network. In this paper, we use network structure analysis to characterize the community of resprouting shrubs in semi-arid *Stipa tenacissima* steppes in Alicante (SE Spain). Resprouting shrubs have been identified as key components of these steppes as they are major drivers of community composition and ecosystem function. These species are frequently organized in patches whose composition and assemblage rules are largely unknown. Fiedler vector analysis of 450 patches of resprouting shrubs grouped species according to their co-occurrence (e.g., *Quercus coccifera* and *Juniperus oxycedrus*) but also according to the links they form with third species. For example, *Ephedra fragilis* and *Osyris lanceolata* co-occurrence is low, but their network of interactions is similar. Network analysis identified two species as less vulnerable to external stress (*Rhamnus lycioides* and *Pistacia lentiscus*). We will relate information derived from network structure analyses with environmental variables, and explore drivers of community assemblage of resprouting shrubs in semi-arid areas.

S.10-03-O

Can plant-pollinator mutualisms increase the diversity of plant communities?

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Mutualistic interactions have long been regarded as being detrimental for the diversity of ecological communities, since positive feedbacks between mutualistic partners tend to lead to an increase of already common species and to the parallel decline of rare species and their partners. In particular, several studies have emphasized the destabilizing effect of plant-pollinator interactions on plant species coexistence. Surprisingly, in a recent study Bastolla et al. (2009) claimed that mutualistic interactions between plants and pollinators or seed dispersers can increase or decrease the diversity of plant communities depending on the structure of the species interaction network. However, their analyses were based on a generic phenomenological model of mutualistic interactions that lacked specific features of pollination mutualisms as well as competition for mutualistic partners. Here, we use a recently developed mechanistic model of plant-pollinator dynamics to test whether interactions with pollinators can increase the number of plant species that can stably coexist above a minimum threshold density. Furthermore, we examine the effect of different interaction network structures on plant diversity. Our analyses show that plant-pollinator interactions can indeed increase plant diversity, but only if the size of the plant community is limited by pollen rather than abiotic resources, and no trade-off between generalist and specialist feeding behavior of pollinators exists. Interaction network structure also plays a critical role for plant diversity. We discuss the implications of these results for the conservation of diverse plant communities.

S.10-04-P

The importance of considering flower availability when weighing interactions in quantitative flower visitation networks.

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Despite considerable work has been carried out describing the structure of weighted and unweighted mutualistic networks, little is known on how different weight measurements can influence network parameters. In this study, we evaluate the importance of different interaction weights in two mutualistic networks, particularly flower visitation networks, from two consecutive years and two different altitudes (1440m and sea level) in the island of Mallorca (Balearic archipelago). We used four types of currency for weighting and calculated several network-level parameters (network size, connectance, weighted nestedness, generality, vulnerability, complementary specialisation H2' and interaction evenness) and species-level parameters (normalized degree, species specialization index d' and strength). Results indicate that interaction weight has a relatively weak effect at the species level, but a great effect at the network level. Including flower availability at the community level in the interaction weight caused significant changes in different network parameters: generality, vulnerability and interaction evenness decreased, thus flower visitors and plants become more specialized, and the heterogeneity in the frequency of interactions across the network increased. Our study suggests that in order to give a more realistic weight to the links between plants and flower visitors, and thus to obtain more robust information on the structure of quantitative flower visitation networks, it is essential to consider flower availability of each species in the plant community.

S.10-05-O

An evaluation of the sampling completeness in a mutualistic network.

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The study of plant-pollinator interactions in a network context needs to estimate community level interaction richness, relative abundance and species composition. Therefore, network studies are subject to the same sampling issues as any study of diversity. We analyzed the completeness of a plant-pollinator network from the Argentinean Monte desert using asymptotic species richness estimators. Our goal was to assess the extent to which the realized sampling effort allows for an accurate description of species interactions and to estimate the minimum number of additional censuses required to detect 90% of the interactions. We also evaluated whether sampling completeness was influenced by sampling effort and plant characteristics, such as flower abundance, flower life span, number of interspecific links (degree), and selectiveness of flower visitors. In spite of our high sampling effort, and although we sampled 80% of the pollinator fauna, we recorded only 55% of the interactions. Furthermore, although a 64% increase in sampling effort would suffice to detect 90% of the pollinator species, a 5-fold increase in sampling effort would be necessary to detect 90% of the interactions. Detection of interactions was incomplete for most plant species, particularly specialists with a long flowering season and high flower abundance, or generalists with short flowering span and fewer flowers. Our results suggest that equal sampling effort for all plant species in a network is inadequate to sample interactions. Our study contributes to understanding what affects sampling accuracy in a plant-pollinator community, one of the major challenges in the field of plant-animal interactions

S.10-06-P

Quantifying the connectivity as a key landscape property; the Case of Seferihisar (Turkey).

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Landscape connectivity is a fundamental indicator that primarily depicts the interaction between landscape structure and function and thus, it is also a key landscape property to understand the landscape change over time in the human-dominated landscape. In order to examine how landscape is likely to change in response to human impacts, landscape metrics are very useful quantifying tools. Through landscape metrics, landscape connectivity can be assessed in order to provide a foundation for sustainable land-use and spatial planning. This study was conducted to quantify the connectivity of landscape components in Seferihisar and its vicinity using landscape metrics. Seferihisar, an urbanizing coastal settlement, was probed in terms of landscape change between 1963 and 2005. The question of this research was to determine how landscape change affected the landscape connectivity. In order to quantify the connectivity, 1963, 2000 and 2005 land-cover maps were utilized to calculate landscape metrics using FRAGSTATS. Based on this analysis, landscape changes and connectivity were interpreted and discussed in detail to guide the future spatial planning strategies. Key words: connectivity, natural landscape, landscape metrics, Seferihisar

S.10-07-O

Evolutionary and ecological constraints on the architecture of a highly resolve host-parasitoid network.

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Understanding the processes shaping interaction among species is a major prospect of community ecology. It has been proposed that the evolutionary history of species could play a major role: related species tend to share traits among which some involved in the choice of interacting partners. It is thus expected for related species to interact with the same species. Counterbalancing these evolutionary constraints, ecological processes such as indirect interaction should lead species to minimise niche overlap, and thus to interact with different partners. Depending on the relative strength of both these evolutionary and ecological constraints, a phylogenetic signal or anti-signal should be observed in the structure of interaction networks. We tested these hypothesis using a highly resolved network with four trophic levels (plants-aphid-primary and secondary parasitoids) sampled over ten years, and the molecular phylogenies of the species involved. Our results indicate that related species tend to be consumed by the same species (phylogenetic signal) but do not tend to consume the same species and this, whatever the trophic level considered. Moreover, related primary and secondary parasitoids tend to consume different species (phylogenetic anti-signal). Our study confirms the effect of the evolutionary history of species but also highlight the importance of ecological processes in shaping networks. In the context of species colonisation expected under climate change scenario, our results indicate that phylogeny can help to predict how a new species should integrate an existing network, but only to know by which species it will be consumed and not which species it will consume.

S.10-08-O

Genetic consequences of losing seed dispersal mutualisms.

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Understanding the role of dispersal agents in shaping the amount and the spatial distribution of genetic variation across the landscape is of utmost importance if we are to anticipate the chances of fragmented populations to persist. Connectivity patterns eventually collapse in ever-shrinking populations when mutualistic interactions providing dispersal services are lost. This is the case of many tree species inhabiting dry tropical and subtropical forests once dispersed by large frugivorous vertebrates that became extinct at the end of the Pleistocene. This study aims at investigating to what extent the loss of legitimate seed dispersers translate into persistent and predictable spatial genetic prints at the landscape level. Our study species is *Enterolobium cyclocarpum* (Fabaceae) a native tropical species inhabiting dry-tropical forests. We sampled, genotyped (microsatellites), and georeferenced 20 populations across the Guanacaste province (Costa Rica). We applied spatial-explicit genetic networks to: (i) assess the spatial distribution of the genetic variation at the landscape level; (ii) evaluate the role of seed dispersal vs. pollen dispersal in shaping current patterns of spatial genetic structure; (iii) identify key populations providing most of genetic variation at the landscape level; and (iv) evaluate what topological features become more sensitive to the loss of dispersal mutualisms. Our results provide new insights to forecast the genetic outcomes of disrupting dispersal mutualisms due to rapidly increased defaunation and forest fragmentation in the latest decades.

S.10-09-O

Ecological interactions are evolutionarily conserved across the entire tree of life.

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Ecological interactions are crucial to understand both the ecology and evolution of organisms. Since the phenotypic traits regulating species interactions are largely a legacy of their ancestors, it is widely assumed that ecological interactions are phylogenetically conserved, with closely related species interacting with similar partners. However, the existing empirical evidence is inadequate to appropriately evaluate the hypothesis of phylogenetic conservatism in ecological interactions because it is both ecologically and taxonomically biased. In fact, most studies on the evolution of ecological interactions have focused on specialized organisms, such as some parasites or insect herbivores, belonging to a limited subset of the overall tree of life. Here we study the evolution of host use in a wide and diverse group of interactions comprising both specialist and generalist acellular, unicellular and multicellular organisms. We show that generalized interactions, as previously found for specialized ones, can also be evolutionarily conserved. Significant phylogenetic conservatism of interaction patterns was equally likely to occur in symbiotic and non-symbiotic interactions, as well as in mutualistic and antagonistic interactions. Host use differentiation among species was higher in phylogenetically-conserved clades, irrespective of their generalization degree and taxonomic position within the tree of life. Our findings strongly suggest a shared pattern in the organization of biological systems through evolutionary time, mediated by marked conservatism of ecological interactions among taxa.

S.10-10-P

How do exotic gardens in the desert affect local bee communities and pollination network characteristics?

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Conversion of natural habitats to human settlements creates an alternative habitat that differs in its bio-physical characteristics such as micro-climatic conditions and resource availability. Deserts are especially sensitive to such effects due to generally low nutrient levels and water availability. Gardens in human settlements in the desert are often a main source of exotic plant species that provide ample foraging resources year round. These changes in floral composition and availability may alter pollinator community composition and foraging behaviour, as well as pollination network characteristics. We investigated these effects on local bee communities in the arid Jordan Rift Valley (Israel). We studied seasonal diversity patterns of plants and wild bees in natural habitats and in gardens in settlements. We compared bee communities between the two habitat types along the season and constructed plant-pollinator networks. We found that bee abundance was greater in the gardens, and that rarefied bee species richness was greater in the natural habitat. Seasonal patterns differed between habitats, as did their bee community composition and bee species' geographical range. We also found a higher level of generalisation of the pollination network in the gardens compared to the natural habitat, which may indicate a response to a disturbed and unstable environment. We conclude that exotic gardens in desert although promoting overall bee abundance, negatively affect bee species richness and change bee community composition and pollination network characteristics, with possible implications on the composition of native flora in the natural habitat surrounding the gardens.

S.10-11-O

Seed dispersal networks in the Galapagos and the functional consequences of plant invasions.

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Despite the dramatic threat posed by introduced plants to the Galapagos unique biotas, our knowledge on the main ecosystem processes in the archipelago is still very basic. Here we analyze for the first time seed dispersal patterns in these islands and evaluate the impact of plant invasions on eight, quantitative seed dispersal networks from the two most populated islands. In total, 9124 seeds from 58 plant species were dispersed by 18 animal species. The global resulting network was composed by eight modules, the four main ones respectively dominated by: 1) Darwin finches; 2) Lava lizards and non-finch birds; 3) Giant tortoise; and 4) Land iguana and Lava lizards. Modules were connected through ubiquitous species such as the native *Tournefortia psilostachya* and several herbs. There were five network hubs: *Chelonoidis nigra*, *Microlophus albemarlensis*, *Conolophus subcristatus*, *Rattus rattus* and *Geospiza fuliginosa*. These results highlight, for the first time, the importance of Lava lizards and Land iguanas as key seed-dispersers in the Galapagos. The integration of introduced plants into the seed dispersal networks reduced network size and the number of seeds dispersed while increasing network compartmentalization, link density, interaction evenness and nestedness. Networks from the humid zone, were smaller, with lower interaction diversity and link density, lower interaction evenness and reduced robustness when compared to dry lowlands. Several dispersers are assisting the spread of invasive plants (e.g. *Rubus niveus*, *Lantana camara*). Although the dispersal of invasive alien seeds is still incipient in our study sites, it already has marked consequences for network structure.

S.10-12-0

Keystone dynamics in networks: perspectives for systems-based conservation.

Jordan, Ferenc.

The Microsoft Research - University of Trento Centre for Computational and Systems Biology.

The complexity of ecological processes can be depicted by large interaction networks. Network analysis provides useful and fast information about the critical elements of these networks: centrality and other indices quantify key interactors and key interactions. In order to understand also the mechanistic details, carefully parameterized dynamical models may be used. I present a stochastic dynamical modelling framework for food web simulations. The variability inherent in biological systems will be quantified and analysed, instead of being considered as noise. I present some relationships among structure and dynamics by determining structural and dynamical key species. The community effect of the most important species will be quantified. I illustrate all these methods on the Prince William Sound ecosystem (Alaska) as a case study. Finally we will discuss how to use these kinds of results for setting conservation priorities.

S.10-13-0

Using pollination networks in tropical island conservation.Kaiser-Bunbury, Christopher N.
Aarhus University, Denmark.

Islands harbour a large proportion of the world's threatened biodiversity. To preserve and restore this biodiversity it is crucial to maintain native interactions between species, which are vital for ecosystem functioning. Mutualistic interactions, such as pollination, play a pivotal role in the long-term persistence of native plant communities, and pollination networks can be used to assess both the current status and the effectiveness of restoring native island communities. Here, I present pollination networks in an invasive species context on a tropical island and discuss the opportunities and challenges inherent to the application of complex ecological networks in conservation management.

S.10-14-P

A comparison of methods for clustering species in bipartite ecological networks.

Leger, Jean-Benoist. Vacher, Corinne. Daudin, Jean-Jacques.

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The diversification of species and their interactions during the course of evolution has produced ecological networks with a complex topology. In order to prioritize the mechanisms underlying the topology of a given ecological network, the first step is to recognize subsets of interacting species and/or identify the species having similar interaction ranges. For that, it is necessary to use methods of graph clustering. Numerous methods have been proposed by physicists, computer scientists and statisticians. Some methods are based on algorithms, such as Markov Chains Clustering, Edge-Betweenness or Spectral Clustering. Other methods are based on the optimization of a criterion, such as modularity, cut's costs. Finally, some methods are based on a statistical model, such as Stochastic Block Model. Our aim here is to review and compare the different methods available for clustering species in an ecological network. Methods are compared on simulated bipartite ecological networks (weighted and unweighted) and on real bipartite ecological networks (antagonistic and mutualistic).

S.10-15-O

Network approaches and its implications for conservation.

Montoya, Daniel.

School of Biological Sciences, University of Bristol.

Network perspectives of biological communities are increasingly recognized as an important tool for guiding conservation policies. The reason for this is that network properties underpin many aspects of the stability of biological communities, as well as the provision of fundamental ecosystem services such as pollination and pest control. The aim of this oral presentation is to explore how knowledge of network theory on ecological interactions can be applied in the field of conservation and restoration ecology. In particular, network approaches are very useful (1) to investigate the likelihood that certain ecological properties can be restored, (2) to study the spatial dimension of ecological restoration (e.g. how much habitat is needed to be restored to restore some minimum level of robustness and stability in the community), (3) and to make predictions about what kind of communities restore more rapidly, providing information about which 'routes' or sequences of species addition or removal are more efficient to restore a community in terms of resilience and stability. Quantification of ecological networks is also useful to shed light on the role of invasive species in native communities subject to conservation. To successfully fulfil the objectives stated by the Convention of Biological Diversity last year, a network approach of ecological interactions is key.

S.10-16-P

Genetic variation, predator-prey interactions and food web structure.

Moya-Laraño, Jordi.

Estación experimental de zonas áridas, CSIC.

Food webs are networks of species that feed on each other. The role that within-population phenotypic and genetic variation plays in food web structure is largely unknown. Here, I show via simulation how variation in two key traits, growth rates and phenology, by influencing the variability of body sizes present through time, can potentially affect several structural parameters in the direction of enhancing food web persistence: increased connectance, decreased interaction strengths, increased variation among interaction strengths and increased degree of omnivory. I discuss other relevant traits whose variation could affect the structure of food webs, such as morphological and additional life history traits, as well as animal personalities. Furthermore, trait variation could also contribute to the stability of food web modules through metacommunity dynamics. I propose future research to help establishing a link between within-population variation and food web structure. If appropriately established, such a link could have important consequences for biological conservation, as it would imply that preserving (functional) genetic variation within populations could ensure the preservation of entire tangled communities.

S.10-17-O

The potential for phenotypic feedback in ecological networks.

Moya-Laraño, Jordi. Rossberg, Axel G.. Wise, David H.. Woodward, Guy. Montoya, José M.

Estación experimental de zonas áridas, CSIC. Queens University Belfast. University of Illinois at Chicago. Queen Mary University of London. Marine Sciences Institute, CSIC.

We argue that phenotypic variation within nodes in ecological networks can potentially generate network structure for robustness and stability and at the same time that the structure of ecological networks entail variability in selective pressures and in the grain of the environment, thus likely allowing higher phenotypic variation (both genetically driven and from phenotypic plasticity) to be maintained within highly connected populations. We term this “phenotypic feedback”. We present recent simulation work that supports the idea that phenotypic variation and diversity (across orthogonal axes of variation) can enhance network structure in a manner consistent with ensuring the stability and the robustness of food webs. In addition, experimental data of a complex leaf-litter food web show how experimentally increasing the diversity of interactions of ants and centipedes increases centipede variation in a central trait driving food web interactions (i.e., body size), thus supporting the idea that increasing the connectivity of a node may lead to the maintenance of higher trait variability. Such a feedback mechanism, if characteristic of most ecological networks, could have important consequences for conservation biology, as conserving ecosystems and their ecological networks could ensure the conservation of higher levels of functional variability and diversity within species. Meanwhile, preserving variation within species could feedback to the preservation of the entire network and associated ecosystem functions.

S.10-18-O

Ecological networks crossing habitat borders.

Olesen, Jens M.

Aarhus University, DK.

In general, networks of interacting species are studied in homogeneous study plots. This is a basic requirement to most kinds of analysis. However, networks are open systems crossing from one habitat to the next. I explore how networks behave when they cross habitat borders. I discuss several new concepts relevant to this analysis, e.g. spatial couplers, border permeability, and spatial species turnover. The analysis used is based on module-detecting algorithms, where modules are small, highly linked species groups. As study examples I use a super-network of a community of plants and their interacting flower visitors, herbivores and pathogens, and a couple of pollination networks. The conclusions are that much is to be gained by allowing network analysis to cross habitat borders and also to use algorithm-defined modules as one's study units.

S.10-19-P

Evaluating plant species co-occurrence patterns in a semiarid ecosystem across a grazing gradient.

Saiz, Hugo. Alados, Concepción L.

Pyrenean Institute of Ecology. Pyrenean Institute of Ecology.

Understanding the interaction patterns between species in natural communities is important for the evaluation of ecosystem properties, and identifying keystone species in the system. This is particularly important for plant communities in arid environments, where plant species associate in vegetation patches to enhance their survival. In this work, we analyze the association pattern in semiarid plant-plant local co-occurrence networks across a grazing gradient in Cabo de Gata-Níjar Natural Park. We identify positive, negative and neutral associations between all species. We modelled the expected number of associations due to the relative abundance of species for the whole community, each species and each species pair, and compared them with the empirical values. We found that: a) all plant communities displayed fewer associations than expected, due to one very abundant and highly competitive species, *Stipa tenacissima*; b) each species presented a particular association pattern which remained constant across grazing gradient; c) more than 90% of the associations for species pairs were the same as that expected by species abundance; and d) with high grazing levels and after controlling for the effect of *Stipa*, the ratio of positive associations versus negative ones increased. Identifying plant species association patterns can help the development of more accurate conservation and restoration programmes in these especially sensitive areas.

S.10-20-P

The effect of landscape context on quantitative plant-pollinator networks.

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Florida State University, USA. Florida State University, USA.

Interactions among plant and pollinator mutualists form networks that often conform to a characteristic structure. The quantitative structure of local plant-pollinator networks may be influenced by the number, abundance, and composition of species. Landscape-scale habitat variation is known to affect the local plant-pollinator community, however little is known about how landscape-scale spatial variation can alter the quantitative structure of mutualistic networks. We examined the effects of forest habitat fragmentation on the structure of local plant-pollinator networks in a region of Florida longleaf pine forest and ask: (1) How does network structure change with surrounding habitat fragmentation and (2) is the landscape effect on local networks due to changes in abundance, richness, and/or species composition? We constructed 15 local plant-pollinator networks using visitation rate and duration as quantitative measures of interaction strength. Sites have similar local habitat quality but span a gradient of habitat fragmentation in the surrounding landscape. We used a variance partitioning approach to examine how variation in landscape structure affects local networks: by altering local abundance, richness, or composition of the plant/pollinator community. Results indicate that surrounding landscape context is important for local network structure. The effects of habitat fragmentation on local network structure are expressed mostly through landscape dependent changes in local species richness and abundance, and to a lesser degree via species composition. The landscape-dependent effects of species richness and composition on network structure appear to be independent, suggesting that landscape heterogeneity can influence network structure in multiple and different ways.

S.10-21-P

Shrubs as nurse plants in the establishment of *Quercus petraea* seedlings on lands mined for coal in Spain: insights for forest expansion.

Torroba, Paloma. Zaldivar, Pilar. Fernandez-Santos, Belen. Martinez Ruiz, Carolina.

University of Valladolid. University of Valladolid. University of Salamanca. University of Valladolid/Sustainable Forest Management Research Institute UVa-INIA.

It has been demonstrated the role of some shrub species facilitating colonization of other plant species, by means of the microenvironment amelioration under their canopy and/or their mechanical defence from browsers. This study try to asses the protective role of shrubs on the *Q. petraea* natural regeneration in three microhabitats frequent in the coal mines of Northern Palencia: the adjacent oak forest edge (B); the restored mine area close to forest (M1); and the restored mine area away from forest (M2). Spatial distribution and habitat of *Q. petraea* individuals included in twenty 2x2m plots for each microhabitat were assessed using three different variables. Results showed that individuals of *Q. petraea* occupied more protected sites as abiotic stress increased from B to M2. This trend is consistent for the three variables under study, as show the mean values of angle of contact (B=3.3°; M1=147.7°; M2=241.7°), shrub cover (B=11.7%; M1=72.9%; M2=83.1%) and overgrowth (B=8.1 cm; M1=238.7 cm; M2=256.3 cm) in the three microhabitats considered. The results also showed that some shrub species took part in the protection role, but their importance decreased as abiotic stress increased, except for *Genista florida*, which influence increased as abiotic stress increased. *G. florida* is the main shrub species facilitating *Q. petraea* establishment, maybe because of its particular architecture. We conclude that in the study area there is a positive relationship between shrubs and *Q. petraea* establishment that became stronger as abiotic stress increase.

S.10-22-P

Spatio-temporal dynamics in a mutualistic network: underlying mechanisms emerged from a 12-year study.

Traveset, Anna. Stefanescu, Constantí. Olesen, Jens M.

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Ecological networks are usually depicted as static structures, devoid of any dynamics, what hinders our understanding of how nature responds to large disturbances, such as changes in climate, land use, or biological invasions. We studied the long-term (12-yrs) dynamics flower-visitation networks in four different communities, consisting of flower-visiting butterflies and their nectar plants, and the mechanisms underlying such dynamics. In this work, we were especially interested in determining (1) what butterfly traits (phenology, abundance, voltinism, polyphagy, habitat specialization) influence species-level parameters describing network topology, and (2) which of those traits contribute most to the temporal variation in linkage level of a butterfly species. We find that butterfly phenology, abundance and habitat specialization are the most consistent and important predictors for most network parameters. Moreover, the importance of factors determining temporal variation in generalization level varied across the four communities. Possible explanations for such results and their ecological implications are discussed.

S.10-23-P

Is there any relationship between plants' generalism and their pollinator dependence for seed production?

Tur, Cristina. Castro-Urgal, Rocío. Traveset, Anna.

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Although much information has been accumulated with the so-called pollination networks studies on the number of links between a plant and their flower visitors, there is still a gap of knowledge on the real importance of those links from the plant's perspective. In other words, at a community level, we know little on the actual effect of such flower visits for plant reproductive success. In this study, we want to contribute to such knowledge by examining the breeding system of the most representative plant species of two different communities in the Balearic Islands (one at sea level and the other at 1400 m altitude). We test the hypothesis that there is a relationship between the level of generalism (linkage level in network terminology) of plants and their real dependence on pollinators for seed production. We do find evidence for such a relationship, although it varies between the two communities. The implications of these findings for conservation and restoration ecology are discussed.

S.10-24-O

Compartmentalization in plant-parasite and plant-herbivore networks: how to assess the relative contribution of the different underlying mechanisms?

Vacher, Corinne. Leger, Jean-Benoist. Daudin, Jean-Jacques.

INRA. AgroParisTech. AgroParisTech.

Ecological networks are generally very heterogeneous, consisting of areas with sparse links among species and distinct areas of tightly linked species. The groups of species with high link density, which are often referred to as compartments (or modules), seem to increase the stability of bipartite antagonistic networks. Several non-mutually exclusive mechanisms, such as habitat fragmentation and phylogenetic constraints, may explain the origin of compartmentalization. A current challenge is to assess the relative contribution of these different mechanisms. After having reviewed the mechanisms which may explain compartmentalization in plant-parasite and plant-herbivore networks, I will present a method to assess the relative contribution of different factors to the heterogeneous architecture of a given ecological network. The method is an extension of the stochastic block model that deals with weighted networks and accounts for possible covariates (Mariadassou et al. 2010). The factors which may account for species interactions are introduced as covariates in the model. The explanatory power of each factor is measured as the gain in goodness of fit obtained when switching from the best model without covariate to the best model with covariate. The method will be applied to elucidate the architecture of well-resolved bipartite networks describing the antagonistic interactions between tree species, parasitic fungal species and insect herbivores in the French forests. Mariadassou, M., Robin, S., Vacher, C. 2010. Uncovering latent structure in valued graphs: a variational approach. *Annals of Applied Statistics* 4(2):715-742.

S.10-25-O

Plant Facilitation Networks and the Assembling of Ecological Communities.

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Universidad Nacional Autónoma de México. Centro de Investigaciones sobre Desertificación (CSIC).

Complex network theory recently has been expanded to the analysis of multi-species plant communities in which more than 90% of the species recruit successfully only through facilitation beneath the canopies of perennial plants. In networks established among plant species, many of these facilitative interactions occurring between a benefactor (nurse) and a beneficiary (facilitated species) turn into competition over time and are mainly restricted to closely related taxa. In this study we show how the overall (i.e. nestedness and connectance) and the phylogenetic structure of facilitation networks in semi-arid communities change when facilitation turns into competition and some of the early species associations established by facilitation disappear. We show that the initial facilitation networks retain the overall, but not the phylogenetic, structure. Phylogenetic analyses show that as seedlings, facilitated species tend to associate with the same subset of nurses while, on the contrary, nurses are indifferent to the identity of their facilitated seedlings. However, when competition becomes important, closely related nurse species appear associated only with a subset of facilitated species in the community. These temporal rearrangements in the phylogenetic structure of the facilitation networks provide evidence that ecological communities are assembled by highly species-specific networks in which the phylogenetic history has a pervasive influence not only on recruitment but also on adult community composition. The use of phylogenetic methods combined with complex network approaches opens the possibility to understand the complexity of ecological interactions occurring in nature as a way to predict coextinction cascades following species removal from ecosystems.

S.10-26-P

Influence of *Cytisus multiflorus* on survival and early growth of *Quercus ilex* and *Q. pyrenaica* seedlings.

Villa, Sara. Fernández-Santos, Belén. Pérez-Pérez, Leticia. García, Jose Antonio. Puerto, Ángel. Martínez-Ruiz, Carolina.

Universidad de Salamanca. Universidad de Valladolid.

Some recent studies have shown a facilitating effect of shrubs on Mediterranean forest restoration. Nevertheless, the same result of interaction is not always detected; effects can be different depending on the environments and shrubs species involved. So far it is not known literature about *Cytisus multiflorus* possible effects, one of the most abundant shrubs in NW of Spain. In this study it has been proposed to assess the *C. multiflorus* influence on *Q. ilex* and *Q. pyrenaica* seedlings survival and early growth and to describe the mechanisms involved. To this purpose, a manipulation experiment was carried out, mainly considering two factors of variation: a) shrub presence or absence; and b) grazing maintenance or elimination. A block design was established with 4 experimental units per block: fenced shrub, not fenced shrub, fence without shrub and unit without neither fence or shrub; 5 replicates. A total of 200 oak and 100 holm oak seedlings were planted in April 2010; 10 and 5 respectively in each experimental unit. Survival and growth (height, diameter and trunk diameter) of each seedling were monitored every two weeks, until middle of autumn. The main results to be emphasized were: 1) Survival rates were very low, higher values in oaks than in holm oaks; 2) Most of surviving individuals were located within the shrub experimental units; and 3) *C. multiflorus* positive effect has been also shown for *Q. pyrenaica* and *Q. ilex* early growth.

S.11- Impacts of global environmental change on the structure and functioning of dryland ecosystems

S.11-01-P

Effect of water, shade and competition with grass on germination and early survival of tree seedlings in Africa Savanna.

Barbosa, Eduardo. van Langevelde, Frank. Tomlinson, Kyle. Kirkman, Kevin. Ward, David. de Bie, Steven. Prins, Herbert.

Wageningen University and Research Center. Wageningen University and Research Center. Wageningen University and Research Center. University of KwaZulu-Natal. University of KwaZulu-Natal. Wageningen University and Research Center. Wageningen University and Research Center.

Seedling establishment is critical for recruitment of plants in dry ecosystems. A better understanding of trees species recruitment traits is essential to comprehend woody plant invasions in grasslands and savannas. To examine the effect of multiple environmental factors (competition with grass, shade and water availability) and seed traits (mass, nutrient concentrations) that potentially influence seed and seedling ecology of savanna trees, a greenhouse experiment was set up in Africa savanna, where 14 common savanna tree species were submitted to different environmental treatments and seed germination and seedling survival of was followed for 2 years. The results revealed that seed nutrient concentrations had a negative effect and seed biomass had a positive effect on the germination and seedling survival. The results also show that constant water availability had a positive effect on the germination of almost all studied species, but had a negative effect on two species. The presence of grass affected species differently, having a negative effect on seed germination of five species and a positive effect on four tree species. For the remaining four species, effects of grass depended on the presence of the other two factors. Shade had a positive effect on seven species but a negative effect on two species. Regardless of the shade conditions, the treatments without grass and constant water supply provided the best conditions for seedlings survival for all species. Our study is one of the few to experimentally test the effects of seed characteristics and a range of biotic and abiotic factors on a large number of savanna tree species. This approach revealed the great variety of physiological adaptations among the various tree species.

S.11-02-P

Dung Beetles and Ecosystem Functions in UK Uplands: Predicting Responses to Future Changes in Climate and Land Use.

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Countless authors have reported changes in the distribution and success of organisms during the last century which have been attributed to climate and land-use change. These have been recorded across the globe and in the majority of taxa. These studies however, have often focused on changes up to the community level at the highest; rarely empirically assessing the wider implications of such changes for ecosystem health and function. This poster presents the results of the first stage of a project to contribute to this fascinating area; through the study of UK upland dung beetles and the ecosystems in which they are found. The aim of this work has been to record and map the current distribution of dung beetle in an upland study area. The study area used was the moorlands of the UK's Peak District National Park where such data has never before been recorded. Here field data was collected on the dung beetle species, landscape and land use found at 34 sites from a range of altitudes and habitat types. Having statistically modelled the data, it was identified that altitude is a significant determinant of species distribution, with the majority of species - including the functionally important *Acrossus rufipes* and paracoprid (tunneller) species - having a positive relationship with this factor. This would suggest that such species are likely to benefit from upward range expansions as the climate warms; the implications of which will be explored in future stages of the overall project.

S.11-03-P

Response of annual pastures to increased levels of tropospheric ozone and nitrogen deposition: Overview of the research developed in Spain.

Calvete, Héctor. Sanz, Javier. Bermejo, Victoria. Elvira, Susana. González-Fernández, Ignacio. Alonso, Rocio.

CIEMAT. CIEMAT. CIEMAT. CIEMAT. CIEMAT. CIEMAT.

Calvete, H., Sanz, J., Bermejo, V., Elvira, S., González-Fernández, I., Alonso, R. Ecotoxicology of Atmospheric Pollution, CIEMAT. Avda. Complutense 22, 28040 Madrid, Spain. Pastures are among the most important ecosystems in Europe considering the high biodiversity of its plant communities and the extension covered in the European territory. However, little is known about their sensitivity to atmospheric pollutants and climate change drivers. In the last decade, a high effort has been done to characterize the response of these communities to increasing tropospheric ozone (O₃) levels and nitrogen deposition, two of the main factors linked to global change. In the frame of the Convention on Long-range Transboundary Air Pollution of the UN/ECE (CLRTAP), critical levels and loads of ozone and nitrogen deposition have been defined to protect the structure and functioning of herbaceous communities. The high biodiversity and the variability in local meteorology and topography are factors modifying air pollution sensitivity, making difficult the establishment of critical loads and levels. Up to now, there is some information about several representative species of perennial herbaceous communities from Central and Northern European climates but scarce information is available about annual pastures typical of Mediterranean landscapes even if high O₃ levels are frequently recorded in Southern Europe. In this work, the main results and the experimental studies done in the last years on the response of annual pastures to O₃ and nitrogen are reviewed. The high O₃ sensitivity detected in annual legumes compared to grasses in terms of growth, seed production or leaf visible injury, can compromise the structure and diversity of these ecosystems in areas of chronic O₃ pollution. Moreover, O₃ effects on quality parameters such as fibre or protein content, have been observed on species relatively resistant to the pollutant in terms of growth. So far, quality parameters have not been included in the derivation of O₃ critical levels, raising the discussion about which response should be considered for the definition of these limit values for the protection of the natural or semi-natural ecosystems. Ozone response of annual species is modulated by nitrogen supplementation in the substrate, but the effects depend on both nitrogen and O₃ levels and the parameter analyzed, showing complex relationships between factors. New experiments are currently going on aiming to characterizing interactive effects of O₃ and nitrogen availability on annual grassland ecosystems.

S.11-04-P

Controls of the spatial and inter-annual patterns of vegetation greenness in scrublands and grasslands of the Iberian Southeast.

Cabello, Javier. Alcaraz-Segura, Domingo. Ferrero, Rosana. Castro, Antonio J.. Liras, Elisa.

University of Almería. University of Almería. University of Almería. University of Almería. University of Almería.

To better understand the variation of carbon gain dynamics in drylands of the Iberian Southeast, we analyzed the environmental controls of the spatial patterns and the inter-annual 2001-2009 trends of Enhanced Vegetation Index annual mean (EVI_mean). A small proportion of the variability in the EVI_mean (30%) was explained in a general linear model (GLM) by local climatic conditions, vegetation type, and lithological substrate, being precipitation the main control of the spatial differences in EVI_mean. However, a large proportion of the variability (70%) in the inter-annual trends of the EVI_mean was explained in a GLM, where mainly temperature trends and secondly precipitation trends were the main drivers of inter-annual changes in the EVI_mean. Soil properties and root depth, controlling water availability, emerged as controls of the spatio-temporal variability of primary production in the study area. Our study revealed the necessity of accounting for the seasonal pattern of trends in temperature and precipitation to better understand the mechanisms that drove the observed increases in EVI. The earlier arrival of the rains after summer drought and the fresher temperatures during early-autumn may cause strong increases in the EVI at the beginning of the growing season that influenced the rest of the growing season. Acknowledgements: Fondos FEDER, Junta de Andalucía (Proyectos GLOCHARID y SEGALERT P09-RNM-5048), Organismo Autónomo de Parques Nacionales (Proyecto 066/2007), and Ministerio de Ciencia e Innovación (Proyecto CGL2010-22314, subprograma BOS, Plan Nacional I+D+I 2010).

S.11-05-O

A holistic approach to understanding demographic responses to climate change in desert plants.

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How species respond to climate change will be determined by the underlying features of individuals, such as their phenology or physiology, but expressed through demography. Demographic responses impact the viability and growth rates of existing populations and determine the species' likelihood for geographic range expansion or contraction. We suggest that a holistic approach, including studies of anatomy and physiology, is necessary to understanding how different developmental stages, and thus demography, will respond to changes in the total amount or seasonal distribution of precipitation. We use the arid-land chamaephyte *Cryptantha flava* (Boraginaceae) as a model organism to explore stage-specific responses to predicted changes in precipitation because a great deal is known about this species' anatomy, physiology, phenology, and demography. Drought increases mortality in all stage classes but reduces overall plant size only for larger, more mature individuals. Leaf level measurements of photosynthesis, transpiration, and water use efficiency do not explain stage-specific responses because leaf-level physiology of juveniles seems more negatively affected than that of adults. We explain why it is necessary to take whole plant architecture, including root structure, into account. We also make predictions about how particular changes in seasonal precipitation will affect different vital rates and also population growth. We do so by applying stochastic integral projection models, based on 15 years of demographic data with *C. flava*, to understand the consequences of various precipitation recurrence intervals predicted by IPCC scenarios for the desert in which this species occurs.

S.11-06-P

Differential responses of radial growth to climate in five sympatric tree species of the Chiquitano tropical dry forest (Bolivia).

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Instituto Pirenaico de Ecología (CSIC). Instituto Pirenaico de Ecología (CSIC). ARAID-Instituto Pirenaico de Ecología (CSIC). Universidad de Barcelona. Instituto Boliviano de Investigación Forestal (IBIF).

Tropical dry forests account for 22% of the forest area in South America, despite they are highly degraded and diverse ecosystems. Furthermore, their dynamics as related to the coexistence of tree species are mostly unknown. Specifically, there is little information about the growth response of their dominant tree species to climate. To determine if the radial growth of five sympatric tree species responds similarly to seasonality in water availability, which characterizes these forests, we used dendrochronological methods. We studied growth dynamics in five tree species forming annual rings (*Acosmium cardenasii*, *Anadenanthera macrocarpa*, *Aspidosperma tomentosum*, *Centrolobium microchaete*, *Zeyheria tuberculosa*) in a Chiquitano tropical dry forest (INPA, south eastern Bolivia). Indexed ring-width chronologies were built for the period 1950-2010 for each species and they were correlated with monthly climatic variables (mean temperature and total precipitation). All species except *A. macrocarpa* showed significant positive correlations between radial growth and precipitation in November (*A. cardenasii*, *A. tomentosum*, *C. microchaete*) and February (*Z. tuberculosa*). The associations between growth and temperature were mostly negative and only appeared for *Z. tuberculosa* (November) and *C. microchaete* (December). Our results show a differential response of radial growth to rainfall at the beginning of the period of lowest water deficit from November to May. The divergent responses of co-occurring tree species to water deficit may be caused by specific cambial phenologies and explain their coexistence in tropical dry forests.

S.11-07-P

Soil macrofauna effects on microbial community structure under climate change.

Coulis, Mathieu. Hättenschwiler, Stephan. Fromin, Nathalie. David, Jean-François.

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Climate change is predicted to result in 30 to 50% less rainfall in Mediterranean regions with likely far ranging consequences for the structure and functioning of Mediterranean ecosystems. Here we ask how decreased water availability will affect soil macrofauna communities and their feedback on microbial decomposers, and what the consequences on litter decomposition and nutrient recycling might be. Our study system is a typical Mediterranean shrubland dominated by *Quercus coccifera*, *Cistus albidus*, *Rosmarinus officinalis* and *Ulex parviflora*. We found a soil macroarthropod community biomass of 9.2 g m⁻² (fresh mass) dominated at 99 % by *Ommatoiulus sabulosus*. This widespread diplopod occurs here at the southern limit of its distribution range and is thus expected to be particularly sensitive to climate change. With an experiment under controlled conditions we study how *Ommatoiulus s.* is affecting microbial activity and community structure and how this effect is influenced by decreasing precipitation. With the removal/addition of fecal pellets, we specifically distinguish between direct effects of *Ommatoiulus s.* on microbial communities mediated through their presence and litter feeding activities and its indirect effects through feces production as a supposedly favourable microbial growth substrate. Preliminary results show strong litter-type dependent *Ommatoiulus s.* effects on litter decomposition with an expected drastic shift in microbial activity and community structure (data analysis currently underway). The macrofauna - microorganism interactions determine ecosystem processes in this Mediterranean ecosystem under climate change to an important extent.

S.11-08-P

Biological soil crusts increase the resistance of soil nitrogen and phosphorus variables to changes in temperature and soil moisture.

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Biological soil crusts (BSCs) composed by mosses, lichens, liverworts and cyanobacteria are a key component of arid and semi-arid ecosystems worldwide, and play key roles modulating several aspects of the nitrogen (N) and phosphorus (P) cycles, which affect to mineralization and N fixation. While the performance of its constituent organisms largely depends on temperature and moistures, the influence of these environmental factors on N and P transformations under BSC soils has not been evaluated before. We aimed to do so using soils collected from open areas with and without BSCs in a semi-arid *Stipa tenacissima* grassland (BSC and BS soils hereafter). Soil samples were incubated under different temperature (T) and soil water content (SWC) conditions, and changes of microbial biomass-N, dissolved organic nitrogen, amino acids, ammonium, nitrate and Inorganic N and P, and Net N transformation rates were monitored. The Orwin and Wardle Resistance (RS) index was also estimated for the N and P variables in this study. Changes in T affected the different N and P variables and N process in this study more than changes in SWC for both BSC and BS soils. Under BSCs, but not in bare ground areas, the ratio inorganic N:P increased with temperature. Our results showed that BSC soils had a higher RS than BS soils for most of the N and P variables evaluated. Thus, BSCs could play a key role in minimizing the likely impacts of climate change on the N and P cycles in semi-arid environments, given the prevalence and cover of BSCs worldwide.

S.11-09-O

Warming enhances biological soil crust performance in a semi-arid Mediterranean environment.

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Biological soil crusts (BSCs) composed of mosses, lichens and cyanobacteria are a key, but understudied biotic component of dryland ecosystems worldwide. Despite their importance, and the multiple ecosystem processes affected by them, little is known on the effects of climate change on their constituents and the processes modulated by them. We conducted a climate manipulation experiment in a semiarid shrubland community in central Spain to study the joint effects of temperature increase (2.5°C·year⁻¹) and rainfall reduction (20%) on the performance of BSCs. After three years, experimental warming promoted a significant increase in BSC cover, changes in the BSC species composition and an increase in the physiological activity of BSC-forming lichens, as measured with the maximum efficiency of PSII (F_v / F_m). Rainfall reduction per se had little effect on the performance of BSCs. Enhanced BSC performance under projected climate change scenarios could lead to important consequences for ecosystem structure and functioning in dryland ecosystems.

S.11-10-P

Facilitation effects on biodiversity depends on grazing and climate in a mountain Ecuadorian dry scrub ecosystem.

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To unveil mechanisms driving species composition and maintenance of species diversity in plant communities has remained central to ecology during the last decades. Among them, biotic interactions and more specifically, the existence of positive ones, have strong, often species-specific, effects on plant diversity. These positive interactions would expand species distribution across environmental gradients and increase the extent of suitable habitats into physically harsh. Our working hypothesis is based on two complementary ideas: i) nurses increase the diversity because many species recruit successfully only beneath their canopies but the importance of this facilitation decreases in areas with lower abiotic stress, ii) this primary effect is modulated by the herbivory pressure which can force some plants to survive only under nurse canopies. Our results support the proposal that magnitude of the effects of ecosystem engineers in species diversity and productivity vary along environmental gradients, in zones with higher environmental stress the engineering plants effect is higher. Moreover, our results show that inclusion of grazing pressure as a driver of plant-plant interactions alters the importance of positive - negative interactions, in the presence of herbivores, the importance of the engineering plants is maintained in zones with benign environmental. Biotic interactions change with the elevation from positive relationships in the lower zone to neutral or negative in the higher zones, responding to the stress hypothesis of the gradient, these effects are evaluated both the cover and species richness. However, the inclusion of grazing has a substantial impact on the interactions changing the patterns interaction.

S.11-11-P

Environmental factors involve in natural regeneration success of pine forest on inland dunes in the Spanish Northern Meseta.

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Changes in climate may reduce the success of natural regeneration and hence require adjustments to silvicultural management. Special attention is required for pine forest situated in the center-south of the Spanish Northern Meseta, in a region known as Tierra de Pinares (due to the historic importance of its forest formations), dominated by *Pinus pinaster* Ait and *P. pinea* L. because of impediments to achieve successful natural regeneration. The aim of this study was to assess the factors that affect Maritime pine (*Pinus pinaster*) regeneration. The evolution of soil temperature, air temperature and regeneration during a growing season were analyzed. A high percentage of the solar radiation is able to reach the ground due to forest stand is formed by group of trees instead of a continuous cover stand. Soil temperature reached maximum values of 55 °C from July to September, for periods up to 4 consecutive hours for 2-5 days. Air temperature reached values of up to 57 °C during the months of June to September, for periods up to 4.5 hours in periods of 7 consecutive days. In the collected seedlings injuries and banding wounds in the neck of the root were observed. That may result from physiological and morphological changes induced by high temperatures. One of the conclusions of this study is that the high measured temperatures could compromise the regeneration success.

S.11-12-O

Climate change effects on above- and belowground interactions on arid ecosystems.

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Arid and semi-arid ecosystems are predicted to be more vulnerable to recent climate change than other more diversity ecosystems. Individual species respond to climate changes however is less evident the effect on multitrophic interactions, and its consequences on food web dynamics. Although deserts and arid systems are generally conceived as detritivore-driven, donor-controlled systems, a growing opinion that indirect effects are structuring communities and food webs reinforces the importance of interactions in desert ecosystems. This review highlights the effect of climate change in arid and semiarid ecosystem focusing on the consequences for aboveground and belowground multitrophic interactions.

S.11-13-P

Soil microbial communities under *Retama sphaerocarpa* shrubs in a semiarid environment.

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Retama sphaerocarpa shrubs in semiarid environments build islands of fertility that ameliorate abiotic conditions and promote establishment of other species under their canopies. Plant community richness and productivity in the understory increase with shrub age and size. We aim to determine whether this successional process is linked to changes in the structure and activity of the soil microbial community. Twenty-four *R. sphaerocarpa* shrubs grouped into three different sizes (small, medium and large) were randomly selected in Rambla del Saltador (Almería, Spain). Mean shrub height in each size class was 1.0, 2.1 and 3.3 m, with a mean projected canopy area of 0.9, 7.2 and 37.4 m², respectively. Soil was sampled under the canopy of each shrub and in eight gaps between them. For each of the 32 composite samples, 4 soil cylinders sampling 0-15 cm depth soil were combined, homogenised and sieved through 2 mm mesh. Soil C and N content, enzymatic activities, soil respiration and phospholipid fatty acids (PLFA) were analysed and linked to the molecular characterisation of the microbial community. We found high C and N content in soil under large shrubs, low in gaps, and intermediate in small and medium-sized shrubs. Preliminary results suggest that function, abundance and composition of microbial communities change with plant age. Results are discussed in terms of the relationships between soil community and plant community dynamics under *R. sphaerocarpa* shrubs.

S.11-14-P

Changes in *Macrochloa tenacissima* activity after undergoing an altered rainfall regime in natural environment (SE Spain).

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Introduction and objectives: a change in precipitation patterns affecting both annual rainfall and its temporal distribution has been predicted for the Mediterranean basin. This study aims to determine the effects of these changes in one dominant species of the Mediterranean ecosystems, *Macrochloa tenacissima*. Methods: Experimental plots located in a grassland in the Natural Park of Cabo de Gata, Spain, are being used. A transparent polycarbonate mobile shelter with a rain sensor has been designed to cover the *Macrochloa tenacissima* plots when rainfall, and uncover them the rest of the time to avoid micro-climatic changes. Two factors are being tested by differential watering (1) amount of water and (2) number of rain days, both with three levels, 100%, 75% and 50% in relation to natural rainfall, generating nine treatments, with three replicates of each. After each rainfall event, we apply the watering treatments using collected rain water, and measure photosynthesis, stomatal conductance, transpiration and fluorescence. Results and conclusions: after two years we have found that the characteristics and timing of the rainfall events and the plant phenology are the main factors that determine the variation of physiological measurements. The most significant effect on photosynthesis takes place in the recovery period after the dry season, and is due to the factor 2, as photosynthesis decreases with the number of rain days. However, there are not significant differences among treatments in spring during the maximum plant activity. The transpiration has a closer relationship with factor 1, resulting significantly lower in the second summer for the 50% of reduction in rainfall amount.

S.11-15-P

Do Climatic Change affect Biological Soil Crust functions?

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Biological soil crusts (BSCs) affect ecosystem features and processes (biodiversity, hydrology and erosion, pedogenesis, vegetation development, CO₂ fluxes). However, very little is known about their on-site response to climatic variations. Although they tolerate wide environmental ranges, on-site fluorescence and net photosynthesis are associated to environmental conditions. Therefore, the duration of BSC growth will probably depend on the duration of the favorable conditions, resulting equally affected the functions and ecosystem services that BSCs modulate. To verify this, we started an ongoing experiment at Sorbas, SE Spain, combining 3 factors: rainfall (natural and reduced), temperature (natural and increased), and BSC (high and low cover), generating 8 treatments, with 8 replicas of each. We used Open Top Chambers (OTC) to increase temperature and rainout shelters for partial rain exclusion. Temperature and humidity of air and soil as well as incident and excluded precipitation are monitored. Every two months, on-site fluorescence, net photosynthesis and respiration are measured. The rainfall reduction was around 40% and the OTCs increased temperatures about 2° C. Fluorescence, net photosynthesis and respiration show daily and yearly cycles, vary with BSC cover and its specific composition, are very sensitive to the hydration state, and these variations partially masked the effects of the treatments. However, there are trends: Fluorescence and respiration increase with temperature, and more where BSC cover is high. Both net exchange of CO₂ and photosynthesis decrease when temperature increases. It seems that BSC are close to be carbon-neutral and can change from sink to source of CO₂ with relative ease

S.11-16-P

Fragmentation and drought modulate the impact of habitat quality on fertility and microbial activity of semiarid gypsum soils.

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Plant-soil interactions are an integral and crucial component of ecosystem function. Most global change studies have focused on impacts on plant communities so information on soil properties and biotic activity remains poorly understood. Our goal was to assess both the individual and joint effects of three global change drivers that are especially important in Mediterranean ecosystems: habitat fragmentation, changes in habitat quality and climate change (water availability) on nutrient availability and soil microbial activity of soils. Moreover, we assessed the influence of microhabitat heterogeneity and its interaction with these global change drivers. We performed a field experiment selecting two fragment sizes (large and small), two levels of habitat quality (high and low), two levels of water availability (mesic, watered plants and dry, non-watered plants) and two microhabitats (soil samples collected under the canopy of *Centaurea hyssopifolia*, and in the open). We analyzed nutrient concentrations (organic C, total N and total P) and enzyme activities (β -glucosidase, urease and acid phosphatase activities). Habitat quality and microhabitat had the strongest impact, supporting a strong interdependence between plant and soil. Fragmentation and reduced water availability modulated the stronger effect of habitat quality through synergistic interactions and they had an indirect effect on soil properties mediated by plant cover. These results highlight the importance of considering several drivers simultaneously to forecast realistic ecosystem responses to global change, and of including ecosystem effects mediated by soils.

Short-term effects of grazing abandonment and temperature enhancement on Mediterranean grassland productivity, functional groups biomass and shrub establishment (*Cistus salvifolius*).

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Grazing abandonment generally affect species composition in Mediterranean grasslands and other plant communities. However little is known on how these processes will interact with temperature increases in the framework of global warming. Although shrub encroachment in grasslands after grazing abandonment through end of herbivory and trampling has been reported in many studies, indirect effect of abandonment on the establishment of woody species through lack of manure addition has been less frequently studied, especially in the context of global warming. We have studied these aspects by manipulating cattle manure level and ambient temperature in oligotrophic Mediterranean annual grassland. The experiment was conducted in a savannah-like ecosystem (dehesa) grazed by cattle in Doñana Natural Park (37° 14' 46'' N, 6° 37' 7'' W) in a closed area. Temperature of the vegetation was passively enhanced (0.8°C mean temperature increase along the growing season) using 1.5 m tall 5 x 10 m open top chambers (two replicates). Inside the chambers 20 1m² plots were established before grassland germination. Cattle manure was added to the half of plots at the same level (3200 g DW /m²) found in surrounding cattle dungs. The other half plots did not receive manure. Within each plot a 223 cm² round subplots was established and seeds of the shrub *Cistus salvifolius* (a regionally representative rockrose very abundant in the adjacent area) whose germination is enhanced by high temperature) were added at naturally seeds produced density (10.000 seeds/m²). A similar experimental design was established outside the chambers. At the end of the growing season (spring) total aboveground biomass of the herbaceous community (80 to 234 g/m²) was significantly affected by warming (P = 0.006 and P = 0.001) and manure addition (P= 0.002 and P = 0.0001) with not significant interactions among treatments in any site. Distinct functional groups of herbaceous plants exhibited differential treatments response with respect to aboveground biomass. Grasses that represented 51-72% of total biomass in different treatments significantly increased by warming in the two sites (P = 0.003 and 0.002) but not by manure addition, while Legumes that represented 6-24% of total biomass increased by manure addition but not by warming (differences were significant in one site P= 0.02). The group of species in "other families" was not significantly affected by treatments. *Cistus salvifolius* seedlings density in the spring (0.3 - 4 seed/m²) was also significantly affected by treatment (X² = 10.45, P= 0.015) although only the warming-no manure treatment with the highest seedling density was responsible of these general differences presumably due to positive effect of temperature increase and the lack of too high grasses competition. These results subject that grazing abandonment could promote a higher rate of grasslands changes in the framework of global warming, enhancing grasses dominance, decreasing Legumes abundance and increasing establishment of given woody species.

S.11-18-P

Why gypsum outcrops maintain high vegetation greenness during the summer drought in semiarid Mediterranean climates?

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Gypsum soils are confined to arid and semi-arid climates where low precipitation prevents gypsum from being removed by leaching. These substrates impose stressful conditions for vegetation, leading to a high specialization and endemism of plant species. By using satellite-derived vegetation index, we have observed that scrublands in SE Iberian gypsum outcrops maintain much higher vegetation greenness during the summer drought than other vegetation types (either scrublands, shrublands, or grasslands) growing on any other substrate. In this work, we evaluate several hypotheses that may explain the higher summer vegetation index of gypsum outcrops: 1) The light color of gypsum rocks would favor a reduction of evaporation due to a high reflectance of solar radiation (i.e. high albedo and low surface temperature); 2) The biological and physical soil crusts would also reduce evaporation; 3) The structure and composition of the gypsum mineral, the presence of micro cavities in the gypsum outcrops, and the structure of gypsum soils would favor the condensation of air humidity and the reduction of water losses, providing a buffer for vegetation greenness during the summer lack of precipitations. MODIS-TERRA satellite images of surface temperature, albedo, and vegetation indices from 2001 to 2009, field radiometry, laboratory experiments, and field survey are used to test the former hypotheses.

S.11-19-O

Which community attributes govern ecosystem functioning in drylands? A global assessment.

Maestre Gil, Fernando Tomás. , EPES-BIOCOM network.

Universidad Rey Juan Carlos. 38 researchers from all over the world.

A major challenge facing today's ecologists is to determine the links and relative importance among abiotic and biotic factors acting as determinants of ecosystem functioning and stability. We conducted a field study at a global scale to test the relative importance of biotic and abiotic factors as drivers of ecosystem functioning along environmental gradients at multiple spatial scales (from regional to global). The composition and structure of vegetation, and different soil variables acting as surrogates of ecosystem functioning, were evaluated in 220 plots (30 m x 30 m size) located in 16 countries from all continents except Antarctica. In this talk I present the preliminary results from this study, and discuss the implications of the results for ecosystem functioning under global environmental change.

S.11-20-P

Variations in connectivity patterns indicate abrupt changes in the ecosystem functionality of Australian semiarid landscapes.

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Dryland landscapes generally show self-organized spatial patterns as mosaic like structures of sources and sinks of water runoff and sediments with variable interconnection. Good examples of such landscapes are banded shrublands displayed by semiarid Mulga in central Australia. In these ecosystems, vegetation is spatially distributed in bands aligned along contour lines of gentle sloping terrain, optimizing the capture of water runoff and sediments generated in the upslope barely covered inter-bands. Human disturbances and climate variations can disrupt the spatial distribution of vegetation causing a substantial loss of both water and soil resources by increasing landscape hydrological connectivity and consequently, affecting ecosystem functionality. We analyse connectivity patterns obtained from the coupled analysis of high-resolution remote sensing scenes and digital elevation models from several nearly pristine and disturbed Mulga landscapes. Our results reveal a characteristic non-linear relationship between the integrity of the vegetation patterns and the landscape hydrological connectivity. In other words, small reductions in Mulga fractional cover near a particular threshold can cause a sudden collapse in the hydrological functionality of the landscape, driven by sharp increases in the length of the connected flow-paths. Simulations of landscape degradation trends show that these thresholds are especially sensitive to the type of disturbance. In fact, selective thinning of the vegetation patches from their edges (e.g. grazing) causes a higher impact on the landscape hydrological connectivity than spatially random disturbances (e.g. bushfires). Overall these results highlight surface connectivity patterns as practical indicators for monitoring the landscape health in semiarid and arid landscapes.

S.11-21-P

Drivers of litter decomposition under climate change in drylands.

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Decomposition of plant litter in drylands decreases with climate change-induced reductions in precipitation. However, the decrease in litter decay with increasing aridity proceeds at a slower rate than the decrease in biomass production. The relatively high decomposition rates under dry conditions are caused by alternative drivers of litter decay that come into play, once rainwater availability is reduced. Litterbag studies were carried out in heterogeneous Mediterranean shrubland during extended rainless seasons to evaluate drivers of litter decomposition in the absence of rainwater. Decomposition of leaf litter under dense shrubs with low UV transmittance was driven by absorption of water vapor from the atmosphere at times of high relative humidity. According to field and lab studies, water-vapor absorption enabled microbial degradation of plant litter, even in the absence of dew and fog. At intershrub microsites with high UV transmittance, litter decayed by photochemical degradation, as shown by a rapid loss of lignin from the litter. Under small, open shrubs, decay of leaf litter appeared to be driven both by water-vapor absorption and solar radiation. Overall, characteristics of water-vapor uptake by litter, initial lignin concentration and UV transmittance at the microsite explained litter decomposition in the dry season. Climate change might reduce the duration of wet seasons and might increase the number and length of dry spell during the wet season in many dry regions. Those litter decay and biogeochemical cycling of nutrients might be increasingly affected by drivers other than rainwater, such as atmospheric water vapor, dew, fog and solar radiation.

S.11-22-P

How is beta-glucosidase activity related to soil organic carbon in drylands? A global and multi-scale survey.

Ochoa, Victoria. Maestre, Fernanto T., 38 researchers.

Universidad Rey Juan Carlos. Universidad Rey Juan Carlos. From all over the world.

Understanding how soil enzyme activities mediate microbial nutrient acquisition from organic matter is crucial in ecological studies related to soil microbial community function. The most widely assayed enzymes are those involved in the degradation of cellulose and lignin, which are the most abundant components of plant litter. Several factors, as pH, aridity or latitude can modulate the function of soil enzymes. We studied them by exploring the relationship between the enzyme b-1,4-Glucosidase, which hydrolyze cellobiose to glucose, and soil organic carbon (SOC) from global (220 30m x 30m plots located in 16 countries around the world) to micro-site (bare soil vs. soil under shrubs, grass or trees) scales. The positive relationship between b-1,4-Glucosidase and SOC at the global scale is not always found at finer scales, and we will discuss the factors and implications of such mismatches across spatial scales.

S.11-23-O

Experimental study of the effects of climate change on flowering phenology in the Mongolian steppe.

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Rising temperatures and increased variation in precipitation due to global climate change are expected to affect plant development and thus the timing of flowering, which can have important implications for reproduction. Here we examine flower production during the first two years of a four-year climate change experiment in the semi-arid steppe of northern Mongolia. The experiment employs open top chambers (OTCs), which are passive warming devices that warm during the day, and OTCs used in conjunction with water addition. The experiment is set up at the top and the bottom of a south-facing slope; the upper slope is steeper and drier than the lower slope. We used constrained analysis of proximities (CAP) to examine overall patterns of average time of peak flowering and average number of flowers for 36 species, and then for 9 selected species, we used analysis of variance and survival analysis to examine effects of chamber, watering, slope location and year on the onset, average time and cessation of flowering, and on the average number of flowers. Slope location and year had large effects on the timing of flowering and number of flowers, and graminoids were more affected than dicots. For example, flowering was earlier on the upper slope and in 2009, which was a wetter year than 2010. Watering and OTCs had smaller but consistent effects on flower timing and OTCs decreased the number of flowers. Species in the OTCs tended to flower earlier and peak later than species in control plots. Watering reduced the differences between OTCs and controls. From earlier work, we know that OTCs reduce volumetric soil water content in addition to elevating temperature and that the effect of OTCs on soil water is more pronounced in wetter years. We suggest, therefore, that delay in flowering time and the decrease in flower production may be primarily a response to water stress in OTCs rather than elevated temperatures. Thus, in the Mongolian steppe, we predict that increasing variation in precipitation will have greater repercussions for plant reproduction than rising temperatures.

S.11-24-O

Climate change alters plant stoichiometry and isotopic composition in a semiarid Mediterranean shrubland.

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Current general circulation models predict temperature increases of 2-5° C and rainfall reductions of 10-30% for the Mediterranean region as a result of the ongoing climate change. We conducted a climate manipulation experiment in a semiarid shrubland community in central Spain to study the single and joint effects of a 2.5°C temperature increase and a 20% rainfall reduction on the performance of the endemic shrub *Helianthemum squamatum*. Warming decreased the foliar N and P concentrations and increased the C:N ratio of this species, particularly when acting together with rainfall reduction. Partial rainfall exclusion caused a significant enrichment in the oxygen isotopic composition ($\delta^{18}O$) of *H. squamatum*, indicating decreased stomatal conductance and cumulative transpiration. The foliar Zn concentration in *H. squamatum* also decreased in response to rainfall reduction. The carbon and nitrogen isotopic compositions of shrubs ($\delta^{13}C$, $\delta^{15}N$) were unaffected by temperature and/or rainfall manipulation. Across climate manipulation treatments, plant $\delta^{18}O$ was strongly positively correlated with leaf C:N ratios and negatively correlated with foliar N and P concentrations, indicating decreased stomatal conductance and transpiration in plants with a poor nutritional status. Reductions in stomatal conductance and foliar nutrient concentrations (particularly N and P) under projected climate change scenarios could lead to additive or synergistic decreases in plant photosynthesis and primary productivity in this semiarid ecosystem.

S.11-25-O

Toward potential transitions in semi-arid plant communities on the face of climatic change: is the magnitude of change on structure and function mediated by abiotic stress?

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The increasing degree of abiotic stress experienced by semi-arid ecosystems in Mediterranean Basin forecasts changes on vegetation at regional scale, from shrublands to *Stipa tenacissima* grasslands. In order to test whether changes on main vegetation will lead to changes on structure and ecosystem function, we have conducted a study in both types of landscapes (i.e. shrubs vs. grasses) along a 370 km gradient from central to south-eastern Spain. We hypothesise that the magnitude of structural and functional changes will be higher as abiotic stress increases along the gradient, and that such changes on ecosystem function will be mediated by community structure.

S.11-26-P

Belowground interactions in shrub-encroached Mediterranean open oak woodlands.

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Universidad de Extremadura. Universidad de Extremadura. Universidad de Extremadura.

Increases of woody plant cover in former pasturelands and savannas are considered one of the major components of global environmental change. In Mediterranean climates, some authors have argued that seedling survival is related to “safe sites” offered by the presence of shrubs. However, the consequences of shrubs presence on neighboring plants performance through interactions for soil resources are still not well known. Our aim was to analyze the effect of a woody understory presence on the functioning and persistence of Mediterranean open oak woodlands. We study the effect of two contrasting, in terms of morphological traits and reproductive strategy, shrub species: *Retama spahaerocapa* and *Cistus ladanifer* in order to assess specie-specific effects on neighboring vegetation (tree and pasture). The presence of shrubs deeply modify tree and pasture root systems. Trees growing either with *Cistus* or *Retama* exhibited a significantly deeper rooting profile than growing without competition, whereas herbaceous species showed the opposite trend, shifting most of their roots upwards to shallower soil horizons. *Cistus* appeared to be a great competitor for soil resources (soil nutrients and water), while *Retama* widely ameliorated it, showing this shrub both positive effects on top soil fertility and water availability along whole profile. In addition, trees growing with *Cistus* as understory showed significant lower leaf water potential and leaf gas exchange parameters. However, the presence of *Retama* did not affect significantly their physiological state. Therefore, *Cistus* encroachment reduced significantly pasture yield by 68 to 98 %, tree growth by 17 to 29 % and acorn yield by 6 to 44 %. On the other hand, *Retama* increased significantly pasture yield by 11 to 157 % and tree growth by 6 to 13 %, but had a neutral effect on acorn yield. The effect of shrub on tree seedling emergence in spring was similarly, being consistently higher than that of open zones of pastures. However, the survivorship after summer was deeply hampered under *Cistus*, whereas under *Retama* there were no effects. To sum up, we conclude that the presence of a shrubby understory in Mediterranean open oak woodlands has the potential to modify the functioning and persistence of Mediterranean scattered trees, but these effects are species-specific.

S.11-27-O

Divide to survive: desert plant module shedding increases whole individual fitness.

Salguero-Gomez, Roberto. Casper, Brenda.

Max Planck Institute for Demographic Research. University of Pennsylvania.

The ability of perennial plants, as modular organisms, to partition resources through sectorized transport systems is thought to be adaptive in deserts because (i) sectorized plant species are especially common in aridlands and because (ii) sectorized desert plants attain longer lifespans than non-sectorized desert species. We explore whether the death of some modules within a plant (i.e. groups of leaf rosettes within the canopy that are connected to the same transport sector) increases fitness in the remaining modules by improving their survival and/or reproduction. To do so we marked and tracked 5747 leaf rosettes within 145 individuals of the perennial sub-shrub *Cryptantha flava* (Boraginaceae) for four years (2007-10) within a natural population in the Great Basin desert. In addition, we simulated pulses of 4.5 cm of precipitation, as predicted by climatic regional models, and estimated survival, changes in size, reproductive probability, and flower and seed production for each leaf rosette and for each module. We examined leaf rosettes' and modules' vital rates and compared them for individuals that had undergone natural shrinkage by means of losing ≥ 1 module vs. those where no shrinkage occurred. We show that increased precipitation in conjunction with the death of some modules increases both survival and reproduction of the whole-plant following module shedding. We discuss how our work contributes to the scarce literature regarding why hydraulic sectoriality is so common in arid ecosystems, and whether it might be an adaptive strategy.

S.11-28-P

Main drivers controlling subterranean CO₂ exchanges in a semiarid ecosystem of SE Spain.

Sánchez-Cañete, Enrique P. Serrano-Ortiz, Penélope. Kowalski, Andrew S.. Oyonarte, Cecilio. Domingo, Francisco.

Estación Experimental de Zonas Áridas. CSIC. Estación Experimental de Zonas Áridas. CSIC. Dept. de Física Aplicada. Universidad de Granada. Dept. de Edafología y Química Agrícola. Universidad de Almería. Estación Experimental de Zonas Áridas. CSIC.

Soils are a large pool of terrestrial carbon (C), nearly three times higher than the amount of C in aboveground biomass, and double that of the atmosphere. Arid and semiarid soils represent 30% of the water-free Earth and have the potential to store large amounts of CO₂ in cracks, pores or cavities. Later, through venting of these subterranean spaces, stored gaseous CO₂ can be exchanged with the atmosphere. In this study we analyze a soil CO₂ profile using sensors buried at 0.15, 0.5 and 1.5 meters in a semiarid steppe ecosystem located in Southeast Spain. We analyze the main drivers of increments in the CO₂ molar fraction, examining their determinants and implications for net CO₂ emissions to the atmosphere measured with an Eddy Covariance system. Preliminary results show the subterranean CO₂ molar fraction increasing with depth, with a constant baseline for each horizon throughout the year. However, periodically it is observed that soil CO₂ increases to double its mean value within a few hours. These changes in soil CO₂ were strongly influenced by external factors, such as atmospheric pressure or even wind speed, but not directly related to precipitation or respiration. These increases in the CO₂ molar fraction can be explained only by the ascension of deep subterranean air, richer in CO₂.

S.11-29-O

Effects of temperature, moisture and land use on CO₂ efflux in cyanobacteria-crusts soils.

Thomas, Andrew.

Manchester Metropolitan University.

There are increasing concerns that climatic and land use changes will enhance soil CO₂ efflux rates and organic carbon loss, compromising agricultural productivity and further elevating atmospheric CO₂. Current understanding of CO₂ efflux in dryland regions is, however, insufficient to enable prediction of the consequences of these changes for soils or CO₂ fluxes. In-situ data from sites in the Kalahari of Botswana are used to determine the effects of temperature, moisture and land use on CO₂ efflux. Moisture is the primary limiting factor to efflux. Given sufficient moisture, efflux increases with temperature, with Q₁₀ ranging from 1.5 to 3.0. Prolonged periods of rainfall can, however, lead to carbon exhaustion as readily available substrates are completely respired. Net efflux is muted by autotrophic organisms in biological crusts which photosynthesize and take up CO₂. Where crust cover is disturbed or absent, respired soil carbon losses are higher than in well-crusts areas. The complexity crusts add to diurnal variations in soil efflux can be predicted with a modified soil efflux model which includes independent autotrophic and heterotrophic components. Findings suggest that the predicted warming of southern Africa will lead to higher soil carbon losses from Kalahari Sands due to soil efflux. Intensification of grazing, leading to the breakup of biological soil crusts will reduce the opportunity for a major input of organic carbon to the soils and thus further increase atmospheric CO₂ concentrations.

S.11-30-O

Understanding population dynamics of annual plants under climate change.

Tielbörger, Katja. Siewert, Wolfgang.

University of Tübingen. University of Tübingen.

Bioclimatic envelope models attempt to predict the response of organisms to climate change using a correlative approach. Here, we used a mechanistic approach for analyzing extinction risks of annual plants. We focus on the Eastern Mediterranean - a global biodiversity hotspot with particularly high vulnerability to change. We could utilize eight years of demographic data from experimental field sites along a steep climatic gradient in Israel for analyzing population dynamics of 20 annual plant species. By coupling matrix population models with updated regional climate models, we were able not only to forecast species' response to climate change but to understand the ultimate causes of this response. Thus, by identifying vulnerabilities and indicators of change rather than sheer extinction numbers, our findings may serve as a scientific basis for conservation management under climate change.

S.11-31-O

Biological soil crusts controlling vegetation pattern in arid dunes - can we replace time by space ?

Veste, Maik. Yair, Aaron.

Centre for Energy Technology Brandenburg. Hebrew University of Jerusalem.

Vegetation cover and biomass production in drylands are largely controlled by rainfall amounts on a regional and global scale. Therefore, the impact of climate change on the ecosystem functioning in drylands is very crucial. Various large-scale comparisons showed that standing biomass and rainfall have a positive relationship, and therefore, rainfall gradients are often used as models for climate change studies. The key question is: can we replace time by space? To study the interrelations between vegetation and rainfall on a relatively homogenous substrate, we conducted a vegetation survey along a climatic gradient in the sand dunes of the north-western Negev. Biological soil crust build up by cyanobacteria, green algae, mosses and soil lichens plays in this ecosystem an important role for the ecosystem processes. The results emphasized the role of the biological soil crusts in this arid ecosystem. The infiltration properties of the biological soil crusts counteract the rainfall gradient and limit soil water availability on the small-scale. Under low annual rainfall amount the biological soil crusts, composed mainly by mosses in the wetter area of the sand dunes prevent deep water infiltration, while thinner cyanobacterial crusts in the arid parts absorb less water, allow deeper infiltration and generates surface run-off. Therefore, surface properties like crust and fine material are key factors for the hydrological processes and control water redistribution on the local scale and, thus, vegetation patterns. We conclude from our findings, that the use of rainfall gradient as model systems for studies of the impact of climate change at desert margins is problematic. The reality is far more complex and small changes in surface properties exercise a strong effect on the spatial redistribution of water resources and have to be taken into account for the analysis of the foreseen effects of climate change.

Drought induced mortality and biotic interactions in associations of grass genotypes with contrasting dehydration tolerance.

Voltaire, Florence. Locht, Jonathan.

CEFE-CNRS - INRA, Montpellier. LECA-CNRS, Grenoble.

Perennial grasslands in Mediterranean and semi-arid areas provide numerous ecosystemic services but their response to increasing summer aridity under climate change has been little studied. We aimed to analyse the effects of drought intensity and biotic interactions on plant mortality by comparing Mediterranean and temperate genotypes of two species of perennial grasses (*Dactylis glomerata* L. cocksfoot and *Lolium arundinaceum* (Schreb.) Darbish, tall fescue) with contrasting functional strategies to cope with severe drought. Dehydration tolerance was measured either in mono, bi and pluri-specific swards by plant survival rate under successive rehydration patterns. We carried out two pot experiments imposing a contrasting drought intensity and duration resulting in plant survival stages from 23 to 45 days. Based on soil moisture associated with 50% of plant survival, both fescues were less dehydration tolerant, senesced and dehydrated at higher soil moisture than both cocksfoots. Intra-specific differences for these responses were more significant between genotypes of cocksfoot than between those of fescue. Relative Interaction Intensities calculated on biomass recovery revealed a strong competition effect on fescues and a facilitation effect on cocksfoots that exhibited significant over-yielding after drought when grown in association with fescues. The level of dehydration tolerance of genotypes and species can therefore markedly impact plant persistence and evolution of grassland composition under climate change. Moreover, the respective contribution of both strategies of dehydration tolerance and dehydration delay through water uptake on drought survival, is now investigated in grass mixtures grown in the field under contrasting summer droughts.

S.12- Evolutionary history, ecosystem function, and conservation biology: new perspectives

S.12-01-P

Using Ecosystem Functional Types to evaluate the regional controls of ecosystem functional diversity.

Alcaraz-Segura, Domingo. Puelo, José M.. Epstein, Howard E.. Cabello, Javier. Jobbágy, Esteban G.

CAESCG-Universidad de Almería. CONICET-Universidad de Buenos Aires. University of Virginia. CAESCG-Universidad de Almería. Universidad Nacional de San Luis.

Global environmental change effects on biodiversity are particularly noticeable at the ecosystem level and have a faster influence on the functional than on the structural or compositional components. However, the regional controls of biodiversity patterns have been traditionally evaluated using structural and compositional components of biodiversity. During the last decades, though, the role of ecosystem functioning in both management and conservation is increasing. Approaches such as the remote sensing-based monitoring of Ecosystem Functional Types (EFTs, patches of the land-surface with similar carbon gain dynamics) now open the possibility of characterizing over vast areas the spatial and temporal heterogeneity of functional diversity at the ecosystem level. Our aim was to evaluate whether the environmental controls of species richness that are globally observed can also be revealed at the ecosystem level using EFTs richness across natural and agricultural systems in non-tropical South America. The yearly identification of EFTs was based on three descriptors of carbon gain dynamics derived from seasonal curves of Enhanced Vegetation Index (EVI): annual mean (surrogate of primary production), seasonal coefficient of variation (indicator of seasonality), and date of maximum NDVI (descriptor of phenology). The EVI timeseries was obtained from the MODIS-Terra satellite dataset (MOD13A1) and consisted in 16-day maximum value composite images at a spatial resolution of 0.05° x 0.05° from 2001 to 2008. The climate dataset (CRU TS3.10) consisted in monthly gridded time-series at a spatial resolution of 0.5° x 0.5° including precipitation, potential evapotranspiration, and temperature. Relief heterogeneity was derived from the SRTM DEM.

S.12-02-P

Experimental plant communities become phylogenetically overdispersed during assembly.

Allan, Eric. Jenkins, Tania. Fergus, Alex. Roscher, Christiane. Peterman, Jana. Weisser, Wolfgang. Fischer, Markus. Schmid, Bernhard.

University of Bern. University of Bern. University of Zurich. UFZ, Helmholtz Centre for Environmental Research. University of British Columbia. University of Jena. University of Bern. University of Zurich.

The importance of competition between similar species in driving community assembly is much debated. To help resolve this question, phylogenetic patterns in species composition have been investigated: phylogenetically clustered compositions are taken to imply environmental filtering and phylogenetic overdispersion to indicate limiting similarity between species. Previous work has been mainly observational, and determining assembly mechanisms has been difficult because other processes, such as dispersal, may also have driven the resulting patterns. Here, we used data from a biodiversity experiment (the Jena Experiment) to examine change in the phylogenetic pattern in species abundances in communities with initially random species composition. First, we used weeded communities, where colonisation was prevented and only changes in the relative abundances of species could affect phylogenetic pattern, to test for the effects of initial phylogenetic and species diversity on the development of phylogenetic dispersion. Secondly, we used communities opened to colonisation by species from a common species pool to test for convergence in phylogenetic diversity. Where composition was held constant, overdispersion in species abundance increased through time, suggesting that limiting similarity processes structure these communities. Initial phylogenetic diversity of the communities affected the development of overdispersion and only communities containing a mix of close and distant relatives became overdispersed. Communities open to colonisation, where species abundances and composition could re-assemble simultaneously, developed even stronger overdispersion; and their phylogenetic diversity converged after three years. Our results add a new perspective to the evidence that niche complementarity is critical in driving community assembly.

S.12-03-O

Phylogenetic diversity promotes ecosystem stability.

Cadotte, Marc. Dinnage, Russell. Tilman, David.

University of Toronto. University of Toronto. University of Minnesota.

Ecosystem stability in a variable world depends on the diversity of form and function in a community. This type diversity is the product of evolution and the evolutionary history represented by co-occurring species has been shown to be an important predictor of ecosystem function. If evolutionary history is a surrogate for ecological differences, then greater evolutionary diversity should buffer ecosystems against environmental variation and result in greater stability of ecosystem function. We calculated measures of plant community diversity that incorporate evolutionary information for a long-term biodiversity-ecosystem function experiment at Cedar Creek, Minnesota. We calculate a detrended coefficient of variation in aboveground biomass production, and examine how evolutionary diversity explains variation in stability. Our results indicate that communities where species are equivalently related to one another are more stable than communities where evolutionary relationships are imbalanced. Two hypotheses could potentially explain this result. First is that there are some evolutionary lineages that have inherently greater stability in biomass production than others and greater evolutionary distances reduce the chance of sampling only unstable groups (evolutionary selection effect). Using tests of phylogenetic signal, we failed to find evidence for closely-related species having correlated stability. The second hypothesis is that greater evolutionary distances between co-occurring species result in greater stability because they are more likely to be ecologically different (evolutionary complementarity). We found that species were less likely to be stable when they were in communities with only closely-related species. Ecosystem stability is affected by the diversity of form and function in communities and accounting for evolutionary relationships can reveal how such diversity may affect stability.

S.12-04-P

Reacquisition of the sexual status in the invasive *Oxalis pes-caprae*.

Costa, Joana. Ferrero, Victoria. Loureiro, João. Navarro, Luis. Castro, Sílvia.

University of Coimbra. University of Coimbra. University of Coimbra. University of Vigo. University of Coimbra.

Biological invasions are serious threats to biodiversity, comprising significant ecological and evolutionary consequences. Evolutionary changes in the colonizing populations may contribute to invasion success, becoming crucial to understand the evolutionary processes during invasion. In this study, *Oxalis pes-caprae*, a native species from South Africa and a widespread invasive weed in Mediterranean climate regions, was used as model for assessing how evolutionary changes on the reproductive system may contribute to invasion. In its native range, this species reproduces asexually and sexually, presenting tristylous flowers with a self- and morph-incompatibility system, and it is composed by three cytotypes (2x, 4x and 5x). In the Mediterranean region, a shift to obligate asexuality was observed as a result of founder events after the introduction of the 5x short-styled morph, only. However, recent field observations in the Atlantic coast revealed the occurrence of mixed populations composed by several morphs and cytotypes. To investigate the origin of these new forms, we evaluated the possibility of the 5x short-styled morphotype to produce seeds. For this, controlled hand pollinations were performed and female reproductive success recorded. The obtained seeds were sown and germination rates and ploidy of the offspring were assessed. Preliminary results revealed that the 5x short-styled is able to yield some viable gametes and produce offspring (4x and 5x), suggesting the breakdown of the heterostylous morph-incompatibility system. These results open the possibility for punctual sexual reproduction in the absence of compatible mates, suggesting that new floral morphs and cytotypes may have originated in the invaded area.

S.12-05-0

Exploring the phylogenetic history of species richness gradients.

Davies, Jonathan. Buckley, Lauren.

McGill University. University of North Carolina.

At broad geographic scales, species richness is a product of speciation, extinction, and migration. Whilst paleontological studies can provide information on speciation and extinction rates, data are frequently lacking. I use a recent dated phylogenetic tree of mammals to explore the relative importance of these three processes in structuring contemporary richness gradients. I combine macroecological data with phylogenetic methods more typically used in community ecology to describe the phylogenetic history of regional faunas. Using simulations, I explore two simple phylogenetic metrics, the mean and variance in the pairwise distances between taxa, and describe their relationship to phylogenetic tree topology. I then use these two metrics to characterise the evolutionary relationships among mammal species assemblages. I show that the mean and variance in the pairwise distances describe well phylogenetic tree topology, but are less sensitive to phylogenetic uncertainty than more direct measures of tree shape. I show that the phylogeny for South America mammals is imbalanced and stemmy, consistent with recent diversification. In contrast, the phylogeny for African mammals is balanced and tippy, more consistent with the slow accumulation of diversity over long times.

S.12-06-0

Phylogenetic diversity in conservation biology: the third man.

Devictor, Vincent. Monnet, Anne-Christine.

CNRS. University Montpellier II.

Our approach of biodiversity is paradoxical. While we acknowledge that biodiversity is complex and multifaceted, we generally model, measure, and protect only particular components of biodiversity while ignoring others. Is phylogenetic diversity a component like the others? Encapsulating biodiversity in simple metrics has been a long-lasting goal for ecologists. But are these indices really useful for conservation biology? In this talk, I investigate the strengths and limits of using spatial and temporal dynamics of phylogenetic diversity in conservation biology. Using concrete examples on birds, I show that, on its own, phylogenetic diversity provides little insights on community responses to global changes. However, when integrated in a more holistic framework in which phylogenetic, but also functional and ecological aspects of biodiversity are studied simultaneously, it can become a useful descriptor of community dynamics.

S.12-07-P

New insights on the sexual reproduction of the invasive polyploid *Oxalis pes-caprae* in the Western Mediterranean region.

Ferrero, Victoria. Castro, Sílvia. Costa, Joana. Navarro, Luis. Loureiro, João.

CFE, Centre for Functional Ecology, University of Coimbra, Portugal; AND University of Vigo, Spain. CFE, Centre for Functional Ecology, University of Coimbra, Portugal. Centre for Functional Ecology, University of Coimbra, Portugal. University of Vigo, Spain. Centre for Functional Ecology, University of Coimbra, Portugal.

Biological invasions have long been recognized to comprise significant ecological and evolutionary consequences, both for the species and communities being invaded and for invasive species themselves. Facing the growing evidence on the possibility that rapid evolutionary changes in colonizing populations contribute to invasion success, it became fundamental to understand the evolutionary processes operating during invasion. *Oxalis pes-caprae* is a tristylous species native from South Africa that was introduced in several areas of the world, particularly in Mediterranean climate regions, where it is currently widespread invasive weed. This species has a complex reproductive system, and besides presenting 3 floral morphs, each plant may have one of three cytotypes (2x, 4x or 5x), with sexual reproduction being possible only after legitimate crosses between floral morphs with compatible ploidy levels. In the invasive area, a shift to obligate asexuality through clonal propagation has been described as a result of founder events with the introduction of the pentaploid short-styled morphotype, only. The introduced form not only lost the mating partners but it is also an apparently sterile form from a cytological point of view. However, it has been recently found the presence of new floral morphs and cytotypes in the western Mediterranean basin. The occurrence of new forms opened the possibility for sexual reproduction and constitutes a new mean of dispersal and source of genetic diversity. In this study we provide new findings on flower morph and cytotype distribution patterns and their implications for sexual reproduction of the invasive species across the Western Mediterranean region.

S.12-08-O

Detecting areas of high evolutionary potential with phylogenies and species distributions?

Jabot, Franck.

Cemagref.

Evolutionary thinking has encouraged ecologists to consider biodiversity as a dynamic outcome of evolutionary processes. In this light, biodiversity conservation should aim at favoring ecological processes of present and future diversification as much as preserving present biological diversity. In this regard, phylogenies offer us a testimony of past macro-evolutionary processes, processes which may be worth targeting for conservation actions. I will here use simulated evolving metacommunities to assess whether and how one can delineate areas of high evolutionary potential by combining information on phylogenetic relationships and present species distributions.

S.12-09-0

The dechynchronization of major angiosperm clades: climatic niche evolution and species diversification.

Lavergne, Sébastien. Roquet, Cristina. Thuiller, Wilfried.

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Inferring the mode and tempo of evolution in species characters and niches has been central to evolutionary biology since the seminal work of G.G. Simpson. This question has recently seen a regain of interest due to the unresolved debate around the hypothesis of phylogenetic niche conservatism. Whether species niches, and especially their climatic requirements, should be assumed to be stable over time remains an open question, mainly because of conceptual and methodological impediments. The issue of this debate should have fundamental implications for forecasting climate change impacts on species distributions and deciding whether forecasting tools should account for potential evolutionary lability of species climatic tolerances. Based on the inference of contemporary species climatic niches, large scale phylogenetic reconstructions and a range of newly developed comparative analyses, we show that rates of climatic niche evolution have been highly heterogeneous in time and between different angiosperm clades. We also test whether some biological traits adequately predict rates of climatic niche evolution and whether rapid climatic niche diversification has triggered evolutionary radiation of some angiosperm clades. Finally, we argue that focusing solely on the existence of phylogenetic niche conservatism may be of limited interest. A more interesting perspective would be the inference of rates and drivers of niche evolution and their comparison between different clades and niche dimensions.

S.12-10-0

Integrating evolution into conservation biology: beyond phylogenetic diversity as a metric.

Morlon, Helene.

Ecole Polytechnique.

Over the past few years, there has been an active debate on the value of considering phylogenetic measures of diversity when setting conservation priorities. There is some empirical evidence that measures of diversity taking into account evolutionary history perform better than measures that do not in predicting ecosystem function, but only limited evidence; conservation priorities aimed at preserving phylogenetic diversity differ to some extent from those aimed at preserving species richness, but not dramatically. Hence, given the need for immediate action, conservation planners might choose to ignore phylogenetic information. Phylogenies, however, can provide much more than the availability to compute diversity metrics. Recent phylogenetic inference methods may allow us to detect specific lineages and specific geographic areas that may be particularly important for future diversification. Combined with scenarios of climatic and land use change, they may allow us to assess the impact of global change on diversification processes. I will discuss these underexplored possibilities in the use of phylogenies in conservation, and I will argue that much is to be gained by integrating macroevolution into conservation research.

S.12-11-O

Phylogenetic constraints on ecosystem functioning.

Mouquet, Nicolas.

CNRS - Université Montpellier II.

It has been recently hypothesized that evolutionary history should influence the Biodiversity Ecosystem Functioning (BEF) relationship. This important new direction in the BEF literature is however based on few empirical investigations. Here we combine re-analysis of one of the plant dataset from one of the European BIODEPTH experiments and ecological experiments with bacteria to illustrate how evolutionary constraints impact the BEF Relationship. Using the dataset collected at the German site of the pan-European BIODEPTH project we have examined the unique and additional effect of phylogenetic and functional diversity on the prediction of ecosystem processes. Mainly we found that functional diversity was a better predictor of ecosystem function, particularly as the number of traits used to compute functional diversity was increasing. This a posteriori analysis is very useful but is limited by the strong co-variation between species richness and phylogenetic diversity. In an experiment with bacteria we manipulated phylogenetic diversity and species richness independently. Combining experimental ecological and evolutionary mechanisms, we found that productivity is significantly related to species richness and phylogenetic diversity for this system, and that the latter is a much stronger predictor of ecosystem functioning. However, by evolving lineages under different environments, we were able to randomize the distribution of traits across the phylogeny, breaking the relationship between phylogenetic diversity and ecosystem functioning. These different results show how the BEF relationship depends critically on the legacy of past evolutionary events and the limitation of using phylogenetic structure to predict ecosystem function without good knowledge on the evolutionary forces and phylogenetic constraints that shaped species diversity within ecological communities.

S.12-12-O

Are we losing phylogenetic diversity? a temporal partitioning of phylogenetic diversity reveals rockfish diversity loss in the Southern California Bight.

Pavoine, Sandrine. Love, Milton. Bonsall, Michael.

Muséum national d'Histoire naturelle, University of Oxford. University of California. University of Oxford, St Peter's College.

Phylogenetic divergences have now been included in studies that aim to elucidate changes in the patterns of biodiversity in space and time. In this context, we have developed an approach to analyse how the phylogenetic diversity of an assemblage changes with time (or space), for instance due to modifications in the environment (Pavoine, Love, Bonsall 2009). This approach is based on three observations: (i) the importance of evolutionary history in structuring communities can only be fully understood by analyses that partition the phylogeny into different lineages and associated evolutionary epochs or time periods; (ii) to evaluate how communities respond to environmental change we need a method that can compare the phylogenetic composition of communities across geographical space and/or time (months and/or years); (iii) environmental change can affect rare and abundant species differently so our method should be able to account for these differences in levels of rarity and abundance. We applied our approach to the Southern California Bight, a hotspot for rockfish diversity. Rockfish species are affected by fishing pressures and warming sea level. The analysis of phylogenetic diversity revealed a recent decrease in the amount of fish caught from six evolutionary deep lineages, with implications for the community structure of this speciose group. This application showed that our approach, which can also be applied to trees assembled from functional traits instead of phylogenies, can contribute to the description of the consequences of human-driven impacts on the environment.

S.12-13-O

Complete, accurate, mammalian phylogenies aid conservation planning, but not much.

Rodrigues, Ana. Grenyer, Richard. Bininda-Emonds, Olaf. Gittlemann, John. Hoffmann, Mike. Safi, Kamran. Stuart, Simon. Brooks, Thomas.

CNRS, France. University of Oxford, UK. Carl von Ossietzky Universität Oldenburg, Germany. University of Georgia, Athens, USA. IUCN Species Survival Commission, UK. Max Planck Institute for Ornithology, Germany. IUCN Species Survival Commission, UK. NatureServe, USA.

In the face of unprecedented global biodiversity loss, conservation planning must balance between refining and deepening knowledge versus acting on current information to preserve species and communities. Phylogenetic diversity, a biodiversity measure that takes into account the evolutionary relationships between species, is arguably a more meaningful measure of biodiversity than species diversity, but cannot yet be applied to conservation planning for the majority of taxa for which phylogenetic trees have not yet been developed. Here, we investigate how the quality of data on the taxonomy and/or phylogeny of species affect the results of spatial conservation planning in terms of the representation of overall mammalian phylogenetic diversity. The results show that the better the quality of the biodiversity data the better they can serve as a basis for conservation planning. However, decisions based on incomplete data are remarkably robust across different levels of degrading quality concerning the description of new species and the availability of phylogenetic information. Thus, given the level of urgency and the need for action, conservation planning can safely make use of the best available systematic data, limited as it may be.

S.12-14-O

Global species-energy relationship in trees: the role of functional diversity across spatial scales.

Šímová, Irena. Violle, Cyrille. Storch, David. Boyle, Brad. Donoghue, John. Enquist, Brian.

Center for Theoretical Study. University of Arizona. Center for Theoretical Study. University of Arizona. University of Arizona. University of Arizona.

Strong correlation between climate (particularly variables associated with productivity) and number of species is a commonly observed ecological pattern. However there is currently no consensus concerning the main processes responsible for the observed correlation. One possibility is that abiotic and biotic parameters of the environment ultimately limit niche space which consequently affect the total number of coexisting species. This constraint is often valid within local communities of closely related species, but it is not clear whether this approach can limit diversity at large scales. We tested this hypothesis comparing communities differing in their size. We used 'Gentry-style' forest plots and USGS trees range maps located in US and Canada. For each community we calculated variables representing niche space (variance in particular plant traits and functional diversity indices) and explored whether functional diversity varied with climatic variables, species richness and the size (area) of the community. As expected, we found strong increase in number of species with climate but surprisingly, increase in functional diversity was in general much weaker and not strongly affected by scale. These results indicate that other processes, namely evolutionary constraints in species' spreading, may play the most important role in generating global species richness patterns.

S.12-15-O

Consequences of climate change on the tree of life in Europe.

Thuiller, Wilfried. Lavergne, Sébastien. Roquet, Cristina. Isabelle, Boulangeat. Araujo, Miguel.

CNRS. CNRS. CNRS. CNRS. CSIC.

Many species are projected to become vulnerable to twenty-first-century climate changes, with consequent effects on the tree of life. If losses were not randomly distributed across the tree of life, climate change could lead to a disproportionate loss of evolutionary history. Here we estimate the consequences of climate change on the phylogenetic diversities of plant, bird and mammal assemblages across Europe. Using a consensus across ensembles of forecasts for 2020, 2050 and 2080 and high-resolution phylogenetic trees, we show that species vulnerability to climate change clusters weakly across phylogenies. Such phylogenetic signal in species vulnerabilities does not lead to higher loss of evolutionary history than expected with a model of random extinctions. This is because vulnerable species have neither fewer nor closer relatives than the remaining clades. Reductions in phylogenetic diversity will be greater in southern Europe, and gains are expected in regions of high latitude or altitude. However, losses will not be offset by gains and the tree of life faces a trend towards homogenization across the continent.

S.12-16-O

On the comparison of taxonomic, functional and phylogenetic diversity of plant communities.

Turcati, Laure. Sauquet, Hervé. Porcher, Emmanuelle.

Université Pierre et Marie Curie. Université Paris Sud 11. Muséum national d'Histoire naturelle.

Whereas taxonomic indices (species richness mostly) have long been used to measure and monitor biodiversity, there is a recent surge of interest in biodiversity measures that incorporate information on the ecological, functional or evolutionary differences among individuals or species. However, it remains to be demonstrated whether such measures are more informative than traditional taxonomic measures, and whether they inform on ecosystem functions and services. Here, we address the former issue by comparing the taxonomic, functional and phylogenetic diversities of plant communities and their spatial distribution in France at two spatial scales (regional and national). As expected, we observed a strong positive correlation among all diversity metrics, but functional and phylogenetic diversities nonetheless carried additional information beyond taxonomic diversity. Furthermore we observed a spatial mismatch between taxonomic, functional and phylogenetic diversities. Our results have strong implications for the choice of metrics to monitor biodiversity in a changing world or to design protected areas; they support the idea that no single metric alone can summarize biodiversity and that the choice of metrics should be target-dependent.

S.12-17-O

Twenty years in agony - About the integration of phylogenetic diversity into conservation practice?

Winter, Marten. Kühn, Ingolf. Devictor, Vincent.

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Exactly twenty years ago Richard I. Vane-Wright et al. (1991) introduced the concept of the diversity of evolutionary history (EvDiv) as additional biodiversity measure as “agony of choice” for nature conservationists. Especially in the last years the implementation of EvDiv into biodiversity studies increased tremendously. But is EvDiv a really applicable concept in nature conservation? One common argument for the importance of high EvDiv is that it represents a high amount of functional diversity and hence a representation of niche spaces. This is believed to increase the stability of ecosystems and adaption potential against global change. But this arguments are still under discussion and highly controversial. Assessments of those relationships are heavily dependent on the analyzed taxa, regions and the conservatism of traits and no general pattern linking EvDiv and ecosystem functioning have emerged so far. Is the already visible loss of species and hence the irreversible loss of evolutionary information sufficient and relevant enough to convince stakeholders to care about evolutionary history? Let’s pretend that it is sufficient: the conservation of evolutionary diverse regions would probably result in new conservation areas or in extending already existing areas, which are based mostly on species richness and rarity. But this seems very unlikely especially in regions with a long nature conservation history or intensive land use such as Europe, North America or South East Asia. Let’s be realistic: will we ever see a national parks designated (also) on the basis of EvDiv? On the other hand, why not? It took some decades until scientific knowledge of climate change effects on biodiversity were accepted by decision makers and turned into relevant policy actions. With this talk we want to raise awareness to this topic and contribute to the discussion on why and how phylogeny should be an important additional measurement of diversity and integrated in nature conservation. In this respect, we review contrasting results, reasons for misunderstandings and research to be filled to help linking pure science and applied conservation planning. Vane-Wright, R. I., Humphries, C. J. & Williams, P. H. (1991) What to protect?--Systematics and the agony of choice. *Biological Conservation*, 55, 235.

S.12-18-P

More plant lineages - less mineralization: phylogenetic diversity of litter slows down decomposition processes.

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Plant communities differ drastically in their phylogenetic diversity. What are the consequences for ecosystem functioning and more specifically for the decomposition of litter? Does an increased diversity of lineages result in increasingly complementary resources for litter-feeding decomposers, in more diverse decomposer communities, and in a more efficient decomposition? Or does increased diversity of lineages result in reduction of preferred resources for any group of decomposers, with a decrease in their efficiency, and in decomposition? We experimentally tested how decomposition depends on phylogenetic diversity of litter (ranging from within 12 tree species to two-species combinations within and between 4 genera and 4 families). We found no effect of increased phylogenetic diversity on litter-mass loss or diversity of multiple invertebrate decomposer taxa. However, we found a decrease in the microbial mass and slower improvements in C/N ratios. High phylogenetic diversity of plants seemed hence to impede the processing of their litter by decomposers. We stress that our (and most other) experiment does not account for possible local trait evolution in response to coexisting plants. We suggest that the increased mineralization of litter composed of closely related plants favors their coexistence and thereby the evolutionary conservatism of niches.

S.12-19-O

Beyond conserving species: phylogenetic information does matter in conservation planning.

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Our planet is facing a major biodiversity crisis marked by species loss of magnitude comparable to prehistoric mass extinction events. There is much need in protecting species and biodiversity features but the resources allocated to conservation action are limited. Prioritization is required and needs to be supported by a profound understanding of different aspects of spatial biodiversity distribution. So far, most of the published reserve selection strategies focus exclusively on species, and often on static occurrence patterns of a reduced number of focal taxa. However, species occurrence patterns inform little about ecological and evolutionary processes and thus ignore key components driving the macroecological distribution of species and communities. Here we propose to evaluate and compare the distribution of different component of diversity at the European scale using bird dataset. Three different measures of diversity within communities are used: (1) the species richness expressed as the number of species, (2) the evolutionary distinctiveness richness reflecting the amount of evolutionary distinct species, and (3) the phylogenetic diversity representing the dissimilarity of the evolutionary past of species. These measures are then used as conservation targets in a reserve selection exercise. We found that while species richness and evolutionary distinctiveness richness are highly correlated at the European scale, phylogenetic diversity shows lower agreement with these two measures. This suggests that we miss important aspects of diversity and associated evolutionary and ecological processes when using species richness as a primary surrogate for overall diversity of a site.

S.13- Evolutionary Ecology

S.13-01-P

Geologic habitat template may override Late Quaternary climate change as a determinant of range dynamics and phylogeography in habitat-specialist species.

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Saline aquatic ecosystems, in which environmental constraints are imposed by both geological and climatic conditions, are globally distributed in arid lands such as some areas of the Iberian Peninsula. Despite that these habitats are particularly interesting due to their high number of rare and endemic species, little is known about how past climates have affected the distribution of species inhabiting them and the configuration of their genetic diversity. We combined species distribution modelling and comparative phylogeography for four co-distributed species of water beetles from the Iberian Peninsula (genera *Ochthebius*, *Nebrioporus* and *Enochrus*) to investigate the role of geological and climatic conditions in constraining their ranges over time, including how they have been affected by glacial-interglacial climate changes. We found that: (1) Lithology forms an important range constraint for Iberian saline habitat water beetles. (2) Species for which lithology is the dominant range constraint were not affected by the glacial-interglacial climate changes, i.e., had a more or less static range and population size over this period; in contrast, species whose ranges are importantly affected by climate have experienced a population and range expansion since the LGM. (3) For species for which lithology is the dominant range constraint, phylogeographic structure mainly reflects habitat connectivity; in contrast, in species with contracted, disjunct LGM ranges phylogeographic structure mainly reflect these refugia.

S.13-02-O

A piece of the puzzle: a method for comparing pollination quality and quantity across multiple species and reproductive events.

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Understanding how pollination affects plant reproductive success and how changes in pollination services affect plant populations, communities and ecosystems are of increasing concern. Yet supplemental hand-pollination customary used to assess pollen limitation is prohibitive for large scale comparative work and problematic because its inability to differentiate between quality and quantity aspects of pollen limitation, an open question particularly unclear for species with mixed mating system. Here, we highlight pollen tubes as the functional link between pollen arrival and seed production. We propose that piecewise regression analysis of the relationship between the numbers of pollen grains on stigmas and pollen tubes within styles can provide quantitative insight into the relative relevance of quantity and quality of pollen receipt in limiting natural pollination success, free of the confounds of resource availability to fill seeds. We assess the rigor of the method and demonstrate how parameters obtained from this analysis can facilitate broad-scale comparisons across species or reproductive events. We foresee that analyzing the relationship between pollen grains and tubes of wilted naturally-pollinated flowers in this manner we will more rigorously evaluate the relative importance of quantity and quality of pollination in limiting plant reproduction from a community perspective.

S.13-03-O

A generalist pit-building antlion is more efficient than a related specialist even in the latter's preferred environment.

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Generalists utilizing a wide range of resources are intuitively expected to be less efficient in exploiting each resource type compared to specialists, which have developed an optimal phenotype for utilizing only one or few resources. We report here the results of an empirical study whose aim was to test if habitat specialization confers superiority in utilizing a specific habitat type, while resulting in reduced performance when exploiting other habitats. As a model system to address this question we used two highly abundant species of pit-building antlions, exhibiting different levels of specialization in their habitat use: the generalist *Myrmeleon hyalinus*, inhabiting a variety of soil types but occurring mainly in sandy soils, and the specialist *Cueta lineosa*, which is restricted to light soils such as loess. Remarkably, prey capture success of the generalist was higher than that of the specialist in both soils, indicating that habitat specialization of *C. lineosa* to light soils does not necessarily confer superiority in utilizing such habitats. We thus suggest that habitat specialization in this species is an evolutionary dead-end and that its superiority, in light soils might be evident only when considering additional niche axes.

S.13-04-P

Reconstructing the origin of high-alpine niches and cushion life form in the genus *Androsace* s.l. (primulaceae).

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Relatively few species have been able to colonize extremely cold alpine environments. The study of their history is therefore necessary to reveal the general mechanisms that enable adaptation to changing environments. In this study, we investigate the role played by the cushion life form in the evolution of climatic niches in the plant genus *Androsace* s.l., which spreads across the mountain ranges of the Northern Hemisphere and contains species found at locations among the highest in the world. To reveal the evolutionary history of *Androsace*, we first build the largest phylogeny of the genus to date. Then, we compare species' climatic niches in a phylogenetic framework and reconstruct ancestral life forms in the genus. We develop robust methods that control for various sources of uncertainty (e.g. phylogenetic inference, intraspecific niche variability and uncertainty in ancestral state reconstructions) and show that climatic niches in *Androsace* evolved recently and punctually. Macroevolutionary models of habitat selection show that the cushion life form has been a key innovation in the genus *Androsace*, providing the opportunity to occupy extremely cold environments and thus contributing to rapid climatic niche diversification. Comparing *Androsace* with other alpine plant genera described in the literature, we propose a general scenario for the adaptation of plants to alpine habitats.

S.13-05-P

Incidence of polyploidy and evolution of genome size in Iberian Scrophulariaceae s.l.

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As new evolutionary entities can arise by a single genomic event, polyploidy has been proposed as an important mechanism of sympatric speciation. Therefore, studies focused on the ecological processes and selective pressures that govern polyploidy origin, establishment and maintenance are of utmost importance. Contrarily to other regions, only a few studies concerning polyploidy incidence were focused on the Iberian Peninsula flora, an important center of diversification. With the advent of flow cytometry it became possible to perform large scale screenings focused on understanding polyploidy and genome evolution and their role in plant diversification. The aim of this work is to study the incidence of polyploidy and the evolution of genome size in Scrophulariaceae s.l. from Iberian Peninsula, a family with potential polyploid taxa according with chromosomal data records. Up to the moment, 91 populations (up to 30 individuals/population) of 42 distinct taxa were already analysed, which represents 37% of the Portuguese Scrophulariaceae species. Contrarily to what was expected, only a few taxa presented individuals with more than one ploidy level (e.g. *Veronica persica*, diploids and tetraploids). Genome size estimates revealed that the majority of the analysed species present very small genome sizes (i.e., $2C < 2.8$ pg), with only one taxa presenting small (*Veronica hederifolia*, 4.16 pg/2C) or intermediate genome sizes (*Melampyrum pratense*, 15.59 pg/2C). Furthermore, genome size appears to be highly correlated to the current infra-generic delimitations within the family, eventually being an interesting character for the study of taxa requiring taxonomic revision.

S.13-06-O

Intra-specific variation and plasticity of life history traits in two Mediterranean pines.

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CIFOR-INIA. CIFOR-INIA. CITA. CIF Lourizán. CIFOR-INIA. CIFOR-INIA.

Forest trees and particularly conifers are between the most genetically variable organisms, both between and within populations. We know already a lot on the variation of neutral molecular markers and increasingly more about coding sequences of potential adaptive value, but still very little about quantitative life history traits that could be linked to local adaptation in most forest species. Replicated common garden experiments provide an excellent experimental system to unveil the genetic and environmental effects on vegetative growth, reproductive onset (size and age at reproduction and proxies to reproductive allocation) and other case-specific life history traits like bark thickness and crown and stem allometries. We present results obtained in different provenance and progeny trials of *Pinus pinaster* and *P. halepensis* at various ages ranging from 5 to 16 years. Results showed a general high intra-specific variation for vegetative growth, size at maturity, reproductive allocation and bark thickness. Plasticity patterns and population x site interactions were closely linked to size effects, but the comparison of allometric regression models and logistic models of the probability of reproduction allowed us to distinguish true plastic responses for life history traits. Moreover, significant trade-offs between growth, reproduction, crown architecture and bark thickness have been found in different cases (species, site and age combination). Monte Carlo analysis has been applied to distinguish spurious correlations from true genetic trade-offs across populations, and further comparison of allometric regressions has been applied to detect divergent ontogenetic trajectories reflecting evolutionarily meaningful intra-specific differences in life history strategies.

S.13-07-O

Phenological adaptive responses of oak and beech to altitudinal gradients in the Pyrenees.

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It is widely accepted that genetic diversity and phenotypic plasticity are driving the evolutionary responses of populations and individuals to environmental change. We report on experiments conducted in sessile oak (*Quercus petraea*) and beech (*Fagus silvatica*) aiming at assessing the importance of both diversity and plasticity in the response to environmental changes generated by altitudinal gradients. The experiment consisted in a set of common garden and reciprocal transplantation experiments in two valleys on the Northern side of the Pyrénées mountains, and on the monitoring of bud burst and leaf coloration in situ and in the plantations. We found significant clinal differences in phenology among provenances for most species related to the annual temperature of the provenances' site. However the two species exhibited opposite genetic clines. While oak populations from lower altitude flushed earliest, the opposite pattern was observed in beech. The observed patterns were highly consistent from year to year. Moreover, phenotypic plasticity accounted to the in situ variation observed. We evidenced that reaction norms of flushing timing to temperature followed linear clinal trends for both species with an average shift of 5.7 days per degree C° increase. Timing of leaf senescence exhibited a parabolic trend for beech and no trend in oak. For both species, the length of the growing season increased to reach maximum values for annual temperature ranging from 10°C to 13°C according to the population. Finally, based on the reaction norms, populations tend to occupy suboptimal environments, eg population inhabit colder climates than where their optimum would be. The existence of large population differentiation and high magnitude of plasticity suggest that these populations can respond quite rapidly to temperatures changes.

S.13-08-P

Opposite correlations between exploration behavior and behavioral flexibility in two caterpillar species.

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Mean behavior and intra-individual variation in behavior can strongly differ among individuals. In addition, several studies evidenced correlations between intra-individual variation and personality traits. The proactivity/reactivity hypothesis predicts that more flexible individuals should be less aggressive and less explorer. On the other hand the adaptive flexibility hypothesis predicts that more explorer individuals may have an advantage in displaying a higher flexibility to adapt to new environments. Both kinds of relationships were evidenced in different species from different taxonomic groups. It remains however unknown whether such relationships are maintained within taxonomic groups. In addition, most of these studies considered very different measures of flexibility, and the opposite relationships observed between species might be related to differences in flexibility measures. Here we compared the relationship between exploration behavior and behavioral flexibility in two caterpillar species known to display large among individuals variation in exploration behavior, *Pieris brassicae* and *Inachis io*. Using the same measure of both behavioral flexibility and exploration behavior in both species, we found opposite correlations between these two traits. Fast explorer *Pieris brassicae* caterpillars were more flexible whereas fast explorer *Inachis io* caterpillars were less flexible. Our results thus confirm the existence of opposite correlations between exploration behavior and behavioral flexibility, and evidence that such differences exist even within taxonomic groups. Both ultimate and proximate causes of such differences remain to be studied. We suggest that such inconsistency between the two species is the result of ecological and evolutionary differences favoring the proactive/reactive hypothesis in *Inachis io*, and the adaptive-flexibility hypothesis in *Pieris brassicae*. Particularly, differences in mobility and habitat spatial heterogeneity could explain a part of these differences.

S.13-09-O

How do genetic correlations affect species range shifts in a changing climate?

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Natural selection imposed by local climate affects many phenotypic traits (phenology, propagule size ...), and optimal trait combinations vary in space along climatic gradients. Climate change projections predict large geographic shifts in these optima in the next decades. Quantitative genetics methods can give insight into species responses to such changes over a few generations. So far, existing models have either focused on genetic constraints in a non-spatial framework, or explored how migration and selection interact in species facing shifting selection gradients, while overlooking multivariate genetic constraints or correlational selection as factors limiting adaptation. We model the demography and the joint adaptation of multiple traits in a species whose phenotypic optima vary across space and shift in time. All traits develop clines shifting in space, some of which may be in a direction opposite to univariate predictions, and the species tracks its environmental optimum with a constant lag. At equilibrium, the local density and trait means are described by simple analytical expressions, which can be used to predict whether species or populations are likely to be able to cope with ongoing climate change. A species can sustain faster environmental shifts, widen its distributional range, and increase its local adaptation when the spatial environmental heterogeneity is perceived as weak (generating low migration loads), and multitrait adaptive potential is high. These conditions are favoured when nonlinear (stabilizing) selection is stronger in the direction of the spatial selection gradient, and genetic variation is abundant in that same direction.

S.13-10-O

Anthropogenic fire drives the evolution of seed traits in a naturally fire-free ecosystem.

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Fire is a major disturbance affecting ecosystems worldwide. Phylogenetic studies have shown that seed persistence (fire-resistance) has evolved with fire in Mediterranean-type ecosystems. However, the existence of specific seed traits resulting from natural selection mediated by fire remains as a key question in plant evolution. We evaluated the role of fire in the evolution of seed traits from a microevolutionary perspective, using as study system a native annual plant (*Helenium aromaticum*) from the Chilean matorral, where fire is a novel disturbance. The interpopulation variation of seed pubescence, seed shape and pericarp thickness was strongly associated with fire frequency. Within a given *H. aromaticum* population, fire produced directional selection on seed pubescence and stabilizing selection on seed shape. These were shown to be heritable traits. Our findings provide insights into the understanding of seed trait evolution in Mediterranean ecosystems and demonstrate that human-made fires can be driving evolutionary changes in plant species from ecosystems where fires do not occur naturally. Funded by FONDECYT-3090018 (CONICYT, Chile).

S.13-11-O

Empirical evidences of genetic surfing in the spur-thighed Tortoise.

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There is a growing interest in those population and genetic processes that occur during range expansions since they can be key in understanding range shift scenarios. Much of the current knowledge about the genetic dynamics in range expansions originates from models, simulations, and microcosm experiments and needs to be corroborated with field data. Here we report one of the first empirical examples of genetic surfing, occurring in a range expansion of the spur-thighed tortoise. Genetic surfing can occur during expansion when the population density in the expansion front is low and dispersal is limited. Under those conditions, stochastic genetic drift can greatly change the allelic frequencies in the expansion front. Subsequently, only those alleles that catch the wave of advance will be able to ride it into new territory. As result of these repeated founder events, a strong genetic structuring is achieved at the same time that genetic diversity decreases with the progression of the wave. It is even possible that initially rare alleles reach high frequencies in the colonized territory. In this study we compare the genetic structure of a recently expanded Spanish population of tortoises with that of its original population in the north of Africa (Morocco and Algeria). Our results reveal a neutral genetic pattern that matches the predictions made by surfing models. They support the theory that genetic drift can be important in population expansions if we do not ignore the spatial component. Since surfing can also happen with functional genes, this little known process has ecological relevance as well.

S.13-12-O

Seasonal contingency of compensatory responses to apical damage in a Mediterranean annual plant.

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Plants are able to tolerate tissue loss through vigorous branching, which is often triggered by release from apical dominance and activation of lateral meristems. However, damage-induced branching might not be a mere physiological outcome of released apical dominance, but an adaptive response to environmental signals, such as damage timing and intensity. Here, branching responses to both factors were examined in the annual plant *Medicago truncatula* from two populations that vary in their onset of reproduction. Phenotypic selection analysis was used to evaluate the strength and direction of selection on branching following damage. Plants exhibited an ontogenetic shift in tolerance mechanisms: while early damage induced greater meristem activation, late damage elicited investment in late-determined traits including mean-pod and seed biomass and supported greater germination rates. Severe damage elicited greater activation of higher-order meristems, but this response was limited to early damage as well. Selection analyses revealed positive selection on branching but only in plants under early-damage treatments. The results demonstrate that damage-induced meristem activation is an adaptive response, which is adaptively contingent on the plant's developmental stage and extent of tissue loss.

S.13-13-P

Phylogenetic analysis of the angiosperm-nectarivorous insect-yeast association: have yeast and angiosperm lineages co-diversified?

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The ascomycetous yeast genus *Metschnikowia* (42 species) is characterized by the formation of needle-shaped ascospores. Widely distributed over all the continents, members of the genus are present both in aquatic and terrestrial ecosystems, and some species are frequently associated with angiosperm flowers and their insect pollinators. The diversity of the genus, its wide distribution, its association with angiosperm flowers, and the fact that it includes some of the best-studied yeasts in terms of biogeography and ecology make *Metschnikowia* an excellent group with which to investigate a possible history of coevolution with angiosperms. Previous phylogenetic studies have confirmed the inclusion of the genus *Metschnikowia* within the order Saccharomycetales, forming a well-supported clade (*Metschnikowia* clade) together with the genus *Clavispora* (3 species) and some asexual forms (33 species) assigned to the genus *Candida*. Close relationships between these three genera are supported by their relatively uniform nutritional profile. To gain insight into the degree and nature of temporal correlation in nectarivorous yeasts and angiosperm diversification, we present a phylogeny for the *Metschnikowia* clade based on ≈ 2 kilobases of DNA sequence data (3 nuclear genes) from a sample including all members of the clade (3 genera, 78 species). Additionally patterns of evolution of yeast habitats are explored in the *Metschnikowia* clade lineages with the purpose of inferring the origin of the nectarivorous habit.

S.13-14-P

Polyploidy and evolution of genome size in Portuguese orchid flora.

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Polyploidy is for long known as an important mechanism of plant evolution. Iberian Peninsula as an important center of diversification harbors a high diversity of orchid species, some of which have already been suggested as putative polyploids. Only in Portugal, according to the latest findings, there are 65 described taxa of orchids, with new taxa/populations still being discovered in the latest years. In order to estimate the incidence of polyploidy among Portuguese orchids and evaluate the usefulness of genome size as an additional parameter to characterize a given taxa, we started field collections and flow cytometric analyses of a large number of individuals from several taxa. So far, we already analysed 42 taxa, which represents a coverage of 65 % of the Portuguese orchids. Most of the analysed orchids presented a special pattern of endopolyploidy, termed elsewhere as progressively partial endoreplication, which caused some difficulties in clearly detecting the polyploids. Still, it was possible to detect the occurrence of polyploids in several genera, such as in *Anacamptis*, *Dactylorhiza* and *Ophrys*. Also, as the ratio between different partially endoreduplicated fluorescence peaks seems to be species specific, it was very helpful to assist the classification of several taxa (e.g., subspecies of *A. coriophora*). Finally, most orchids presented intermediate to large genome sizes (minimum of 10.39 pg/2C in *Ophrys speculum* and maximum of 69.77 pg/2C in *Neotia nidus-avis*), which is in accordance with previous estimates performed in orchids from other regions and that belong to the same sub-sections.

S.13-15-O

Heterozygosity-fitness correlations among wild populations of European tree frog (*Hyla arborea*) detect fixation load.

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University Lyon1. CEFE. University Lyon1. University Lyon1. University Lyon1. University Lausanne. University Lausanne. University Lyon1.

Quantifying the impacts of inbreeding and genetic drift on fitness traits in fragmented populations is becoming a major goal in conservation biology. Such impacts occur at different levels and involve different sets of loci. Genetic drift randomly fixes slightly deleterious alleles leading to different fixation load among populations. In contrast, inbreeding depression arises from highly deleterious alleles in segregation within a population and creates variation among individuals. A popular approach is to measure correlations between molecular variation and phenotypic performances. This approach has been mainly used at the individual level to detect inbreeding depression within populations and sometimes at the population level but without consideration about the genetic processes measured. For the first time, we used in this study a molecular approach considering both the interpopulation and intrapopulation level to discriminate the relative importance of inbreeding depression versus fixation load in isolated and non-fragmented populations of European tree frog (*Hyla arborea*), complemented with interpopulational crosses. We demonstrated that the positive correlations observed between genetic heterozygosity and larval performances on merged data were mainly caused by co-variations in genetic diversity and fixation load among populations rather than by inbreeding depression and segregating deleterious alleles within populations. Such a method is highly relevant in a conservation perspective because, depending on how populations lose fitness (inbreeding versus fixation load), specific management actions may be designed to improve the persistence of populations. Luquet E., David P., Léna J.-P., Joly P., Konecny L. Dufresnes C., Perrin N. & Plénet S. Heterozygosity-fitness correlations among wild populations of European tree frog (*Hyla arborea*) detect fixation load. *Molecular Ecology*, 20: 1877-1887

S.13-16-O

High performance genotypes in a newly invasive species.

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Museo Nacional de Ciencias Naturales (csic). Wesleyan University. Wesleyan University.

A species' invasive potential will be enhanced by the existence of genotypes able to maintain very high fitness across diverse habitats in its introduced range. Such high-performance genotypes can promote the species' immediate spread as well as lead to the evolution of increased invasiveness as those genotypes become prevalent. We investigate the existence of such genotypes in *Polygonum cespitosum*, an Asian annual plant that has recently become invasive in northeastern North America. We sampled 462 genotypes from 18 populations in the introduced and native range of the species to identify high-performance genotypes under favorable greenhouse conditions (i.e., those representing the top 5% in total reproductive output). We then compared their fitness and functional traits to a randomly selected group of the remaining genotypes in three contrasting habitat treatments. The high performance genotypes initially identified in Open/Moist/Warm growth conditions also had higher reproductive output in both Understory/Moist/Cool/ and Open/Dry/Hot conditions. Surprisingly, these differences did not correspond to differences in functional traits. Rather, the high-performance genotypes shared a distinctive developmental syndrome characterized by greater and faster germination, faster seedling growth, earlier reproductive onset, and higher reproductive allocation, resulting in higher achene number in all habitats. These results show that *P. cespitosum* includes a subset of highly successful, broadly adaptive genotypes that may play a key role in the species' spread. These genotypes occurred only in certain populations from the introduced range, highlighting the importance of population-level variation for invasion dynamics.

S.13-17-P

What makes a good neighbourhood? Temporal and spatial components of pre-dispersal fruit predation.

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Temporal variability in fruit production has been considered a key mechanism to increase plant fitness by reducing fruit predation levels. Fruit predators are also sensitive to fruit production at different spatial scales; however the effect of small scale spatial variation in plant fitness has received considerably less attention. Here, we examined fruit damage by three arthropods on the fleshy cones of *Juniperus thurifera* during three years with contrasting fruit production in a 1.4 ha plot in Central Spain. In addition, we assessed the form of phenotypic selection exerted by fruit predators during the year of larger crop size. Fruit production and the proportion of female trees producing fruits varied among the three years. The percentage of fruits damaged by the three arthropods did also differ accordingly, being higher the year with low fruit crop. The number of trees that produced fruits in consecutive years was low, although fruit damage levels for individual trees were relatively consistent from year to year. The main fruit predators during the year of high fruit production were lepidopteran larvae, followed by mites and chalcid wasps. Predation rates by Lepidoptera and chalcids were spatially structured probably reflecting the movement pattern of these taxa, whereas mite predation did not show any spatial structure. Crop size had an indirect positive effect on tree fitness through its effect on mite damage. At the patch level, fruit abundance decreased fruit predation by Lepidoptera thus positively affecting female fitness. Finally, Lepidoptera selected trees with bigger fruits containing more unviable seeds.

S.13-18-O

Neo-allopatry and rapid reproductive isolation.

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Geographic separation of populations and subsequent reproductive isolation via divergent selection and restricted gene flow is central to theories for speciation. Human activities are breaking ancient dispersal barriers and dramatically increasing the distribution ranges of many species. Subsequently, these distributions result in new non-native ranges which are highly geographically isolated from the original native ranges. This colonization of new geographic ranges appears to be producing rapid evolutionary changes in traits of many species in their non-native ranges. However, there is no evidence yet for such neo-allopatry leading to reproductive isolation. We manually cross-pollinated *Centaurea solstitialis*, *C. calcitrapa* and *C. sulphurea* plants grown from seed collected from multiple populations in the native range in Spain and the non-native range in California. All three species are closely related and have overlapping distributions in both ranges. For *C. solstitialis* and *C. sulphurea*, we find that seed production of North American flowers treated with pollen from European populations is 59% and 44% lower, respectively, than flowers pollinated with North American pollen, suggesting that exceptionally rapid reproductive isolation has occurred between populations between the native and non-native ranges of these species. We compared the degree of reproductive isolation by comparing the decrease in cross-continental seed set to the decrease observed in interspecific cross-pollinations between *C. solstitialis* and either *C. calcitrapa* and *C. sulphurea*. Cross-species pollinations produced seed, but a decline in seeds per flower of 78% relative to within-continent, intra-specific *C. solstitialis* crosses. In less than 200 years the degree of intraspecific reproductive isolation that appears to have developed between Californian and Spanish populations of *C. solstitialis* is already 69% of the reproductive isolation observed for interspecific hybridization among these three closely related species.

S.13-19-O

Genetic diversification of life history strategies influencing seasonal germination in *Arabidopsis thaliana* along a climate gradient.

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Adaptation to climate is likely to require coordinated changes in multiple functional traits and life history transitions. The earliest life history transitions often are crucial in determining the timing of the entire life cycle, thus influencing survival and lifetime reproduction. Germination timing results from the integration of a suite of processes occurring within the seed after seed release. We genetically characterized *Arabidopsis thaliana*'s after-ripening, thermal and seasonal germination response in the simulated temporal sequence and seasonal conditions in which they occur in the field. We hypothesized that 1) lineages and populations vary in seed traits related with these pre-germination processes, 2) seed traits exhibit genetic correlations in a manner consistent with adaptively differentiated life histories and 3) genetic correlations scale with source populations' climate, suggesting adaptive differentiation in life histories. As expected, lineages genetically biased to germinate in spring have long after-ripening time and high thermal dormancy induction. Clinal genetic differentiation is associated with a climatic gradient. In sites with warm summers and wet winters seeds have long after-ripening times, high thermal dormancy induction and high seasonal germination bias towards spring. Results are discussed in the context of evolution of life histories in annual plants exhibiting life history polymorphisms.

S.13-20-O

The evolution of constitutive immune defence in relation to life-history and parasitism in European birds.

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The constitutive immune system is the first line of defence across vertebrates, but its activity can vary largely among species. We examined the variation in natural antibody and complement activity, and the concentration of leukocytes in relation to life-history traits, ecology and infestation level by parasites of avian species. We predicted that components of the constitutive immune system are more active in species with a prolonged embryonic developmental period, when the first line defence system develops, and in species under high parasite pressure. We quantified circulating antibody concentrations, the activity of the complement system, the concentration of different leukocytes, key life-history traits (body mass, clutch size, incubation period, fledging period), ecological variables (habitat, migratory behaviour, coloniality) and infestation level by blood parasites and the ectoparasitic lice of 89 European free-living bird species of 556 individuals captured during the breeding season. The five components of the constitutive immune system (agglutination, lysis, counts of heterophiles, lymphocytes and total white blood cells) correlated positively and significantly with the body mass and the relative incubation period corrected for the body mass, and, as predicted, the activity and concentration of leukocytes also increased with the intensity of infestation by blood parasites, but not with the parasitism of the ectoparasite lice (Phthiraptera). Furthermore, agglutination and lysis was significantly higher in migratory related to sedentary species. These findings indicate that several components of the constitutive immune system modulate key life-history responses to the environment, and blood parasites play an important role in the evolution of the base-line defence system in European birds.

S.13-21-P

The importance of seed size in the origins of agriculture.

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The evolution of domesticated crops was a crucial stage in the development of agriculture and the earliest evidence of cultivated crops can be dated to 10,000 years BP, with domestication likely occurring independently in many locations. Prior to that there is evidence of substantial exploitation of wild plant species, including crop progenitors and species which never became domesticated. A number of traits are associated with domesticated plants, including larger seed size, loss of germination inhibition and reduction of natural dispersion. Our aim was to characterise the features associated with seed size in wild species, crop progenitors and domesticated species and determine the degree to which these traits co-vary with variation in seed size. The central hypothesis was that seed size correlates with a suite of functional traits (including plant size, seed yield, growth rate) favouring some species as crops over others. Thirty-five species of grasses and legumes were selected comprising wild, progenitor and domesticated species all known to be present in the archaeobotanical record for western Asia at the time of early domestication. Following measurements of seed size, plants were grown in controlled environment facilities and the relative growth rates and specific leaf area of the species were measured. The same 35 species were also grown in a glasshouse study and a number of characteristics were measured including survival, date of flowering, plant height and seed yield. These novel studies will be discussed in the context of the roles of natural selection and human agency in the emergence of agriculture.

S.13-22-P

Contrasting evolution of leaf size and shape in cork oak (*Quercus suber* L).

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Recently, a couple of studies have documented that Moroccan cork oaks present singularly large leaves compared to cork oaks originating from the rest of the distribution range of the species. One of these studies also showed that Moroccan cork oaks presented low additive genetic variance for this and other phenotypic traits. In the present study, we used six nuclear microsatellites and a phenotypic selection approach to investigate the role played by natural selection and neutral evolutionary processes on both the pattern of differentiation and intrapopulation genetic diversity in leaf morphology. For this purpose, 264 phenotypically characterized saplings were genotyped using six nuclear microsatellites. Individuals were originating from 45 maternal lines from contrasting populations from Morocco, Spain and Portugal. We found that genetic differentiation for leaf size far exceeded the molecular differentiation and this trait was under positive directional selection in a dry year by implementing phenotypic and genotypic selection analyses. These results suggest that the exceptional large leaves of Moroccan cork oaks are caused by divergent selection. In contrast, the low population genetic differentiation in leaf shape and the no observation of phenotypic and genotypic selection for this trait suggest that the differences in leaf shape among populations are probably due to neutral evolution. Finally, the genetic differentiation among maternal lines within populations was much higher than that observed among populations. Besides, there was a correlation between maternal-line pairwise distance in molecular markers and phenology suggesting that genetic differentiation among maternal lines within populations is partly maintained by assortative mating.

S.13-23-P

The Colonization History of *Juniperus brevifolia* (Cupressaceae) in the Azores Islands.

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A central aim of island biogeography is to understand the colonization history of species using current distributions, fossil records and genetic diversity. Here, we analysed five plastid DNA regions of the endangered *Juniperus brevifolia* across its distribution range in the Azores archipelago. A time-calibrated phylogeny of the section *Juniperus* suggests a single colonization event from the European continent, which may have taken place as soon as the beginning of island emergence (8.12 Mya). Phylogeographic analyses yielded a high diversity of haplotypes (17) connected in a single network. Several of the most frequent and internal haplotypes of the network are well distributed across the archipelago, which indicate significant differentiation and dispersal. In contrast, restriction of tip haplotypes to single islands denotes limited dispersal in more recent times. Our phylogeographic reconstruction points to the sequence of island emergence as a key factor in the plastid DNA variation observed. The broad ecological range of *J. brevifolia*, together with the wide distribution of several haplotypes, suggests an active dispersal despite the high geographic distances among the island groups (over hundred kilometres in some cases). Reproductive traits of this juniper species, as anemophily and endozoochory, appear to be responsible for recurrent long-distance dispersal, and the habitat homogeneity of the Azores archipelago may have contributed to the successful establishment of propagules after dispersive events.

S.13-24-P

The carbon rhythm hypothesis: reconciling the microbial loop and nutrient immobilization concepts.

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The release of carbonic compounds from plant roots has recently been shown to have diverse effects on soil nutrient cycling. On the one hand, carbon emission has been suggested to increase the amount of available nutrients via the "microbial loop", i.e., increased microbial mineralization followed by protozoa grazing and nutrient liberation. On the other hand, the exudation of carbonic substances from roots has also been suggested to limit nutrient availability for long periods of time due to microbial growth and mineral immobilization. We suggest that these two concepts can be reconciled if the temporal dynamics of carbon exudation are taken into account. We hypothesized that when carbon is emitted continuously it should support a relatively constant microbial community size, which in turn should immobilize nutrients, assisting slow growing plants to compete with fast growers. On the other hand, an intervallic emission is likely to cause community oscillations, liberating nutrients during microbial community crashes, therefore assisting plants to increase their nutrient availability. We conducted a fully factorial experiment manipulating the carbon dynamics, nutrient availability and the soil microbial community in the soil of wheat plants. Carbon was added to the soil in five different temporal dynamics ranging from daily additions to 16 day intervals. All plants received the same amount of total carbon. Plants were grown either with or without nutrient supplementation in sterile or non sterile soil. When grown under low nutrients the microbial community had a negative effect on plant performance regardless of the carbon dynamics. However, when grown under high nutrient availability, the microbial community was beneficial to plant growth only under intervallic carbon dynamics. When Carbon was supplied daily plant performance was reduced, probably due to microbial immobilization of the soil nutrients. These results suggest that carbon dynamics, rather than the sheer amounts of carbon, play an important role in nutrient cycling in the soil and therefore plant performance.

S.13-25-P

Resource allocation to inflorescence structures is highly integrated despite the allocation differences between currencies and sites.

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Although resource partitioning to sexual structures has been extensively discussed from a theoretical point of view, empirical data are actually scarce. In particular, three aspects have been neglected in previous research: (1) how does resource allocation within flowers compare to that of inflorescences functioning as pollination units? (2) Does allocation of biomass reflect allocation of other nutrients such as N or P? (3) Does allocation show integration, as suggested for metric traits of flowers? The integration between allocation to inflorescence structures may shed light on one of the most controversial assumptions of sex allocation theory: the trade-off between female and male sex functions. We assessed the partitioning of resources to inflorescence structures in the monoecious *Tussilago farfara* L. (Asteraceae), a species with rayed heads (inflorescences) functioning as pollination units. We studied allocation to inflorescence structures (scape, receptacle, male flowers, rays and ovaries) in terms of three allocation currencies -dry mass, N, and P- at two sites. Direct cost of inflorescence structures was highly plastic and site dependent, suggesting that different factors influence absolute allocation of resources. However, allocation to inflorescence structures in *T. farfara* was significantly integrated at both sites irrespectively of the currency used. The magnitude of the integration differed widely among sites and currencies, with the maximum possible integration ranging from 2.24-46.75%. We suggest that integrated resource allocation might be the rule because cosexual inflorescences (or flowers) are complex modules composed by interrelated organs that jointly work to attract pollinator and achieve as many mates as possible.

S.13-26-P

Melanin-based and depigmented colouration: testing the 'make-up hypothesis'.

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The uropygial gland is the sole exocrine gland of birds. Its size positively correlates with the amount of preen waxes secreted. Recently, it was proposed that sexual selection may contribute to the variation in gland size among individuals. The 'make-up hypothesis' posits that the value of plumage signals can be enhanced by coating them with costly preen waxes acting as cosmetics, because their application to the plumage may alter the reflectance spectra of the given surface. This hypothesis received support for carotenoid-based colouration. Here, we explored whether this hypothesis can be extended to melanin-based and depigmented white colouration. To this end, we surgically removed the gland of half of pre-moult male house sparrows (*Passer domesticus*), while the rest was kept as controls (sham operation). Post-moult, we measured possible effects on the quality of melanin-based throat patch and depigmented white wing-bar, the investment in plumage maintenance activity and the position in the dominance hierarchy. Our preliminary results show that experimental birds tried to gain preen waxes more often suggesting an increased need for plumage coating, but did not bath, dust or preen more intensely than controls. Operated sparrows with unavailable preen waxes had less blackish throat patch and less whitish wing-bars compared to controls. However, these had not realized in average lower rank of controls in the dominance hierarchy. This argues that measuring the effects of cosmetic substances on plumage colouration should be combined with avian visual perception to drive clearer conclusions.

S.13-27-P

Spatial patterns of module specialization in relation to light distribution across wild olive (*Olea europaea* L.) crowns: A niche construction approach.

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Trees are modular, long-living organisms. Crown development changes the environment experienced by the tree. This environment modification, suspected to be a niche construction process, is expected to involve consequences that are not restricted to ecology, but can affect evolution by modifying sources of natural selection in their environments. To assess whether across-crown light distribution pattern is driven by a niche construction process, it is necessary to confirm that: 1) Light distribution across the crown is heterogeneous, 2) Light extinction through the crown follows a non-gradual pattern, 3) Leaves' light-responsive traits are different in contrasted light environments and 4) Modular specialization optimizes the use of complementary light resources. We have characterized light distribution across wild olive crown using hemispheric photography and remote sensing, and we have measured leaves' light-responsive traits and photosynthetic performance. As expected, light distribution along the crown was not homogeneous. Light interception by outer crown leaves resulted in an abrupt reduction that gave rise to a more homogeneous shade environment. Thus, light variation from outer to inner layers displayed a threshold like pattern. We have detected 2 leaf phenotypes: sun vs. shade leaves, with different photosynthetic performances. This body of evidence confirms the hypotheses that module specialization results in a limited number of phenotypic solutions within an environmental continuum, and enables the use of complementary light resources, suggesting an underlying niche construction process. This work sets the basis for further assessing the presence of feedbacks between modules and the effect of niche construction on fitness at both the individual and module levels.

S.13-28-O

Evolutionary Agroecology - Applying Evolutionary Theory to Plant Production.

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Evolutionary theory can be applied to improve agricultural yields and/or sustainability, an approach we call Evolutionary Agroecology. The basic idea is that plant breeding is unlikely to improve attributes already favored by millions of years of natural selection, whereas there may be unutilized potential in selecting for attributes that increase total crop yield but reduce plants' individual fitness. In other words, plant breeding should be based on group selection. We explore this approach in relation to crop-weed competition, and argue that it should be possible to develop high density cereals that can utilize their initial size advantage over weeds to suppress them much better than under current practices, thus reducing or eliminating the need for chemical or mechanical weed control. We emphasize the role of density in applying group selection to crops: it is competition among individuals that generates the "Tragedy of the Commons", providing opportunities to improve plant production by selecting for attributes that natural selection would not favor. When there is competition for light, natural selection of individuals favors a defensive strategy of "shade avoidance", but a collective, offensive "shading" strategy could increase weed suppression and yield in the high density, high uniformity cropping systems we envision.

S.13-29-O

Weed suppression by cooperative shading.

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Increased crop density and uniformity of spatial distribution can significantly reduce weed growth and increase crop yield under high weed pressure. A dense, grid-like cultivation pattern reduces early intraspecific competition between crop plants and increases competition between crop and weed at a stage when the crop still has a size advantage over weeds. However, certain forms of phenotypic plasticity of the crop plants may reduce the potential for weed suppression and high yield in dense, uniform cultivations. Our hypothesis is that shade avoidance, morphological changes with which plants respond to shading and light reflected by other plants, is a disadvantage to crop plants in dense uniform cultivation systems. Though these responses increase the possibility of survival and reproduction of an individual plant, they do not maximise the yield of the population. These responses allocate more resources to vegetative growth than to seed production, elongated plants have a higher risk of lodging and create canopy gaps through which light can penetrate to the ground and stimulate weed growth. To find genotypes that do not show shade avoidance behaviour we have screened chemically mutated seeds of spring wheat under green shading and selected for non-elongating plants as a potential source of genes that can be introduced into high yielding varieties. By finding cooperatively shading crop ideotypes for crowded, uniform cultivation we hope to contribute to a strategy that reduces the use of herbicides and energy-intensive forms of weed control.

S.14- Functional Ecology

S.14-01-O

On the importance of intraspecific variability for the quantification of functional diversity.

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Functional diversity (FD) is a key facet of biodiversity used to address central questions in ecology. Despite recent methodological advances, FD remains a complex concept and no consensus has been reached either on how to quantify it, or on how it influences ecological processes. Here we define FD as the distribution of trait values within a community. When and how to account for intraspecific trait variability (ITV) when measuring FD remains one of the main current debates. It remains however unclear to what extent accounting for population-level ITV would modify FD quantification and associated conclusions. We address two critical questions: (1) How sensitive are different components of FD to the inclusion of population-level ITV? (2) Does the omission of ITV obscure the understanding of ecological patterns? Using a mixture of empirical data and simulation experiments, we conducted a sensitivity analysis of four commonly used FD indices (community weighted mean traits, functional richness, Rao's quadratic entropy, Petchey and Gaston's FD index) and their relationships with environmental gradients and species richness, by varying both the extent (plasticity or not) and the structure (contingency to environmental gradient due to local adaptation) of population-level ITV. Our results suggest that ITV may strongly alter the quantification of FD and the detection of ecological patterns. Our analysis highlights that (1) species trait values distributions within communities are crucial to the sensitivity to ITV, (2) ITV structure plays a major role in this sensitivity and (3) different indices are not evenly sensitive to ITV, the single-trait FD from Petchey & Gaston (2002) being the most sensitive among the four metrics tested. We conclude that the effects of intraspecific variability in trait values should be more systematically tested before drawing central conclusions on FD, and suggest the use of simulation studies for such sensitivity analyses.

S.14-02-P

Allopatry and niche conservatism in small rodents of the isolated Península de Paraguaná in northern Venezuela.

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We use ecological niche modeling to study the biogeography of small rodents in north-central South America, with special emphasis on the highly isolated Península de Paraguaná. On this peninsula, the small Cerro Santa Ana holds mesic vegetation within a matrix of drier xerophytic vegetation in the surrounding lowlands. Using data from fieldwork, verified museum specimens, and trustworthy literature, we made Maxent ecological niche models of species potential geographic distributions. We did so for the three rodents that inhabit Cerro Santa Ana, to test hypotheses regarding allopatry and niche evolution on the peninsula. Models indicate allopatric conditions between peninsular and "mainland" populations. However, for species that occasionally inhabit gallery forests, models made excluding such localities predict much lower levels of habitat connectivity between peninsular and mainland populations than do models made including them. Models made based on localities from the mainland predict the populations found on Cerro Santa Ana, failing to detect any niche shift under isolation.

S.14-03-P

The importance of nurse plant fitness on the intensity of facilitation along two opposed stress gradients in dry alpine ecosystems.

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Plant-plant interaction studies are likely to use altitudinal gradients as a unidirectional assuming increasing severity at higher altitude. Mountain ranges in dry climates however are rather characterised by two opposite gradients related to altitude regarding temperature and precipitation. We hypothesised that the most favourable growth conditions in such mountain systems are located at intermediate altitudes with relatively mild temperatures and lower drought stress, whereas more stressful conditions are found both at high elevation (cooler) and at low elevation (drier). Such conditions will affect the outcome of plant interactions. We addressed the effects of an endemic cushion plant, *Arenaria tetraquetra* ssp. *amabilis*, in the Sierra Nevada range along its whole altitudinal distribution, analysing its effects on plant diversity and soil conditions. As expected, there were two opposing gradients regarding water availability and temperature. Species richness and plant density peaked at intermediate elevations, where facilitation by the cushion was lowest, and increased levels of facilitation mainly towards high altitudes, with only minor increases in facilitation at low altitudes. The physiological status and morphological development of *Arenaria* were positively related to the intensity of facilitation of *Arenaria*, being highest at high altitudes where the cushion plant showed the best status. These data provide evidence for the generally overlooked importance of the nurse plant fitness on its facilitation effect.

S.14-04-O

Invasive Potential of *Broussonetia papyrifera*: Role of Functional Traits.

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Biological invasion poses serious threats to global biodiversity and also leads to the homogenization of the vegetation. A number of plant species are known to be invasive and are a cause of concern for scientists. *Broussonetia papyrifera* (L.) L'Hér. ex Vent. (Paper mulberry; Moraceae) is a woody invasive tree native to China, but is now spreading very fast in several parts of the world including India. It was introduced to other parts of the world, particularly Europe and America, mainly for paper and as a shade / ornamental tree. However, the tree escaped plantations and acquired invasiveness upon entering the natural areas owing to its quick multiplication through roots. A study was conducted to understand the factors imparting invasiveness to *B. papyrifera* in dry deciduous forest in north India. The study revealed that the tree possesses several superior functional traits such as leaf biomass, specific leaf area and leaf thickness besides ability spread fast, high reproductive potential and allelopathic properties. Some laboratory and pot studies revealed that leaf extracts and residues amended in soil severally retard the germination and growth of the associated plants. The soil collected from the understory of the tree and / amended soils were also rich in putative phytotoxins that provide selective advantage to the tree and retard the growth directly and/or through alterations in available soil nutrients.

S.14-05-P

Comparative ecophysiology of two coastal dune perennial herbs co-occurring along a coast-inland transect.

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Plant species of coastal dune systems grow in very hostile and heterogeneous environments. Soil salinity, sand burial, low nutrient and water availability, are some of the main stress factors affecting dune plants. These factors may vary along relatively short gradients in coastal dune systems. In this study, we aim to determine whether or not conditions changing along coast-inland gradients differentially affect some ecophysiological traits of two common perennial herbs that co-occur in the coastal dunes of Galicia (NW of Spain), *Eryngium maritimum* and *Pancreaticum maritimum*. To this aim, at four different distances from the sea (10, 200, 400 and 600 m) in a coast-inland gradient, we measured a number of morphological and functional plant traits (Specific Leaf Area, Stomatal Density, Chlorophyll and Leaf water content, and several reflectance and chlorophyll fluorescence parameters related with photochemical efficiency). Concurrently with these measurements, we took samples to determine soil properties (pH, salt, water and nutrient content). We found significant differences between species, among positions and even some interactions for many of these traits and properties, showing both species a differentiated behaviour along the transect. Species showed different spatial strategies and exploit and transform the environmental resources in different ways, allowing them to coexist, minimizing the exclusion by competition. Our results will increase our understanding of how these species will respond to the ongoing global changes.

S.14-06-P

Dissecting the modular vegetative-development within the crown of wild olive (*Olea europaea* L.).

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Plants are modular organisms composed by iterative units, or modules, organized in different hierarchical levels. Plant growth, viewed as a modular process, implies both an increase in biomass and the modular spatial-partitioning within the crown. In perennial plants, growth is determined by bud activity. Plant performance therefore depends on the interaction between biomass allocation (biomass is a good indicator of energetic content and therefore of constructional cost of plant structures) and the availability of the buds within the crown. Considering that the population of buds in a modular organism is spatially structured, the dynamics of the vegetative bud population largely rules plant architecture and spatial construction has decisive consequences on temporal plant performance and feedback effects on plant growth. The goals of the present study are to characterize the dynamics of modular vegetative growth over a year and to analyze vegetative expression in three different light environments (high, medium and low) within the tree crown. For this study we randomly chose 20 adult individuals of wild olive with equivalent sizes from a population. We labeled 3 branches (terminal shoots with similar structural characteristics and potential growth) per light environment in each tree, and monitored them periodically. In each labeled branch we recorded morphological and demographical data of modules. We hypothesize that difference in the vegetative growth in contrasted light environments within the crown results from a trade-off between light exploitation and structural costs.

S.14-07-O

Breeding barriers maintain a diploid-hexaploid contact zone in the polyploid *Aster amellus* aggregate.

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Polyploidization has long been proposed as an important mechanism of sympatric speciation. Reproductive isolation between cytotypes is an important step in this process. Despite its importance, only a few studies have addressed breeding barriers between polyploids and their diploid progenitors in the field. In this study we investigated the breeding barriers between diploid and hexaploid individuals of *Aster amellus* to understand the factors involved in cytotypic maintenance and coexistence at the contact zone in Central Europe. Large and small scale spatial distributions were studied at the contact zone and phenological segregation, assortative mating mediated by pollinators and crossing ability were assessed under natural and controlled conditions in diploid and hexaploid populations growing in close proximity. The results revealed low levels of reproductive isolation due to flowering phenology and pollinator behaviour. In contrast, almost complete reproductive isolation was due to a series of post-pollination barriers, such as gametic isolation, low viability of tetraploid seeds and/or seedlings. These barriers significantly reduced the production of offspring from inter-cytotype crosses. We conclude that the absence of tetraploids at the contact zone is due to a combination of several factors, including spatial segregation, strong post-pollination barriers, and to a lesser extent, temporal and behavioural segregation. Future studies should explore the genetic relationships between the cytotypes, origin of the hexaploids and attempt to identify the localities of the missing tetraploid cytotypic. This will allow us to understand the evolution of the hexaploid cytotypic, and help in understanding the pattern of distribution at the contact zone.

S.14-08-P

Variations in sink strength affect size-mediated competition within the crown.

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An individual plant could be seen as the integration of many repeated, semiautonomous structural and functional subunits denominated modules. This structure gives rise to a hierarchy in which investment in reproduction takes place. Within this hierarchy, the modules of the same individual compete one with another for resources. We assessed the level of integration within the crown of a woody perennial plant changing the number of sinks (developing fruits) in branches of the same individual. Changes in reproductive allocation strategies within fruits would reflect the autonomy degree of the modules. We manipulated fruit load applying three treatments: removal of 0%, 25% or 75% of developing fruits in branches of *Cistus ladanifer* plants. Our experiment is a randomized complete block design with individual plants as blocks (24) and 1 replicate of each treatment within each block (72 branches). General linear models were performed using treatment as fixed factor, plant as a random factor and branch diameter as covariate. To analyze biomass allocation between seeds and protective structures within the fruit we used total seed weight as dependent variable and fruit wall weight as additional covariate. We found a significant interaction between treatment and branch diameter for both fruit size and total seed weight suggesting that in intensely thinned plants larger branches were not able to increase fruit size nor decrease seed packing costs. These results suggest that competitive advantage of larger branches were reduced in treated branches because of a decrease in sink strength.

S.14-09-O

Costs and benefits of structural photoprotection in a neotropical legume tree (*Caesalpinia spinosa* (Mol.) Kuntze).

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Photoprotection is a crucial ability that allows plants to live under stressful environments. Plants develop structural and chemical mechanisms of photoprotection to preserve their photosystems from light excess. We studied the photo-protective strategy and its physiological consequences in tara (*Caesalpinia spinosa*), a legume tree endemic of South America, showing the adaptive trait of closing the leaflets under stressful conditions. Tara has a significant ecological and economic value thriving in many different ecosystems from semiarid shrub-lands to agricultural areas and dry or fog forests. Its capacity to cope with dry scenarios can be critical for its survival in areas prone to suffer the direct consequences of global climate change. Seeds from four different locations of a wide latitudinal and ecological range, collected in Peru and Ecuador, were germinated and grown under controlled conditions. One year-old seedlings were exposed to two drought treatments of different intensity. A number of leaflets were forced to remain open, and their response was compared with that of mobile ones. As soil moisture decreased, a quick significant response in midday water potential, stomatal conductance, CO₂ assimilation, predawn chlorophyll fluorescence, chemical photoprotection and growth was observed. Growth and physiological differences due to seed origin were also observed. Although the physiology of plants was significantly affected, they readily recovered upon re-watering, indicating the high tolerance to drought of this species. Immobile leaflets suffered more severe photodamage than mobile ones but the assimilation was unaffected, proving the photo-protective benefits of the leaflet closure for the plant, even by assuming some carbon assimilation costs.

S.14-10-P

Inter-population variation in functional traits of *Fagus sylvatica* L. in response to an experimental water deficit.

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Geographic patterns of intraspecific variation of different functional traits in response to water availability were examined in a glasshouse experiment using seedlings from 6 *Fagus sylvatica* L. populations. Inter-population variation in relative growth, leaf size, specific leaf area (SLA) and %N in leaves were studied. The relative importance of the stomatal and photochemical components in inter-population variation in net assimilation rates (A_n) was addressed as well. Two watering treatments were applied throughout a water stress cycle, with half of the plants maintained well watered (C) and the other half water stressed (WS).. The water deficit cycle involved 4 stages with different water availability ranges for WS plants.. Inter-population variation was found in growth patterns and other functional traits such as leaf nitrogen content, average leaf area and gas exchange variables (net assimilation rate, stomatal conductance and electron transport rate). The sensitivity to water deficit of relative growth and net assimilation rate differed also among populations. In particular, rank reversals between well watered and water deficit conditions were found in net assimilation rates. Electron transport rate had higher relative importance than stomatal conductance to explain the differences observed in net assimilation rates in some populations. We discuss whether the observed inter-population variation might conform to latitudinal patterns of environmental variation or local heterogeneity in water availability.

S.14-11-O

Functional groups of plants in a temperate deciduous forest community: an ecophysiological approach.

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Functional diversity of an oak-hornbeam forest at Bab LITER Site, SW Slovakia, former I.B.P. Forest Research Site, have been studied for many years. The uneven aged, ca 120-years old forest stand is vertically stratified and horizontally heterogeneous with many gaps. Several qualitative and quantitative traits, including eco-physiological ones have been used to distinguished basic functional groups of plants. In the species rich community trophic functional groups or guilds, spatial functional groups and temporal functional groups can be recognized. Two basic functional groups - canopy species (tall trees) and understory species - represent spatial and temporal complementarity for long-term coexistence of the species in one plant community. The eco-physiological approach helps to understand traits and attributes of plants in a phytocoenosis.

S.14-12-P

Potential leaf sun exposure: light interception and functional modules in *Olea europaea* L.

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Outer crown leaves arrangement depends on a trade-off between photoinhibition avoidance and light interception. Steeper leaf angles at the outer crown layers reduce exposure to excess of light at midday and improve day-long carbon gain by emphasizing light interception from low solar angles. At the inner crown layers, shallow angled leaves have greater daily light interception, but self-shading, rather than leaf angle, explains most variance in light capture and potential carbon gain (Falster and Westoby 2003). Three leaf angles; leaf pitch, leaf warp and leaf orientation, allow us to determine the % of leaf area exposed to the sun (Silhouette Area of the Leaf blade, SAL) at any given time during the day or the year. Leaf angles were measured for 120 fully expanded leaves of wild olive (*Olea europaea* L.) in three individuals during one day. Silhouette leaf area was calculated for each leaf during one day at four periods of the year. Our results suggest functional differences between crown layers. They provide evidence of complementary patterns of photosynthetic exploitation both at spatial and temporal level. Module specialization leads to division of labour among tree crown subunits which is one of the subsidiary goals in the frame of our research.

S.14-13-O

Allelopathy in *Quercus pubescens* Oak Forest: impact of chemical leaf compounds of an understory plant species on plant diversity.

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The pubescent oak is an ideal model for studying the evolution and functioning of Mediterranean ecosystems. Particularly sensitive and receptive to climatic change, the pubescent oak is a model for monitoring the Mediterranean area in a changing environment. The study of the dynamics of this ecosystem is particularly interesting, especially the allelopathic mechanisms (through secondary metabolites released in the ecosystem) between dominant species and accompanying species of understory. The potential impact of *Cotinus coggygria*, a dominant plant species in the pubescent oak forest and particularly rich in secondary metabolites, on plant diversity of this forest through allelopathy, and the role of microorganisms in these interactions are studied through *in vitro* bioassays. Germination and growth of six target species, including pubescent oak, were tested according to the concentration of aqueous extracts obtained from green leaves, senescent leaves and leaf litter of *Cotinus*. Moreover, two types of soil were used for the experiment: natural and sterilized soils in order to test the impact of microorganisms in allelopathy process. Preliminary results showed that the different target species have contrasting reactions to *Cotinus* allelochemicals. Green leaves seemed to be the most active and leaf litter the less. However, microorganisms play an important role in the plant-plant interactions by altering the expression of allelochemicals released in the ecosystems.

S.14-14-P

Plant-fungal interactions in semi-arid gypsum plant communities.

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Plants living on gypsum (gypsophytes) represent one of the most diversified sets of edaphic endemic plants in arid regions. However, the factors that control their existence and evolution on such soils are far from being understood. Particularly, the knowledge of plant-fungal interactions and their importance in semi-arid gypsum ecosystems is largely anecdotal. We performed a two-step greenhouse experiment to explore the role of mycorrhizae in seedling establishment and performance in *Helianthemum squamatum*, a genuine Iberian gypsophyte known to establish mycorrhizal symbiosis. First, *H. squamatum* seeds were sown in pots with sterilized (lacking potential mycorrhizal microorganisms) and non-sterilized (control) natural gypsum soils. We recorded germination rates and seedling growth and survival six months after sowing. Secondly, we crossed the treatments, transplanting the seedlings grown in both types of soils into new sterilized and control soils following all possible combinations, and monitored them for 8 more months. Germination rates were similar in sterilized and control soils but average seedling size was significantly higher in control soils (p

S.14-15-P

Species-specific environmental requirements for embryo growth: Implications for selection of regeneration niches in three *Lonicera* (Caprifoliaceae) species.

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We analyzed the influence of main environmental germination-driving factors (i.e., temperature and light) on embryo growth and seed-germination phenology of three *Lonicera* (Caprifoliaceae) species which typically distribute according to an altitudinal gradient in the Iberian Peninsula, occupying overall a wide range of Mediterranean forest habitats. Results showed that *L. xylosteum* fresh seeds were morphological dormant. *L. arborea* seeds had deep complex morphophysiological dormancy. *L. etrusca* showed an unusual intraspecific variability in seed dormancy: morphological, nondeep simple morphophysiological, and deep complex morphophysiological dormancy. Species-specific environmental requirements for seed dormancy break contributed strongly to explain the altitudinal gradient of habitat occupation shown by the three *Lonicera* species studied. Under Mediterranean conditions, deep complex morphophysiological dormancy confines *L. arborea* preferentially to subhumid-summer high-mountain environments. In *L. xylosteum*, a prompt autumn seed germination mediated by morphological dormancy should enhance seedling survival in summer-dry Mediterranean mid-mountains where the species lives. The high seed-dormancy variability detected in *L. etrusca* should increase its plasticity in regeneration niche, as indeed reflected by the contrasting Mediterranean environments where it is able to live. The high correspondence between species requirements to break seed dormancy and the altitudinal range at which each *Lonicera* species lives, suggests morphological and morphophysiological seed dormancy as an important filter in determining regeneration niches of species, since such mechanisms impose markedly specific environmental requirements to the earlier stages of recruitment.

S.14-16-P

Sap flow patterns of coexisting trees in continental Mediterranean ecosystems: distinctive features of species at their distribution limit?

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Species at their distribution limit are expected to have more difficulties in coping with limiting abiotic conditions, such as water in Mediterranean ecosystems, than those not in the border of their geographic ranges. Sap flow measurements allow to characterize water relations at tree level and in the long term, which contrasts with other ecophysiological approaches. Sap flow and meteorological measurements were recorded in dominant tree species of two continental Mediterranean forests, the thermally contrasting and dry Alto Tajo Natural Park and the relatively moist Montejo Beechwood, located at 900-1300 m and 1400 m a.s.l. in Guadalajara and Madrid respectively. Species at their distribution limit were present in both sites: *Pinus nigra* (Alto Tajo) in its xeric limit and *Fagus sylvatica* (Montejo) in its southern limit. Other coexisting species studied are *Quercus ilex* and *Quercus faginea* for the former site, and *Quercus petraea* and *Ilex aquifolium* for the latter. Results showed that the deciduous *F. sylvatica* had the highest daily sap flow during the peak growing season. The evergreen *Q. ilex* had the greatest sap flow rates at Alto Tajo, exceeded only occasionally by *Q. faginea*. Species showed contrasting water strategies: while *Q. ilex* kept significant sap flow all year round, *P. nigra* significantly decreased it at the end of the summer. This decreased water use was also observed in *F. sylvatica* vs. *Q. petraea* at Montejo site. The results are discussed within the context of climate change scenarios, which point to an increased aridity in the region.

S.14-17-O

Hydraulic design of sun and shade leaves of five temperate co-occurring tree species.

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CIFOR, INIA. CIFOR, INIA.

Leaves are a major contributor to plant hydraulic resistance to water flow, further affecting plant productivity. In fact, it has been shown that much leaf diversity implies a modification of its water transport capacity. Particularly, both fast dynamic and designed-structural responses to light environment changes have been recently reported. Leaf hydraulic resistance (R_{leaf}), its dynamic response to light, and its vascular component distribution, were measured by the High Pressure Flowmeter (HPFM) method in sun and shade leaves of five tree species (*Fagus sylvatica* L., *Ilex aquifolium* L., *Prunus avium* L., *Quercus petraea* (Matt.) Liebl. and *Quercus pyrenaica* Willd.) co-occurring in a mixed temperate forest in Central Spain. Differences on the hydraulic organization of leaves were found among species and between growth light environments. While about 65-85% R_{leaf} was removed by the effect of light in leaves of *F. sylvatica* and both *Quercus* species, no response was detected for *I. aquifolium* and *P. avium*. Particularly, the vascular leaf resistance to water flow was much higher ($\geq 75\%$) in *I. aquifolium*, which may in part explain its comparatively relative small tree-size and its absence in the highest canopy level of the forest. The other four species showed more balanced R_{leaf} component distributions (vascular $R_{leaf} \approx 35-65\%$). In addition, although species developing a higher specific leaf area (SLA) showed a higher extra-vascular leaf hydraulic resistance, structural changes promoted by the leaf growth light environment resulted to shift this relation towards lower SLA and higher extra-vascular R_{leaf} figures across species.

S.14-18-P

Plant advertisement: effects in pollinator attraction and plant fitness.

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Plant-pollinator interactions are one of the most important and variable mutualisms in nature, with up to 90% of the flowering plants relying on animal vectors to disperse their pollen and achieve pollination. It is known that both plant attributes and the surrounding environment can influence the interaction between plants and their pollinators and thus, determine the reproductive fitness of the plant. In the present study, we investigated the effects of plant and environmental attributes in insect attraction (insect perspective) and plant reproductive fitness (plant perspective) using *Muscari comosum* (L.) Miller (Hyacinthaceae) as model species. *M. comosum* is a widespread perennial herb that occurs in dry grasslands and cultivated grounds and it is highly polymorphic species from a morphological point of view. It reproduces entirely by sexual means, being a protandrous and xenogamous species with low levels of autogamy due to its floral characteristics. It is pollinated by generalist insects such as bees and flies, with *Anthophora* being one of its main pollinators. The effect of plant attributes such as plant height, number of sexual and sterile flowers, flower and inflorescence size, amount of nectar, and plant environment attributes such as number of flowering neighbours, co-flowering species, presence/absence of grasses, shaded vs. sunny patches in insect attraction and plant reproductive fitness were studied by recording insect visitation rates and seed production. The results are presented and discussed in an integrated approach.

S.14-19-P

Understanding Role of Allelopathy in Interference of *Ageratum conyzoides*.

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Ageratum conyzoides (billy goat weed; Asteraceae) is an alien weed native of tropical America that has spread to various tropical and subtropical countries. In India, it is an aggressive weed in north-western Shivalik hills. It invades open and wastelands, forests, pastures, plantations, where it forms monospecific stands and threatens the native biodiversity and changes trophic structure of biological communities. In agricultural fields, in addition to its severe effects on growth, establishment and productivity of crops, it makes the soil deprived of nutrients. Though a number of factors including growth habitat and reproductive strategies have been considered to be responsible for successful colonization of the weed, yet allelopathy has been speculated to play a major role in imparting invasiveness to it. Therefore, a study was planned to investigate nature and mechanism of *A. conyzoides*. A series of experiments were carried out under laboratory and green house conditions in which the effect of rhizosphere soil and the extracts of above- and below-ground parts of *A. conyzoides* were studied against growth of rice and coffee weed. Rhizosphere soil and aqueous extracts of weed significantly inhibited the emergence and growth of rice and coffee weed. Further, the rhizosphere soil and soils mixed with above- and below-ground parts was estimated for macro- and micronutrients. It was observed that contents of organic carbon, N, P, K, Ca, Mg, Fe, Cu, Mn, and Zn were greater in rhizosphere soil and the soil mixed with below- and above-ground parts compared to control soil. The soils and extracts were found to be rich in phenolics, the water soluble phytotoxins indicating their possible involvement in the growth inhibitory effects. The study concludes that *A. conyzoides* negatively affects the establishment of associated species through chemical-mediated interference.

S.14-20-P

Nitrogen use by woodland species of riparian forest, Sao Paulo, Brazil.

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Municipal Faculty "Professor Franco Montoro", Brazil. Municipal Faculty "Professor Franco Montoro", Brazil. Municipal Faculty "Professor Franco Montoro", Brazil.

We investigated the relations between nitrogen metabolism of three woodland species and inorganic nitrogen availability in the soil of a riparian forest in the northeastern state of São Paulo, Brazil. We tested the hypothesis that pioneer species of the ecological succession (*Cecropia glaziovii* - Embaúba) would be more responsive to nitrate available and would have high nitrate reductase activity in leaves while secondary species (*Inga marginata* - Ingá and *Hymenaea courbaril* - Jatobá) would have less responsiveness and would have lower levels of this enzyme on leaf. We evaluated and tested (ANOVA) and compared (correlation coefficient) nitrate reductase activity of leaf, nitrate content in leaves and nitrate content in xylem sap of each species. We measured nitrate and ammonium content in the soil. The results for *C. glaziovii* showed in the wet period a nitrate content of xylem sap that met the demand of high nitrate reductase activity and were correlated with inorganic nitrogen of soil, showed the good responsiveness of specie to nitrate. In *H. courbaril* was verified a less responsive to nitrate assimilation and high nitrate content in the leaves. The specie *I. marginata* showed an intermediate behavior, which suggests the possibility of nitrogen fixation of atmospheric or assimilation of other nitrogen forms of soil. The ecophysiological behavior of the plants was related to seasonal variation of nitrogen inorganic, indicating that these plants use strategies with different responsiveness to the use of soil nitrogen available.

S.14-21-P

Soil resistance and resilience to fire depend on plant persistence traits in Mediterranean shrublands.

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It is acknowledged that the outcome of plant-plant interactions in semiarid ecosystems depend on the specific traits of species involved and on the biotic and abiotic conditions prevailing in the area. Yet, studies are not conclusive about the role of increasing environmental stress, leading to an ongoing debate on this topic. In two steppe areas in southern Spain (Alicante), we examined the net balance of the interactions between mature *Stipa tenacissima* tussocks and *Olea europaea* seedlings species in response to changes in the abiotic stress level. We planted *O. europaea* seedlings nearby and away from *S. tenacissima* tussocks, and manipulated the availability of two key resources by applying inputs of water and nutrients to the planting microsites. All across the abiotic stress gradient established, the negative effects of *S. tenacissima* on *O. europaea* largely prevailed against the facilitative effects. The results suggest that *S. tenacissima* tussocks outcompeted *O. europaea* in exploiting the water and nutrient inputs provided.

S.14-22-P

The importance of pollinator specialization and abundance for the reproductive success of *Opuntia sulphurea* (Cactaceae).

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The degree of specialization and abundance of pollinators can influence their effect on the reproductive success of plants. We studied a generalist plant, *Opuntia sulphurea* (Cactaceae), and evaluated whether the effect per visit of pollinators is determined by their specialization degree, and whether the total, population-level effect is determined by their specialization degree or their abundance. The per-visit effect was evaluated using path analysis based on the number of pollen grains deposited, pollen tubes germinated, and seeds produced per visit for each pollinator species. Total effect (T), the product of the per visit effect (P) and the number of visits (I), was evaluated using path analysis for four alternative models. My results suggest that the per-visit effect is not determined by the specialization degree of pollinators, and that pollinator abundance is more important to determine the pollinator's total effect on the reproductive success of the plants. These results suggest that pollinator abundance is a good indicator of the pollinator's effect on the reproductive success of the plants that they visit.

S.14-23-P

Seed recovery and germination of three Mediterranean shrub species fed to game quail (*Coturnix coturnix*).

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The incorporation of an animal-dispersed plant species into the diet of native frugivores can be an important step to that species can be dispersal in abandoned areas. Six female game quail of similar size and age were fed with seeds of three common Mediterranean shrub species (*Myrtus communis*, *Pistacia lentiscus* and *Corema album*), which were retrieved from the dung along 36 hours after ingestion. The seeds retrieved were tested for germination and viability along with seeds not eaten by the game quail. Between 30-50 % of the seeds eaten were retrieved from the dung, with significant differences between species. The major part of the seeds was retrieved between 12 and 24 h after ingestion in all species. The passage through the goat's gut significantly increased seed germination only in *Corema album*, and depressed it in *M. communis* and *Pistacia lentiscus*. Viability was significantly lower in the eaten seeds of *Myrtus communis* and *Pistacia lentiscus* than in the non eaten ones, and no differences were found in *Corema album*.

S.14-24-P

A phylogenetic survey of the protection capacity against ultraviolet radiation in bryophytes.

Monforte López, Laura. Fabón, Gabriel. Tomás, Rafael. Martínez-Abaigar, Javier. Núñez-Olivera, Encarnación.

Universidad de La Rioja. Universidad de La Rioja. Universidad de La Rioja. Universidad de La Rioja. Universidad de La Rioja.

L. Monforte, G. Fabón, R. Tomás, J. Martínez-Abaigar & E. Núñez-Olivera Universidad de La Rioja, Edificio Científico-Tecnológico, Avda. Madre de Dios 51, 26006 Logroño (La Rioja), Spain Ultraviolet (UV) radiation is a significant abiotic factor that elicits the development of diverse acclimation and protection mechanisms in organisms, influencing their morphology and physiology. In addition, the environmental problem of stratospheric ozone reduction has strongly promoted the study of UV effects on different organisms. UV effects have been abundantly studied in crop plants and marine phytoplankton and macroalgae, but bryophytes have received less attention. Given the structural limitations of bryophytes, that lack hairs and epidermis in their leaves, their main protection system against UV may be the accumulation of protecting UV-absorbing compounds (UVAC). UVAC levels, that indicate the global protection capacity against UV radiation, were analyzed by spectrophotometry after methanol extraction in 90 bryophyte species including 75% of the Orders of mosses and liverworts. We analyzed not only the soluble fraction of the plant extracts, but also the insoluble one. The former corresponds to the compounds located mainly in the vacuole, whereas the latter includes the cell wall-bound compounds. This differentiation may be important because each fraction may house different compounds and may play a different role in UV protection, given that the cell wall-bound compounds would provide a more spatially uniform UV screen for the cell contents than the intracellular compounds. In general, liverworts showed higher levels of UVAC in the soluble than in the insoluble fraction, whereas mosses showed rather the contrary. Thus, liverworts and mosses may follow different protection mechanisms against UV, which would support the hypothesis that the two main evolutionary lineages within bryophytes are more phylogenetically different than thought before. These findings can be important because liverworts were the earliest diverging land plants, and they had to acclimate to an environment enriched in UV radiation. Apparently, mosses and liverworts followed different acclimation mechanisms to UV, which may have influenced the environments they were able to colonize (in general, drier and more sun-exposed sites in the case of mosses than in liverworts).

S.14-25-P

Plant-plant interactions in semiarid steppes as a function of resource availability.

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University of Alicante. University of Alicante. University of Alicante.

It is acknowledged that the outcome of plant-plant interactions in semiarid ecosystems depend on the specific traits of species involved and on the biotic and abiotic conditions prevailing in the area. Yet, studies are not conclusive about the role of increasing environmental stress, leading to an ongoing debate on this topic. In two steppe areas in southern Spain (Alicante), we examined the net balance of the interactions between mature *Stipa tenacissima* tussocks and *Olea europaea* seedlings species in response to changes in the abiotic stress level. We planted *O. europaea* seedlings nearby and away from *S. tenacissima* tussocks, and manipulated the availability of two key resources by applying inputs of water and nutrients to the planting microsites. All across the abiotic stress gradient established, the negative effects of *S. tenacissima* on *O. europaea* largely prevailed against the facilitative effects. The results suggest that *S. tenacissima* tussocks outcompeted *O. europaea* in exploiting the water and nutrient inputs provided.

S.14-26-P

Nectar robbing: a key component in the current interaction between a Tertiary relict plant and their floral visitors.

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Several plant species are exploited by nectarivorous animals, which in many cases evade the morphological restrictions imposed by flowers. This phenomenon is defined as nectar robbing when animals pierce the corolla or use an already existing perforation in order to access directly to the nectar. The consequences for plant reproduction are very diverse and are related with the reproductive system and morphology of the flowers, morphology and behaviour of robbers, and subsequent changes of pollinators' behaviour. In this study, we quantified the levels of nectar robbing at three populations along 12 years in a Tertiary relict plant, *Petrocoptis grandiflora*, and assessed the effect of nectar robbing on seed set (female fitness) and on distance of pollen dispersion (male fitness). *Xylocopa violacea*, *Bombus terrestris* and *B. jonellus* were recorded as the main nectar robbers. Robbing levels between populations were similar, despite the significant differences observed along years. Particularly low insect abundances and low foraging activity of the main nectar robbers occurred in years with strong climate changes during spring. Surprisingly, nectar robbing enhanced plant fitness affecting positively both fruit set and distance of pollen dispersion. In this plant species, nectar robbers contribute directly to pollination by contacting the body with the flower sexual structures during the visit. Robbing also could affect indirectly the reproductive success of this plant species through a reduction of nectar standing crop which promotes an increasing of flying distances for legitimate visitors.

S.14-27-P

Latitudinal pattern in rodent's metabolic flexibility.

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Macrophysiology is defined as the study of variation in physiological traits -including physiological trait flexibility- over large geographical and temporal scales, and the ecological implications of this variation. A classic example of a macrophysiological trend is the one emerging from the climatic variability hypothesis (CVH). This hypothesis states that, as the range of climatic fluctuation experienced by terrestrial animals increases with latitude, individuals at higher latitudes require broader tolerance ranges (i.e., should be more plastic) than individuals inhabiting lower latitudes. Within this context, we evaluate the correlation between metabolic flexibility (taken as the absolute metabolic scope, i.e., maximum metabolic rate minus basal metabolic rate) and different geographic and climatic variables (e.g., latitude, altitude, rainfall, temperature) for 48 rodent species. Both conventional and phylogenetically informed analyses indicated a positive correlation between metabolic flexibility and geographic latitude, and a negative correlation between the former variable and minimum environmental temperature at the collection site. Taken together the findings of the present study with those of rodent digestive flexibility, it appears that organisms' ability to regulate the flux of energy and materials through them is positively correlated with latitude. Moreover, given the central role of digestive and metabolic traits in organism functioning, and the fact that phenotypic flexibility at one hierarchical level can comprise the mechanistic basis for flexibility at other levels, the pattern depicted here could imply an increase in flexibility with latitude for many other phenotypic traits. If this is the case, less amount of phenotypic flexibility is expected where more species live, that is, in the tropical areas of the globe.

S.14-28-P

Seed and seedling traits of Australian alpine species in a climate change context.

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Successful plant reproduction via seed is closely associated with the seasonal timing of germination, influenced most significantly by temperature, soil moisture and light. Timing of germination dictates a seedling's seasonal experience and thus has strong fitness consequences. Physiological dormancy mechanisms are one way seeds control the timing of germination, often postponing germination until a time when the emerging seedling has optimum chances of survival, despite dispersal into pseudo-favourable conditions. We investigated the germination strategies of more than 20 Australian tall alpine herb field species, spanning 11 families. Further we examined the composition of the soil seed bank and the prevalence of dormancy in those species. Here we present the evident range of germination phenologies throughout Australian alpine flora, in relation to plant and seed traits, and discuss the potential consequences of a warmer, drier future climate on the optimisation of seedling establishment in the Alps. Determining when seeds will germinate in the field contributes to our understanding of fundamental processes of population establishment, range expansion and geographic spread in order to estimate the resilience of plant and plant communities to future climate scenarios.

S.14-29-P

Testing methods for rapid assessment of functional plant community composition in a *Quercus ilex* L. montado in the southwest of Portugal.

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Plant species richness and abundance measurements are demanding on resources, requiring time-consuming methods and botanical expertise. Furthermore, the appropriateness of sampling designs to obtain plot-level estimates depends on the purpose of the study (e.g. Lavorel et al 2007), as well as on the type of plant community considered (e.g. Baraloto et al 2010). In the present study our aims were to (i) define an adequate sampling effort based on a species sampling relationship and (ii) test different sampling methods to assess the composition of herbaceous and shrub plant community in a *Quercus ilex* montado in the southwest of Portugal, considering their outputs, manpower and time needed, to evaluate their cost-effectiveness. We tested alternative plot-level methods comprising linear vegetation point transects and nested quadrats placed randomly and systematically and frequency and cover estimations to measure plant species richness, composition and functional diversity. The results obtained allowed us to find an appropriate tool for monitoring this type of habitats, and can be applied in studies focused on ecosystem changes in response to environmental conditions. Acknowledgments to DesertWarning (PTDC/AAC-CLI/104913/2008). Key words: methodology, plant functional diversity; cost-effective assessment; *Quercus ilex* montado.

S.14-30-O

Defoliation by the pine processionary moth (*Thaumetopoea pityocampa*,) does not lead to carbon limitation in trees.

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The pine processionary moth, *Thaumetopoea pityocampa* (Lepidoptera), is a severe pest affecting pine forests in the Circunmediterranean. Canopy defoliation of pine trees has been related to depletion in carbon reserves with potential consequences for tree growth and survival. Here, we assess the long- and short-term impact of defoliation by *T. pityocampa* on the carbohydrate stores of adult *Pinus nigra* trees. Long-term effects were analysed by a 13-year-long experiment with three different intensities of defoliation (severe, intermediate and absent) induced by manipulating the amount of caterpillar nests in the crown. Treatment effects on growth and survival were monitored throughout the experiment, while effects on the non-structural carbohydrate (NSC) stores of trees were analysed on the third year after the completion of treatments. Short-term effects were evaluated by analysing the differences in growth, NSC stores and recovery ability of pine trees subjected to various degrees of defoliation in a natural *T. pityocampa* outbreak during winter 2010-2011. Preliminary results indicate that a high frequency of severe defoliations caused radial growth decline in the long-term. However, repeatedly defoliated trees not only recovered their NSC stores soon after the completion of treatments but showed increased NSC concentrations in their stems than control non-defoliated trees. These results indicate trees were able to over-compensate carbon losses through defoliation, adding evidence to the view that growth decline in defoliated trees is not caused by carbon starvation.

S.14-31-O

The role of hydraulic lift on seedling establishment under a nurse plant species in a semi-arid environment.

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Hydraulic lift (HL) has been shown to improve performance of species occurring next to a plant engaged in HL, but whether this process plays an important role in seedling survival and growth in arid environments remains mostly unknown. Here, we tested the influence of HL on the interaction between *Retama sphaerocarpa*, a nurse lifter shrub from western Mediterranean basin, and the protégé shrub *Marrubium vulgare*. Seedlings of *Marrubium* were planted under the canopy of *Retama* in three types of tubes buried into the soil. Tubes either did not affect (Mesh), reduced (Net) or fully prevented root competition (PVC). At the same time, these tubes allowed (Mesh, Net) or prevented (PVC) the flux of soil water to/from the tube. Additional seedlings were planted in mesh tubes in gaps (open spaces between shrubs). Hydraulic lift was measured using soil psychrometers. We detected HL patterns only in mesh and net tubes but not in solid-walled PVC tubes. Seedling survival was comparable where root competition was reduced and HL allowed (Net) and where these were fully prevented (PVC). Survival was 23% lower in mesh tubes (full root competition and HL) and no seedlings survived in gaps. Differences in seedling biomass showed a similar pattern, although biomass was greatest in tubes where root interactions were prevented (PVC), followed by the treatment where root competition was reduced and HL allowed (Net). These results show that, although HL might have contributed to seedling performance under the canopy of *Retama*, it did not counterbalance root competition by neighbouring roots. When full root interactions occurred, their competitive effects were stronger than facilitative effects of HL. Overall, intense root competition underneath nurse plants may outweigh the positive effects of the extra water source meant by HL. Microclimate amelioration and increased soil fertility under shrubs could also contribute to the reported facilitation of *Marrubium* seedlings under *Retama*.

Approche écophysiological des mécanismes impliqués dans l'expression des défenses induites chez la grenouille rousse (*Rana temporaria*).

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Comprendre comment les organismes répondent à des variations environnementales reste un challenge majeur de l'écologie évolutive. Plusieurs approches selon le niveau d'atteinte biologique peuvent être envisagées pour estimer la réponse des organismes face à des événements stressants. La plus classique, est une approche quantitative basée sur l'analyse de la variation de certains traits (survie, croissance). Elle permet d'appréhender l'impact de la variation environnementale et d'estimer indirectement un coût énergétique de la réponse et en conséquence une réduction de la fitness des individus. Plus intégrative et originale, l'étude des mécanismes endocrines et physiologiques est une nouvelle voie pour comprendre les processus sous-jacents aux compromis évolutifs. Chez les vertébrés, se focaliser sur les hormones glucocorticostéroïdes est judicieux pour examiner la relation entre stress environnemental, réponses biologiques et survie. Ces hormones sont d'importants médiateurs de l'allostase et des réponses aux stress tout au long de la vie. La mitochondrie, centrale énergétique cellulaire, est une cible importante des hormones de stress. Dans cet organite, il existe un compromis entre efficacité de synthèse d'énergie favorisant la croissance, la reproduction et le maintien, et production de radicaux libres au détriment de ces performances. Ce compromis apparaît comme l'élément clé entre effet d'un stress environnemental, conséquences hormonales, impact sur le rendement énergétique, dérèglement de la balance oxydative, et conséquences sur les compromis évolutifs entre les traits d'histoire de vie. Les amphibiens répondent de manière flexible et adaptative aux changements de l'environnement en modifiant leurs traits d'histoire de vie, leur morphologie ou leur physiologie au cours de leur développement, et constituent ainsi de bons modèles. Ces modifications survenant pendant la phase larvaire peuvent sanctionner la qualité de la métamorphose puis la fitness des phases juvéniles ou adultes. Nous avons utilisé chez la grenouille rousse (*Rana temporaria*) un facteur environnemental fortement variable en milieu aquatique, la présence de prédateurs. Il est reconnu qu'en présence de prédateurs, les larves développent des défenses induites. La mise en place de ce phénotype adaptatif est cependant coûteux ; les têtards induits présentent alors une croissance réduite et un développement ralenti associé à une consommation d'oxygène diminuée. Afin de mieux comprendre les mécanismes sous-jacents à l'expression des défenses induites et les compromis qu'elles imposent, nous avons exploré les réponses physiologiques impliquées dans cette réponse adaptative. Un stress environnemental entraînerait des modifications du métabolisme via des changements dans le fonctionnement mitochondrial impactant à la fois sur la balance oxydative mais également sur l'énergie cellulaire disponible.

S.14-33-O

Functional diversity of island parasitoid communities worldwide.

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Islands are natural laboratories for the study of evolutionary and ecological processes due to their discrete and isolated nature. When compared to the mainland, island biotas tend to be species-poor, usually with the absence of entire ecological groups such as predators, parasitoids or pathogens. As a consequence interspecific competition is thought to be relaxed and the ecological space is often not fully saturated. Parasitoids are insects that develop to adulthood by feeding on the body of an arthropod host, eventually killing it. They are a key component of most terrestrial ecosystems, as they are fundamental for the maintenance of the diversity of other animals and plants, being involved in a vast number of trophic interactions and having a regulatory effect on other arthropod populations. Here we investigate the patterns on functional diversity of island parasitoid communities worldwide. We use different morphological and ecological traits (body size, wing length, ovipositor size, development mode, attack strategy and host range) of two parasitoid families (Braconidae and Ichneumonidae) to assess whether: (i) observed functional diversity of island communities is different from what would be expected by chance; and (ii) functional diversity shows the same relationship with island area as species richness does.

S.14-34-P

Study of intra and interpopulational variability of the compounds derived from secondary metabolism of *Cistus ladanifer*.

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Phenotypic variation quantified by the variation in the production of compounds derived from secondary metabolism is very important in the ecology and evolution of plants, contributing to the ability of a species to survive in heterogeneous environmental conditions, and represent an opportunity for species increase its range. In previous studies, phenolic compounds, specifically aglycone flavonoids and diterpenes in the leaf and stem exudate of *Cistus ladanifer* were demonstrated to play an ecophysiological role. They protect against ultraviolet radiation, have antiherbivore activity, and are allelopathic agents. Their synthesis in the plant was also found to vary quantitatively and qualitatively in response to various environmental factors including photoperiod, ultraviolet light, temperature, and water stress. In view of these findings, the present work was designed to clarify whether there also exist variations due to genetic factors, i.e., whether within a single population there are differences among individuals subject to the same environmental conditions; and/o due to environmental factors, i.e., between different populations with different environmental conditions. This would help to quantify the species response to possible environmental changes. The results of this study showed that significant differences exist between individuals within a population and significant differences between individuals of different populations, with a greater interpopulation variation than the intrapopulation variation. This would indicate that this specie has genetic variability among individuals and a high plastic potential which would characterize as a generalist.

S.14-35-O

Functional ecology of aboveground-belowground multitrophic interactions under global climate warming.

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Aboveground-belowground interactions play a key role in maintaining biodiversity, ecosystem processes and ecosystem services. Global climate warming can influence aboveground-belowground interactions in a number of ways, varying from changing the phenology of locally interacting species to altering the pool of interacting species due to local species loss or species gains. These altered interactions can have a variety of influences on community composition ranging from species going extinct to species becoming invasive. I will discuss these various options from a combined theoretical-empirical perspective, and I will conclude with outlining possible consequences of current rapid climate warming for biodiversity and ecosystem functioning in a changing world.

S.15- Synthesizing community ecology, phylogenetics and macroecology

S.15-01-O

Elevational richness gradients caused by directional ecological filtering.

Alexander, Jake. MIREN consortium.

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It is notoriously difficult to dissect the relative importance of contemporary ecological factors (e.g. environmental variation, dispersal) and historical evolutionary processes (e.g. differential speciation, extinction) as causes of large-scale species richness gradients. Non-native species differ from native species in that they have been assembled from an ecologically diverse pool of species over, at most, a few hundred years, so their richness gradients can have only ecological causes. In a study conducted in eight mountain regions around the world, we investigated non-native plant richness along elevational gradients. Richness consistently declined from a peak in the lowest third of the gradient, irrespective of the elevational extent and other environmental differences among regions. In all regions, this decline was due to a loss of species with narrow elevational ranges, so that the species found at the highest elevations were those with the widest elevational ranges that were also found at low elevation. This can be explained by the spread of species from sources of introduction at low elevation, a process we call directional ecological filtering. Aside from explaining elevational richness gradients of non-native species, our data suggest that similar dispersal processes have been important for the establishment of some biogeographical patterns in native species.

S.15-02-P

Climate niches through phylogeny.

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The modeled environmental niche of a species varies in time and space (Holt 2003). It is not clear, however, how niches developed through evolution nor whether and to which extent climatic niches can change rapidly in the face of climate change. This project will analyze the realized climate niche positions of all terrestrial mammals in a phylogenetic context. The poster I would like to present will contain plots describing climate niches occupied by terrestrial mammals. By looking at climate niche plots of different groups, and the orders, families and species within them, it will be possible to see how the climate niche changed through phylogeny. Our analyses show that in some groups lineages pursued different climate niches already very early in their evolution.

S.15-03-P

How do individual species perceive the phylogenetic structure of the community.

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One of the prevalent issues in ecology is elucidating which are the ecological and evolutionary processes that generate and maintain the patterns of species diversity in rich communities. The recent development of methods to quantify the phylogenetic relatedness of co-occurring species has allowed new insights into the forces that structure and assemble rich communities (e.g. abiotic filtering vs. competitive exclusion vs. limited dispersal, etc). Although an individualistic concept of communities pervades current community ecological theory, the phylogenetic structure of ecological communities has not been analyzed from the point of view of individual species. Here, we describe several spatial statistics to measure local scale-dependent phylogenetic structures. The individual phylogenetic species variability (IPSV) measures the expected phylogenetic relatedness in circular neighborhoods of variable radius around the individuals of a focal species. In the same neighborhoods we measure the expected individual phylogenetic species richness (IPSR). We use IPSV and IPSR to investigate whether and at which spatial scales individual species affect or respond to local phylogenetic diversity. Our analysis of three forest dynamic plots (Barro Colorado, Cocoli and Sherman) reveals differences on the amount of species associated to higher or lower local phylogenetic diversity both among the forest and among habitats within the forests (e.g. "accumulators" of phylogenetic diversity predominate in Barro Colorado, "repellers" in Sherman and "neutral" species in Cocoli). On the contrary, when evaluating the effect of big trees on the local community of small ones most species behaved neutrally in the tree forests. This confirms that both IPSV and IPSR can be effective tools to detect hidden spatial patterns in diversity and can contribute to a better understanding of community assembly.

S.15-04-O

Predicting the large-scale consequences of tree phylogenetic diversity for disease dynamics, tree death, Carbon loss and maybe, just maybe, even fire.

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Globally, pest insects account for millions, perhaps billions, of tree deaths. In many regions, tree deaths from pest insects are sufficiently great to lead to regionally significant changes in Carbon budgets (with Carbon flux being triggered by tree death). To date, there is no global predictive model to account for the extent of Carbon flux due to pest insects. Here we suggest a relatively simple model linking the preference of pests (and its phylogenetic basis), tree phylogenetic diversity and carbon flux. This model accounts for observed patterns of Carbon flux in at least two case examples in North America and suggests new avenues for empirical research, particularly with regard to the evolution of host preference in pests.

S.15-05-O

Global comparison of diversification rates and biogeographic patterns across passerine birds.

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Net diversification rates inferred from molecular phylogenies are often declining over time, which is usually interpreted as evidence for initial rapid radiation with filling of ecological niche space. Here, we investigate diversification patterns through time across more than 30 passerine bird groups, with a particular focus on island radiations. To provide independent indications of niche filling, we link these results from diversification analyses to biogeographic patterns, such as species range-size frequency distributions and species richness within grid cells. Given time, radiations on continents or large islands (e.g., the birds-of-paradise on New Guinea or the vangas on Madagascar) should reach a diversity limit through ecological processes, such as competition for limited resources. These groups should then show declining diversification rates in conjunction with smaller species ranges and higher range overlap between species. We propose that geologically dynamic archipelagos (such as in the Indo-Pacific) in combination with high dispersal and colonization abilities of the species have sustained high speciation rates for some bird groups, which do not show declines in net diversification rates and have large species ranges and low range overlap (e.g., orioles, whistlers, and cuckoo-shrikes). Our large comparative analysis therefore adds a new dimension, i.e. the consideration of geographical contexts of diversification, to the growing body of literature showing declining diversification rates across multiple taxa.

S.15-06-P

How community phylogenetic structure can inform us about the invasion rules?

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Invasive species are one of the major threats for biodiversity, and identifying what drives their distributions is therefore of first importance. Recently, renewed interest in two seemingly contradictory hypotheses initially proposed by Darwin to explain invasions has opened new horizons at the frontier between ecological and evolutionary processes. High similarity between an invader and native species could either promote naturalization because of appropriate niche-adaptation, or hamper naturalization because of negative interactions with native species. Niche overlap between an invader and natives species can be quantified through metrics based on functional or phylogenetic distances among species and then tested with an appropriate null hypothesis. However, as shown by Hardy (2008), different metrics and null models have different implicit assumptions that test different ecological questions. Interestingly, in the context of invasion ecology, to date no study has clarified which question can be addressed with which adequate test. To approach this issue, we first build virtual communities (from a species pool with simulated phylogenetic and functional relationships) and simulate their invasion with known assembly rules (habitat filtering and/or species sorting). Then we compute the usual distance metrics and explore their significance against a broad set of null models. Finally, we propose a list of relevant metrics and null model, describe the assumptions they test, and show how combining conclusions from several null model can help to the answer to fundamental ecological questions.

S.15-07-P

Phylogenetic structure of annual plant communities along spatial, temporal and experimental aridity gradients.

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Postdoctoral Researcher. Postdoctoral Researcher. Professor Dr..

The phylogenetic structure of communities has received increased attention the last years. Getting to know the relatedness of species within a community and how it changes under changing conditions gives information about the processes leading to its assemblage. There is a lack of studies dealing with the phylogenetic structure of annual plant communities and also of studies dealing with changes of phylogenetic structure along aridity gradients. Moreover, there is a lack of knowledge on how phylogenetic structure of annual plant communities varies under experimental stress gradients, such as rainfall manipulations, compared to aridity gradients. We studied the species composition and abundance in annual plant-dominated communities during 8 years along an aridity gradient in the Middle East. Added to this, we studied the same parameters in field stations under experimental rainfall manipulations. We will explore and discuss the variability in the phylogenetic structure of communities along the considered spatial, temporal and experimental aridity gradients.

S.15-08-O

Taxonomic, phylogenetic and functional diversity in South American hummingbirds.

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Evaluating the relative importance of ecological, evolutionary and biogeographic processes in the generation and maintenance of biological diversity remains a fundamental challenge in biodiversity science. To date, most studies have focused on taxonomic diversity and have paid relatively little attention to other dimensions of biological diversity, such as phylogenetic (or genetic) and functional diversity. As a result, biodiversity scientists know relatively little about how these three dimensions (taxonomic, phylogenetic and functional) relate to each other and which ecological and evolutionary processes influence variation among the dimensions. We compare taxonomic, phylogenetic and functional beta-diversity in hummingbirds across strong environmental gradients and varying degrees of isolation in northern South American hummingbirds. Through this comparison we evaluate how different mechanisms, including dispersal limitation via geographic barriers, conservatism of functional traits and rapid radiation of lineages, might influence contemporary patterns of diversity. Our results indicate new insight can be gained about the mechanisms influencing diversity patterns by comparing different dimensions of diversity.

S.15-09-O

Effects of glaciations on the species, phylogenetic and functional diversity of European mammals.

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Past and ongoing climatic changes are thought to determine current geographic patterns of diversity through their effects on the evolution of regional communities and the distribution of their species. While the associations between current climate, climate changes and species diversity have been extensively studied, their effects on spatial patterns of phylogenetic and functional diversity are still poorly known. This is in spite of the arguably large impacts that glaciations may have had on the evolution of regional biotas, as well as on the selection of several lineages and/or morphological and life history traits during the assembly of communities through time. Here we study how the phylogenetic and functional diversity of European mammals are related to the past impacts of glaciations and/or to current climatic gradients. To do this, we use a hierarchical protocol to investigate how the associations between Pleistocene climatic changes and current patterns of phylogenetic diversity depart from those of species richness, and then how the patterns of functional diversity depart from those of phylogenetic diversity. More explicitly, we evaluate two hypotheses, based on current knowledge on the determinants of European diversity: (i) The areas most affected by glaciations, in the north, will harbor phylogenetically clustered assemblages due to the importance of phylogenetically conserved climate adaptations and/or traits related to the ability to colonize the north. In contrast, the areas that remained largely stable during the glaciations, in the south, will host phylogenetically overdispersed assemblages. (ii) Non-phylogenetically-structured variations in functional diversity will also differ between glaciated and non-glaciated areas. Northern assemblages will show a trend towards functional redundancy (due to the selection of traits related to the ability to colonize or persist in these areas), whereas functional overdispersion will be more common in southern assemblages, due to the longer time for coevolution (and thus character displacement) of the species inhabiting these areas.

S.15-10-O

Incorporating biotic interactions into models of species richness gradients.

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Species richness gradients are fundamental patterns in ecology exemplified by the multitude of diverse hypotheses offered in explanation. One of these, the mid-domain effect (MDE), suggests that the classic hump-shaped species richness gradient can arise as a result of geometric constraints in the absence of abiotic or biotic drivers. However, stochastic colonization-extinction models have been used to argue that mid-domain effects do not arise in homogeneous environments. Like many alternative hypotheses, mid-domain explanations have assumed biotic interactions are not important determinants of species richness gradients. This is despite evidence that biotic interactions are capable of setting distributional boundaries for geographic species' ranges, which are the fundamental components of species richness gradients. Therefore, here we examine the potential for biotic interactions to mediate species richness gradients that arise in an environmentally homogeneous domain. We developed a process-based model in which the probability of colonization and extinction within a homogenous one-dimensional gridded domain may be functions of standing species diversity, approximating the operation of diffuse competition. These relationships were adapted from those used in the theory of island biogeography. Our results indicate that, in the absence of species interactions, mid-domain effects can arise, but only under extremely restrictive sets of colonization and extinction rates that are unlikely to be realistic. The incorporation of diversity-dependent colonization and extinction rates can produce species-richness gradients that are more peaked than under the independent-species assumption; however, it is unlikely that interspecific interactions alone can produce species richness gradients as pronounced as those suggested by randomization algorithms.

S.15-11-O

Phylogeny, ecology, and origins of climate-richness relationships at regional and local scales.

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A fundamental challenge in ecology is to explain why species richness varies among regional and local communities. Many studies show that species richness is correlated with climate. However, the causes of these climate-diversity relationships are poorly understood because many studies do not make linkages between climate and the processes that directly change species numbers in a community or region (speciation, extinction, dispersal). Using the world's lungless salamanders as an example, I will illustrate why phylogeny is critical to explaining climate-diversity relationships, not only at regional scales, but also at local scales where phylogenetic history is typically thought to be unimportant.

S.15-12-O

Bird communities' responses to global changes : a multifaceted approach.

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Both ecological and evolutionary factors drive changes in the composition of species assemblages at different spatial and temporal scales. During the last decade, community ecology has increasingly developed concepts and methods allowing the integration of functional and evolutionary processes to community ecology and macroecology. However, the ecological and evolutionary mechanisms shaping changes in communities' composition have mainly been studied in space. Here, we provide the first study, as far as we know, on the temporal dynamics of taxonomic, phylogenetic and functional components of diversity at large scale. We used a large-scale dataset on the composition of bird communities: the French breeding bird survey. This standardized protocol has recorded breeding bird species abundance in France since 1989 in more than 1800 plots. We measured several aspects of diversity including functional and evolutionary diversity as well as community specialization. We further compared the temporal trends in biodiversity components in order to highlight ecological processes driving species assemblage reorganization. We obtained the temporal trends of taxonomic, phylogenetic and functional diversities since 1989. We found that while taxonomic diversity is increasing, the functional and phylogenetic turnover among sites (beta-diversity) is decreasing suggesting strong effects of habitat filtering on bird communities induced by global changes. Our results suggest a functional and phylogenetic homogenization of communities over time and underline the importance of adopting a more integrative approach in conservation biogeography. Our study proposes a practical and theoretical framework to assess the spatial and temporal trends of several facets of biodiversity for any taxonomic group.

S.15-13-O

Beyond patterns - from diversity indices to community assembly processes.

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In driving the assembly of communities the interplay between ecological and evolutionary processes has bequeathed macro-ecological patterns of phylogenetic diversity. Many ecologists have met the challenge to explore these patterns, to compare them with those theoretically expected under different community assembly processes and finally to draw conclusions on coexistence mechanisms, niche filtering, dispersal and niche evolution. However, their conclusions differ greatly and few if any general patterns have been identified, even when similar ecological systems were studied. One key problem is method uncertainty. Here we present two approaches that help to forward the study of diversity patterns with null model testing for identifying significant deviations from random expectations. First, we utilize a spatial explicit and individual based model to simulate virtual plant communities under different assembly processes. These virtual data highlight that disentangling assembly processes from observed diversity patterns is only possible if we combine diversity indices at multiple spatial scales and preferably also synthesise phylogenetic, functional and taxonomic information. Second, we explore phylogenetic diversity patterns of plant communities in the Alps and contrast multiple ways to constrain null model tests. We show how these constraints influence our ability to detect biotic vs. abiotic processes. The demonstration of how depended conclusions on community assembly processes are on the used methods is especially striking, as - in this new area of research - no broad consensus on methods exists yet. We advocate intensifying the evaluation of the commonly applied methods and to explore potential biases, which the choice of one over another method may implicate.

S.15-14-O

Linking macroecological patterns and macroevolutionary dynamics in species' range boundaries: global congruence in climatic niche conservatism across mammals and amphibians.

Olalla-Tárraga, Miguel Ángel. McInnes, Lynsey. Diniz-Filho, Jose A. F.. Fritz, Susanne A. Hawkins, Bradford A.. Joaquín, Hortal. Miguel Ángel, Rodríguez. Andy, Purvis.

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Comparative evidence for phylogenetic niche conservatism - the tendency for lineages to retain their ancestral niches over long timescales - has so far been mixed, depending on spatial and taxonomic scale. We quantify and compare conservatism in the climatic factors defining range boundaries in extant continental mammals and amphibians in order to identify those factors that are most evolutionarily conserved, and thus hypothesised to have played a major role in determining the geographic distributions of many species. We also test whether amphibians show stronger signals of climatic niche conservatism, as expected from their greater physiological sensitivity and lower dispersal abilities. We characterise each species' climatic niche using a suite of variables and separately investigate conservatism in each variable using both taxonomic and phylogenetic approaches. Finally, we explore the spatial, taxonomic and phylogenetic patterns in recent climatic niche evolution. Amphibians and mammals show congruent patterns of conservatism in cold tolerance, with assemblages of escapee species (i.e., those escaping most from the climatic constraints of their ancestors) aggregated in the North Temperate Zone. The relative strength of climatic niche conservatism varies across the variables tested, but is strongest for cold tolerance in both mammals and amphibians. Despite the apparent conservatism in this variable, there is also a strong signal of recent evolutionary shifts in cold tolerance in assemblages inhabiting the North Temperate Zone. Our results indicate that distribution patterns of both taxa are influenced by both niche conservatism and niche evolution and that these forces in combination with rapid climate change will provide the necessary ingredients for major biotic turnover in the coming century.

S.15-15-O

Innovative conservatism: why niche conservatism might help finding solutions to changing niche environments.

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Species within the same lineage tend to use more similar niches than species in different lineages. Such niche conservatism is often considered to put species at risk under environmental change, but despite major environmental change in the past most lineages have to some degree conserved their niches. I will outline several possible explanations for this paradox, focusing on how local coexistence of related species in the same niche might improve their chances to respond to environmental change. First, niche conservatism brings in contact related species, which may help each other via sharing mutualists and nutrient cyclers, sharing constructed niches or stabilizing interaction networks. Niche conservatism of lineages might hence mitigate environmental change. Second, by bringing in contact related species, niche conservatism might increase trait variability within lineages. Coexisting related species may fight each other, triggering rapid evolution through character displacement. Coexisting related species may have sex, triggering rapid evolution through hybridization. And coexisting related species may exchange genes without sex, triggering genetic recombination. Increased trait variability within lineages might increase the potential to respond to environmental change. I discuss existing anecdotal evidence in favor or against several of these hypotheses.

S.15-16-O

The day after tomorrow - merging the fields of macroecology to answer the 'holy-grail question' of what determines species diversity.

Rahbek, Carsten.

University of Copenhagen.

Although the exploration of life on Earth has had a long history, it is only during the last decade that rapid developments within computer science have removed many of the technical limitations on the handling and analysis of huge data sets describing climatological, geological, and biological features. Likewise, technologies now exist that provide us with unsurpassed detailed information that elucidates phylogenetic relationships within and between individuals, species, species assemblages and for biogeographical structures in time and space. Thus, compared to a decade ago, we are now in a position to begin reconciling current controversies through the amalgamation of data reflecting or related to historical, evolutionary, and contemporary processes into an analytical framework. By combining modern DNA-techniques with macroecological and species distribution models using bioinformatics tools and statistics, we can begin to shed new light on classic questions. This first part of the talk will be illustrated with some analytical results from research in progress at the Center for Macroecology, Evolution and Climate using global data sets on phylogenies and distributions of the World's species of birds, amphibians and mammals. As progress depends crucially on the successful merging of different schools working with different tools at different spatial scales, the second part of the talk will focus on outlining a spatially-explicit species assemblage modeling framework unifying the approach of species distribution modeling with macroecological modeling using relevant species source pool designations and considering classic assembly rules from community ecology. The framework aims at improving our basic understanding of species assembly across spatio-temporal scales and for anticipating expected consequences of local, regional or global environmental changes.

S.15-17-P

Colonizing both geographic and environmental space: the success story of *Androsace* (Primulaceae).

Roquet, Cristina. Boucher, Florian. Thuiller, Wilfried. Rolland, Douzet. Serge, Aubert. Nadir, Alvarez. Sebastien, Lavergne.

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The long-lasting debate on the relative role of historical contingency versus evolutionary determinism in shaping evolutionary radiations is still under question. Studies of adaptive radiations have traditionally focused on the colonization of ecological space, identifying various predictors of ecological disparification. Instead, non-adaptive radiations have provided examples of geographical conquest, highlighting the importance of temporary biogeographic connexions. Bridging the gap between these points of view, we present here a case study on *Androsace*, a genus spread to most of the mountains of the North Hemisphere, with species that have colonized extreme alpine environments. We use an integrative approach combining biogeographic modeling, ancestral reconstruction characters and diversification analyses while taking into account for several sources of uncertainty. Our results show that life-forms have played a role in the biogeographic history and the diversification of *Androsace*: 1) Annual ancestors colonized new continents from Asia to America and Europe thanks to their good dispersal abilities, possibly via the North Atlantic Land Bridge. 2) The cushion life-form appeared independently two times in Asia and in Europe, where it stimulated an upward shift in diversification rates and triggered two parallel radiations in alpine habitats. Thus, *Androsace* is an exemplary case in which two different biological traits are responsible for its success in occupying geographical as well as ecological space. The contingency linked with past biogeographic connexions and the evolutionary determinism revealed by trait convergence and replicated radiations have both played a key role at different stages of the history of this group.

S.15-18-P

The International Biogeography Society.

Santos, Ana, M. C.. of the International Biogeography Society, Student at large.

Universidade Federal de Goiás. Goiânia, Brazil. The International Biogeography Society Officers.

Biogeography, the study of the geography of life, has a long and distinguished history, and one interwoven with that of ecology and evolutionary biology. Traditionally viewed as the study of geographic distributions, modern biogeography now explores a great diversity of patterns in the geographic variation of nature – from physiological, morphological and genetic variation among individuals and populations to differences in the diversity and composition of biotas along geographic gradients. Given its interdisciplinary and integrative nature, biogeography is now broadly recognized as a unifying field that provides a holistic understanding of the relationships between the earth and its biota. Our abilities to develop more general theories of the diversity of life, and to conserve biological diversity may well rest on insights from the field of biogeography. The International Biogeography Society (IBS) is a non-profit organization, founded in 2000, with the mission to: i) foster communication and collaboration between biogeographers in disparate academic fields - scientists who would otherwise have little opportunity for substantive interaction and collaboration; ii) increase both the awareness and interests of the scientific community and the lay public in the contributions of biogeographers; and iii) promote the training and education of biogeographers so that they may develop sound strategies for studying and conserving the world's biota. Here we present the activities organized by the IBS, the IBS' open-access journal (*Frontiers of Biogeography*) and the benefits of becoming an IBS member.

S.15-19-P

Variability in foraging efficiency of harvester ants along an environmental gradient.

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Foraging models predict that the decisions of optimal foragers, such as which food item to take and how long to spend in a patch, are influenced by physiological limitations and environmental constraints. In colonial ectotherms such as ants, the foraging decisions of individual workers are expected to maximize resource-acquisition efficiency of the colony and are thus expected to differ among colonies that experience varying environmental conditions. In this study we examined the way food selectivity of harvester-ant colonies change in response to variations in three variables at a regional scale: food availability, ambient temperature and foraging distance. The study was carried out for two years in six sites along a south-north productivity gradient in the Eastern-Mediterranean region, where precipitation, the main limiting factor, increases sharply (100-600 mm y⁻¹ within 250 km). Food selectivity, measured as a worker-load size correlation, was examined every month for 25 workers of up to 4 colonies per site. As predicted by foraging-decision models, food selectivity of the harvester ants increased with an increase in precipitation and resource availability and decreased with increased temperature. Interestingly, foraging distance had no effect on food selectivity. These results highlight the way environmental conditions affect the foraging decisions of organisms either directly as physiological constraints or indirectly through their effect on food availability.

S.15-20-O

Paleoclimatic imprints on ecological patterns and function across scales.

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Climate has varied dramatically in the geologic past, from the glacial-interglacial oscillations of the Quaternary to trends and variability at much deeper time scales. While much ecological theory focuses on current conditions for explaining ecological patterns and function, theoretically climatic variability over longer time scales is also expected to affect these phenomena. Using multiple case studies, we provide empirical assessments of the extent to which paleoclimatic changes provide an important influence on current ecological patterns, from global macroecological scales over continental and regional scales to the small scale of local biotic assemblages. Using global data sets on plants (palms) and vertebrates (amphibians, birds, and mammals) we show that diversity patterns may be influenced both by pre-Quaternary and Quaternary climate changes, with the diversity of small-range species often being particularly linked to paleoclimatic stability (notably low climate-change velocity). We also report similar effects for plants and animals at continental and regional scales, with effects that - at least for plants - can penetrate to local scales (even

S.15-21-O

Patterns of species richness versus spatial phylogenetic diversity: a case study from a tropical biodiversity hotspot.

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The geographical patterns of species richness and the processes that determined and shaped species distributions in tropical regions are poorly known. In Madagascar, one of the most diverse biodiversity hotspots, the number of recently described species as well as the knowledge about species distributions have increased significantly during the last decade, challenging previous views about the geographical patterns of species diversity on the island. We integrated this newly available information with dated molecular phylogenies to analyse the spatial patterns of species richness and endemism, and compared them with the spatial phylogenetic diversity and endemism in different clades. Several regions accumulate high numbers of small-ranged microendemic species, some of them representing long-branches that likely persisted in those areas for a long time; while areas with high diversity are characterized by a mixture of recently diversified and older lineages. We explore the potential mechanisms that may have shaped and drove the patterns of species' diversity on the island.

S.15-22-0

Determinants of species diversity patterns of woody plants: linking environmental controls with evolution.

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Abstract: The causes of large-scale patterns of species richness remain one of the most controversial issues in ecology and biogeography, despite of the long time of research since von Humboldt, Wallace, and Darwin. A current challenge is to link the effect of contemporary factors with the factors associated with the evolutionary history of a region and its species. The freezing tolerance hypothesis that was proposed by von Humboldt has recently been renewed to explain the mechanisms of species diversity patterns in terms of contemporary climate and evolution, and has generated widespread attention. Using the distribution maps of all woody species in China and all trees in North America, and the current phylogeny of angiosperms, we 1) compared the effects of different contemporary climatic factors, particularly environmental energy, water-energy dynamics and winter temperature, 2) analyzed how biogeographical affinities (tropical vs. temperate) influence richness-climate relationships, and 3) explored the phylogeography of woody species in China and North America. We found that the species richness of trees, shrubs, lianas and all woody plants more strongly correlated with the species richness of tropical affinity than with that of temperate affinity. The mean root distance of woody species decreased towards the north, and strongly correlated with the patterns of species richness. The mean temperature of the coldest quarter (mean winter temperature) was the strongest predictor of species richness, and its explanatory power was significantly higher for the species of tropical affinity than for those of temperate affinity. These results suggest that the patterns of woody species richness mainly result from the increasing intensity of winter coldness from the equator/lowlands towards the poles/highlands, and hence support the freezing tolerance hypothesis. **Keywords:** biogeographical affinities, China, freezing tolerance hypothesis, niche conservatism hypothesis, North America, phylogeny, woody plants, water-energy dynamics.

S.16- Biodiversity and Ecological Services in Agricultural Systems

S.16-01-P

The effects of climate fluctuations and soil heterogeneity on the floristic composition of natural and sown Mediterranean annual pastures.

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Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL) is a pasture system for Mediterranean areas mixing a large number of pasture species and cultivars, with a predominance of *Trifolium subterraneum*. It rapidly expanded in Portugal in the past decade due to its high dry matter yields (DM) and C sequestration rates in soil organic matter. Although without clear experimental evidence, it is currently admitted that SBPPRL are able to adjust to soil spatial heterogeneity and to reflect interannual climate fluctuations. The study was performed on a semi-natural and on SBPPRL, on a mixed farm in central Portugal. The effects of interannual climatic variability and of soil microtopographic gradients on the floristic composition were explored. Three botanical levels of analysis were used: all species, sown species and *T. subterraneum* cultivar levels. The SBPPRL had higher DM yields, and a lower biomass of spontaneous plants. Unimproved genotypes seemed unable to translate into biomass soil fertility amendments in the semi-natural pasture. The sown legumes appear to have buffered the microtopographic gradients' control of voluntary species diffusion. The distribution of *T. subterraneum* cultivars along the studied microtopographical gradients was congruent with their life cycle duration: short-cycle cultivars had higher relative cover in uphill plots, the opposite occurred down the slope. An enlarged diversity of improved species/cultivars in seed pasture mixtures appear to favour microtopographic gradients and interannual climatic fluctuation tracking. Sown species diversity and *T. subterraneum* cultivar diversity are complementary in this process; they promote, respectively, interannual climatic and microtopographic gradients fluctuation tracking.

S.16-02-P

Spatial distribution of aphid and aphidophagous carabid species abundance in wheat field of two contrasted landscape contexts.

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Aphidophagous carabids suffer by recent agricultural practices - among others by ploughing, which destroys large amounts of carabids in the fields. Carabids adapted to living in the fields must therefore periodically recolonize the fields from non-ploughed refuges nearby. The same happens to aphids, however. When the fields become unsuitable for them, they emigrate to other habitats. Here we investigate the importance of landscape composition on the population dynamics of the carabid-aphid system. We have collected data on population dynamics of carabids and aphids during the season in 12 wheat fields close to Pleine-Fougères in western France. Half of the fields was in a "fine" region, with small fields and lots of semi-natural elements (hedgerows, meadows), the other half was in a contrasting "coarse" region, with large fields. There were 6 randomly chosen sampling points per field, at each of which 1 pitfall trap was placed and checked 5 times in wheat and 25 tillers of wheat were sampled at 10 instants for aphids. Aphids were more abundant in the "fine" region and their numbers were negatively correlated with distance from field margin at the beginning of the season, but not later. Carabid numbers were negatively correlated with aphid numbers and positively with distance from field margin in the "coarse". We hypothesize that the larger aphid abundance in the "fine" region, caused mainly by the dominant *Sitobion avenae*, may be due to more abundant out-of-season refuges here - grassy areas. The negative correlation between aphid and carabid numbers follows from these correlations.

S.16-03-O

Promotion of pollination services, biodiversity and conservation on farmland by sown wildflower strips.

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Intensification of agriculture and the consequent loss of non-crop habitats has been detrimental for farmland biodiversity. Establishing temporal habitats, such as wildflower strips along field edges, is a promising option for mitigating this negative trend. Temporal habitats may also offer foraging, hibernation and nesting sites for arthropods that provide ecosystem services. We studied the efficacy of sown wildflower strips as a mitigation option in a four-year field experiment. The promotion of pollination services was measured by bumblebee abundance, the promotion of biodiversity by total species richness (bumblebees, butterflies and diurnal moths) and the promotion of species of conservation concern, that have suffered from agricultural intensification the most, by the abundance of habitat specialist butterflies. We firstly considered the effects of strip establishment on these three response variables, in comparison with control treatments (untreated field margins, spring cereal and reed canary grass). The promotion of pollination services by wildflower strips was fast, as bumblebee abundance increased rapidly in the second year of the experiment. Biodiversity increased at a slower pace and the promotion of species of conservation concern was an even slower process. In the statistical analyses, the treatment effect was strongly positive in the majority of comparisons. Secondly, we considered strip property effects (shape, placement on the field parcel, sown seed mixture) on the response variables and detected only minor differences between different strip types. We therefore conclude that wildflower strips can be regarded as a useful measure to promote pollination services, biodiversity and species conservation on farmland.

S.16-04-O

Spatial distribution of weeds depends on landscape complexity.

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The drivers of spatial patterning among plant species and the implications of those patterns for the structure and function of plant communities are of ongoing interest. Weeds are key components of agroecosystems because they support biological diversity and provide the primary production upon which food chains are built. The understanding of spatial distribution of weeds is of fundamental importance to achieve realistic models of weeds populations and is crucial for weed management. This study examined the effect of landscape complexity on the spatial patterns of weeds. We analysed the spatial distribution of 151 weed species in 10 landscapes characterized by a gradient in landscape heterogeneity, from structurally complex to structurally simple. We determined whether any differences observed in species' distribution patterns were related to ecological features of species for resource exploitation or dispersion. Increasing landscape complexity reduced spatial autocorrelation in species distribution and promoted generalists species, either at a coarse scale (among fields) and fine scale (within fields). Spatial patterns seemed dependent on the abundance of the species whereas they were not related to dispersal strategies. The species with low densities had either random or aggregated pattern whereas the species with high densities always had aggregated pattern. Our results point to the importance of the landscape complexity in the spatial patterning of weed species even in intensively managed fields. Not all weed species respond to landscape context in the same way according to their life-traits. Because ecological processes operate on a range of spatial scales larger than a single field, understanding the patterns of weeds communities requires a large-scale perspective.

S.16-05-P

Natural mortality factors of *Bemisia tabaci* (Gennadius) Biotype B (Hemiptera: Aleyrodidae) under greenhouse conditions in tropical region.

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The whitefly *Bemisia tabaci* is an important herbivorous of several native and cultivated plant species worldwide. Natural mortality factors are crucial for a better understanding of the population dynamics and therefore for improving management programs. We have identified biotic and abiotic mortality factors of *B. tabaci* in the Southeastern Brazilian region on tomato, under greenhouse conditions. Clip cages containing eight couples of *B. tabaci* each were placed in eighty plants. Insects were allowed to oviposit for 24 hours. After that period, clip cages were removed and a group of three individuals (cohort) per plant was monitored until adult emergence. Natural enemies and/or traces of action of the natural mortality factors were documented by macro photography. The observational method was used to construct cohort-based life tables for *B. tabaci* during ten generations. The results showed that the mortality was due to egg inviability (42.11%) and fungus contamination (37.56%) for egg stage; predation (35.00%) and fungus contamination (16.79%) for first nymphal stadium; and predation for second, third and fourth nymphal stadia (57.59, 52.63 and 44.08%, respectively). Individuals of *Delphastus pusillus* (Coleoptera: Coccinellidae), *Zelus* sp. (Hemiptera: Reduviidae), *Macrolophus* sp. (prob.) (Hemiptera: Miridae), *Orius insidiosus* (Hemiptera: Anthracoridae); *Geocoris punctipes* (Hemiptera: Geocoridae), Phytoseiidae mites and spiders were recorded and collected as predators. Overall, predation was the most important mortality factor. Pathogens, desiccation, spiders and *Tetranychus urticae* webs, and egg inviability (due to unknown causes) were also responsible for population decrease. The largest mortality rate was found in the third and fourth nymphal stadia.

S.16-06-P

Evaluation of Agro Forestry Systems (AFS) using emergy analysis.

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Some climate change models show that native vegetation replacement planted for monoculture pasture and grain production, may lead to rainfall decrease and increase frequency of dry periods in central Brazil, an action that contradicts the sustainability concept. Adoption of agro forestry systems (AFS) is considered to be an alternative. Studies were conducted at the Experimental Station "Ariosto da Riva" Research Center's Production of Cocoa (CEPLAC) in Alta Floresta, Mato Grosso (Brazil). In this study was used emergy methodology and scenarios: two agro forestry systems named SAF I made of rubber tree (*Hevea brasiliensis*), coffee (*Coffea arabica*), cocoa (*Theobroma cacao*), and SAF II with cupuaçu (*Theobroma grandiflorum*) coffee (*Coffea arabica*), cocoa (*Theobroma cacao*), gliricidia (*Gliricidia sepium*), cuiabano pine (*Schizolobium amazonicum*) and peach palm (*Bacta gasipaes* Kunth). The goal was to use the emergy methodology, and show the importance of these systems for family agriculture. SAFs Systemic Diagrams, the calculating tables of flows and emergy indices were prepared. These models represent a viable alternative proposal for family agriculture, can produce environmental services, preserve biodiversity, diversifying production and taking advantage of family labor throughout the year. Can be replicated in the region, local adjustments should be discussed, public policies that help the viability of these models in rural settlements, and the suggestion of quality certification seals and environmental conservation to add value to products from the SAFs. Key words: climate change, emergy, sustainability.

S.16-07-P

Organic farming improve pollination success in strawberries.

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Agricultural intensification has negatively affected biodiversity, but organic farming has been shown to be able to mitigate such effects. This make it possible that organic farming also may mitigate loss of an important ecosystem service, crop pollination, which is thought to be related to diversity and abundance of pollinators. In this study we evaluated the effect of organic farming on pollination of strawberries focusing on two questions. First, if the pollination success in strawberries was higher on organic compared to conventional farms, and second, if there was a time-lag from conversion to organic farming until an effect was manifested. We found a significantly higher pollination success and a higher proportion of fully pollinated berries on organic compared to conventional farms. This difference was manifest rapidly after conversion to organic farming since there was no effect of time since transition from conventional farming on pollination success or the proportion of fully pollinated berries. We discuss implications of these findings on how to mitigate detrimental effects of biodiversity loss on ecosystem services in contemporary agriculture.

S.16-08-P

Drove roads and plant functional diversity in traditional Mediterranean landscapes.

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Drove roads and transhumance are key elements of traditional pastoralism. In some regions of the Mediterranean Basin, drove road systems cover large areas, and may have exerted important effects over landscape heterogeneity, plant species distribution and community organization. With the intensification of husbandry, however, drove road systems are facing a dramatic process of degradation, whose effects on plant community composition at several scales are still unknown. Here we examine the impact of active drove roads on plant species richness and plant functional diversity in four ecosystems of central Spain: (1) extensive croplands, (2) extensive grasslands, (3) deciduous submediterranean forest, and (4) mountain coniferous forest. Our results show that drove roads largely affect species richness and functional diversity in all the ecosystems except in the extensive grasslands. Drove roads account for most of the species pool in the agricultural, deciduous forest and coniferous forest localities. Species density at the fine scale is also higher in the drove roads. Differences in functional diversity are relatively small, what reveals a high degree of functional redundancy in drove road communities. However, when comparing between scenarios with and without drove roads, we found that the disappearance of the drove road would imply a severe loss of species and functional diversity at the locality scale. On the basis of these results, we argue that the abandonment of drove roads will lead to more simplistic and species poorer ecosystems, more vulnerable in the face of environmental changes and disturbances, and with lower capacity to provide ecological services.

S.16-09-P

Providing resources for the diverging ecological needs of natural enemies: biological control in tomato cultivations.

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Scuola Superiore Sant'Anna, Pisa. Scuola Superiore Sant'Anna, Pisa. Scuola Superiore Sant'Anna, Pisa. Scuola Superiore Sant'Anna, Pisa.

The potential of field margins in providing resources for antagonist species and enhancing ecosystem services is well established. Yet, relatively limited research is available on the influence of within-field habitats on community structure, and the ability of different groups to provide ecosystem services. This study investigates the availability of floral resources in conventionally managed tomato cultivations in Tuscany, and their influence on community structure and biocontrol. Within-field assessment of crop damage, from the fruit-attacking lepidoptera, was carried out for 10 fields. This pest complex, composed mainly of *Helicoverpa armigera* (Hübner) and *Tuta absoluta* (Meyrick), which was recently introduced to the Mediterranean region, is one of the most important pests as larvae directly damage the fruit. The floristic composition, availability of floral resources and diversity of separate edges were determined. Another experiment involved collecting *T. absoluta* larvae from damaged fruit, which were subsequently reared to identify the level of parasitisation. Results indicate that reduced floristic species richness and diversity within herbaceous strips are associated with higher levels of yield loss from noctuids but not of *T. absoluta*. A new parasitoid of *T. absoluta* was collected, but the level of parasitisation was found to be particularly low. A multivariate approach was used to analyse the association of several insect groups, and subsequently these results were fitted on environmental data relating to the herbaceous strips characteristics, including vegetation and functional group composition and diversity. An important issue which arises from these results is the diverging and complex ecological requirements of different functional groups.

S.16-10-O

Organic farming, biodiversity, multifunctionality and sustainability.

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In a recent study, it was found that agricultural intensification, especially pesticide use, negatively affected biodiversity and the potential for an ecosystem service on a European scale. Organic farming and other agri-environmental schemes partly counteracted this decrease. However, as organic farming has been shown to have variable effects on biodiversity, the question remains if it is an effective way of increasing biodiversity and ecosystem services in agricultural landscapes. Farming delivers multiple services to society, not only yield or biodiversity. However, most evaluations of organic farming have compared single variables on organic and conventional agricultural farms or fields matched according to "confounding" factors, such as landscape heterogeneity. Such comparisons are - although informative - difficult and often problematic. Which factors should be accounted for, e.g. landscape? Which are systemic components of organic vs. conventional farming, e.g. crop rotations? Does time since transition to organic farming matter? And, are such comparisons relevant for future agricultural landscapes, given that today's industrial agriculture is unlikely to be sustainable because of its reliance on energy and nutrient inputs, e.g. phosphorus, that are predicted to become scarcer in the next 20 years. I will discuss these questions based on 15 years of research on organic farming, biodiversity and ecosystem services. To summarize, since it is clear that pesticides and simplified crop rotations negatively affect biodiversity as well as other ecosystem services, such as carbon sequestration and long term yield, organic farming with appropriate modifications may be the best available blueprint for sustainable agricultural production systems.

S.16-11-O

The role of organic farming in a food-hungry world.

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Demand for food is increasing fast, with a predicted need to close to double production by 2050. There is also increasing recognition that farming needs to be sustainable. However, “sustainable” farming is often equated with less intensive approaches (for example, organic farming practices). Such extensive farming methods are often beneficial to the local environment but typically also have lower yields and, therefore, make the challenge of increasing global production more acute. To explore the tension between our global need to produce food and conserve nature, agricultural landscapes can be thought of as systems that produce two types of products: food (and other economic goods) and ecosystem services. This suggests two basic landscape management strategies: land can be farmed extensively over a large area thereby producing less food but more ecosystem services on the same land (“land sharing”), or farmed intensively over a smaller area and the remaining land can be “saved” to be managed exclusively for ecosystem services (“land sparing”). Recent research indicates that when the extra land needed to maintain yields under extensive systems is taken into account, land sparing strategies may often be optimal in terms of balancing food production while maintaining biodiversity and ecosystem services. Intensive farming systems, if balanced by properly managed biodiversity land, can therefore produce both more food and more ecology. The greening of conventional agriculture, driven by the increasing carbon cost of inputs and new technology, may further reduce the traditional conflict between intensive/productive/unsustainable vs extensive/less productive/sustainable farming systems.

S.16-12-O

Persistent negative effects of pesticides on biodiversity and biological control potential in European agricultural landscapes.

Berendse, Frank. Geiger, Flavia. Bengtsson, Janne. Weisser, Wolfgang. Emmerson, Mark. Morales, Manuel B.. Liira, Jaan. Tscharntke, Teja.

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In the last 50 years, agricultural intensification has caused many wild plant and animal species to go extinct regionally or nationally and has profoundly changed the functioning of agro-ecosystems. Agricultural intensification has many components, such as loss of landscape elements, enlarged farm and field sizes and larger inputs of fertilizer and pesticides. However, very little is known about the relative contribution of these variables to the large-scale negative effects on biodiversity. In a Europe-wide study in nine West and East European countries, we found consistent negative effects of agricultural intensification on wild plant, carabid and bird species diversity and on the potential for biological pest control, as estimated from the number of aphids taken by predators. Of the thirteen components of intensification we measured, insecticides and fungicides had consistent negative effects on biodiversity. Insecticides also reduced the biological control potential. Contrary to expectations, organic farming and other agri-environment schemes aiming to mitigate the negative effects of intensive farming on biodiversity have not increased the diversity of breeding birds. We conclude that despite decades of European policy to ban harmful pesticides, the negative effects of pesticides on wild plant and animal species persist Europe-wide, meanwhile reducing the opportunities for biological pest control.

S.16-13-O

Drivers of non-Apis pollinators in California almond orchards and their benefits for fruit set.

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Given the problems with honey bee health and colony losses, relying solely on the pollination services of a single species may not be sustainable in the long-term. In California almond orchards, we investigated the effect of organic management and surrounding natural habitat on flower visitation and fruit set. Data were collected in 23 almond orchards (15 conventional, 8 organic) surrounded by different proportions of natural or semi-natural habitat. Five of the conventional orchards with little surrounding natural habit had an adjacent strip of semi-natural vegetation and were included to represent a realistic management option for orchards in intensive landscapes. The frequency of flower visits by honey bees and wild insects (wild bees, hover flies (Syrphidae) and all other insects) was recorded. The frequency of flower visits by wild insects was positively related to the proportion of surrounding natural habitat. Fruit set was also greater in orchards with a high proportion of surrounding natural habitat. The presence of a strip of semi-natural vegetation in orchards with little surrounding natural habitat increased the richness of insect groups observed and the frequency of flies visiting flowers. Organic management increased the frequency of flower visits by hover flies. Our results indicate that almond orchards in areas with a high proportion of natural habitat receive additional 'free' pollination services from wild flower-visiting insects, which can improve fruit set. In isolated landscapes there is potential for a strip of nearby semi-natural vegetation to increase the abundance of wild pollinators, primarily flies, visiting almond flowers.

S.16-14-P

Impact of oilseed rape production on functional biodiversity of predators and decomposers.

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While Germany is the largest producer of OSR in Europe (1.6 million ha), OSR production is of increasing importance in Western Balkan Countries (WBC's) where 20% of the area cultivated with arable crops is suitable for OSR production. Problems of OSR growing potentially affecting biodiversity are N-overfertilization, intensive tillage and the use of pyrethroids and phosphoric acids due to pest resistance. Environmentally friendly production techniques are demanded. While most projects on agrobiodiversity focus on non-cultivated areas (field margins, wildflower strips, hedges), this project targets on the within-field biodiversity. Besides classical aspects (species richness/composition) this project comprises functional aspects like biocontrol of pests by predators (Carabidae, Staphylinidae, Araneae), and turnover of plant residues by decomposers (earthworms). In Croatia and Serbia research on OSR is recently focused on general crop production and pest control. Nothing is known about within-field biodiversity of functional groups like epigeic predators and decomposers. Organic OSR production is introduced the first time to Croatia and Serbia through this project. In a 2-year field experiment in each of the three countries the impact of three differently managed OSR fields (conventional, highly integrated, organic) on biodiversity and fitness of predators and decomposers are investigated. The systems differ in tillage, fertilizer and pesticide input, weed control, row space and application of Brassica campestris-trap-crop-strips and are integrated in a crop rotation with winter wheat. The fields are covered by a grid of sampling points using different methods to assess predators (pitfall traps, endogaeic pitfall traps, emergence traps), decomposers (soil samples) and pests (bud/pod/stem samples). Random gut dissections of predator species give information about their importance as biocontrol agents. The results show whether there are country specific assemblages of key predators and decomposers, so that crop management should be regionally adapted. The experimental work will constitute a demonstration of possible ecological approaches in OSR production and thus, will give impulses towards research activities which focus more on aspects of functional biodiversity especially in WBC's. The project started in October 2010. Results of the OSR growing season are presented.

S.16-15-P

Livestock ponds as strategic habitats for wildlife conservation.

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In regions where natural wetlands are scarce, artificial ponds created for stockbreeding purposes represent strategic breeding habitats for amphibian decaying populations. Artificial wetlands policy assumes that managing ponds for wildlife joins livestock welfare requirements, but this hypothesis has not been specifically attended. This research evaluates this premise in a natural area that holds a relevant amphibian community and has an extended grazing history. We chose a variety of ponds that embodied the heterogeneity of water resources and analysed the relationship between amphibian assemblages, water quality, and pond attributes. Risks associated to the dual use occurred in summer when a rising domestic stocking rate coincided with a scarce water recharge that reduced pond hydroperiod, concentrated pollutants, lowered water level and increased water temperature. The negative effects of livestock tightly depend on fencing. Fences ensured a strip of surrounding vegetation, decreased the chance of mechanical damage caused by wading and have an influence on water quality. Water in unfenced ponds degraded with urine and feces of mammals entering the ponds, which increased the dissolved ammonia and boosted the enteric microbial charge. Whereas many species of amphibians may escape contamination by accomplishing its breeding stage before summer water degradation, chemical and microbiological contamination will likely affect the intake of water by livestock. Although the quality of water is essential, other factors less considered by environmental managers emerge as main drivers of amphibian assemblages, such as hydroperiod, predator occurrence and the environmental quality of the surrounding habitat.

S.16-16-P

Plant and soil microorganism diversity associated to Mediterranean extensive agro-ecosystems.

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The importance of biodiversity in agro-ecosystems has been increasingly recognized over the last years. In the Baixo Alentejo, Portugal, soil low fertility and harsh climatic conditions - allied to the preservation of habitats for endangered bird species - has resulted in low intensity farming, including crop rotation with fallow. In this context, biodiversity plays an important role in regulating ecosystem functioning. Our aim was to assess plant and soil microbial diversity associated to these systems and the effects of management options on these components of biodiversity. Sample collection was done in spring, in two consecutive years, in order to sample the same areas under both fallow and wheat crop. The effect of soil mobilization and sludge application - experimental measures used to increase soil fertility in these crop areas - was also assessed. Sampling was done in two farms separated by several kilometers. First results show that the sampled farms are not significantly different regarding soil nutrient content and plant species richness or dominant species, which suggests that fallow areas are similar in both farms. Results also show that, overall legumes and forbs are the functional groups most affected by wheat crop, regardless of soil mobilization and sludge application. Data also suggests that precipitation and time of application of fertilizers and herbicides play a key role in wheat production and plant composition and cover in wheat fields. Soil microbial communities are influenced by plant composition and may be expected to respond to changes in vegetation. Soil mobilization does not seem to have had a significant impact but further data are required to draw conclusions.

S.16-17-P

Effects of farming intensity, field edge and landscape context on plant diversity components at different spatial scales in Mediterranean cereal croplands.

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Farmland biodiversity is affected by factors acting at various spatial scales. However, most studies to date have focused on the field- or farm scales, which only account for local (α) diversity, and thereby, may underestimate the contribution of other components (β -diversity) to overall farmland (γ) diversity. Here we analysed the relative contribution of different diversity components at various spatial scales to overall plant diversity in Spanish cereal croplands. Then, we evaluated how these components responded to a set of local and landscape traits aiming at identifying the most suitable management options to maximize diversity gains. We used measures of plant species richness in plots located in the centre and inner edge of paired fields with and without agri-environmental schemes (AES) from three regions with different landscape configuration. Species turnover among regions and among fields mostly contributed to overall diversity. Such components were not benefited by AES, which increased plant diversity only at the field scale. Positive edge effects were found on all diversity components at both the field- and the regional scales. Length of semi-natural boundaries in the landscape also increased plant diversity at both scales, with additional positive effects of percentage of non-productive land-uses at the regional scale. We conclude that agri-environmental policies should incorporate measures aimed at the maintenance of semi-natural boundaries and non-productive habitats within agricultural landscapes through landscape planning, cross-compliance or high nature value farmland programs. These options will help to conserve overall plant diversity at regional scales and the species spill-over to fields.

S.16-18-P

Unexpected mutualisms in agricultural habitats: great bustard (*otis tarda*) disperses and enhances germination of domestic olive (*olea europaea*) seeds.Corbacho, Casimiro. Delibes, Miguel. Calvo, Gemma. Fedriani, José M^a.

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Agricultural practices has severely disrupted many plant-animal mutualisms by changing the habitats and altering plant traits. However and interestingly, mutualistic relationships between species could be also facilitate by the intensification of agricultural practices with naturally mismatching phenotypes. Here we describe the role of the great bustard (*Otis tarda*), a big steppe bird, as disperser of domestic olive (*Olea europaea*) seeds, an originally forest species. In our study area, 30% of the bustard faeces included olive stones, in numbers ranging from 1 to 13 (average = 4.96, mode = 2). Only 1.72% of the bustard-ingested olive seeds were broken. Moreover, using a sowing experiment, we show bustard ingestion enhanced seed germination. Specifically, sprouting reached 8.8%, 3.4% and 0.0% for bustard-ingested, hand-depulped, and control seeds, respectively, being these differences significant. As expected for Mediterranean habitats, seedling mortality was very high in the first summer for all seed treatments; thus, further sowing experiments using large sample sizes are clearly needed to identify potential spatial variations in recruitment of bustard- ingested olive seeds. Given the large size of domestic olive fruits, bustards are among the scarce local animals able to disperse their seeds and thus to assist in the forestation of field boundaries and abandoned lands. Paradoxically, because bustards are rather restricted to open habitats, their success in shaping the habitat (i.e., 'planting' olive trees) should represent their own removal from the resulting forested landscape.

S.16-19-P

Consequences of long-term grazing exclusion in Rural Parks of the Canary Islands.

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Rural Parks are natural protected areas where traditional agricultural activities coexist with nature conservation. One of the most widespread rural activities in the Canarian Rural Parks is goat grazing, but little is known about its effect on plant communities, especially in the long-term. We assessed the existence or not of these effects, and their extent on different aspects of vegetation (cover, species richness, productivity, and composition), in traditional managed ecosystems. All the variables were measured in exclusion, and control plots located in two Rural Parks from Tenerife, and one from La Gomera, during eight years of monitoring. Differences due to grazing exclusion were detected in plant cover whereas the rest of variables analysed showed patterns more related to interannual climatic variations or vegetation types. Changes from long-term exclusion were not as apparent as expected, and most of the variables showed no trends with exclusion time. Against the generalised opinion, goat grazing does not seem to be a very harmful practise for the vegetation based on the results obtained for the studied areas. The effective management of grazing areas (low-medium stocking rates, rotation and food supplementation in dry seasons) may be among the reasons of a sustainable activity. On the other hand, pastures in the Canary Islands are ecosystems shaped by centuries of land uses and its recovery might be very difficult, therefore its treatment as “novel ecosystems” should be considered.

S.16-20-P

Coexistence in cereal agroecosystems: Microhabitat partitioning and realized niche segregation in four steppe birds.

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Ecological niche theory predicts that coexistent species occupying the same habitat should partition resource selection and this would drive to a segregation and packing of their realized niches, in order to diminish interspecific competition. In this study, we examined differences in patterns of microhabitat selection (which can be assimilable to realized niche) in four sympatric steppe bird species (2 of them separated by sex) associated to cereal agrosystems in central Spain: the little bustard, the great bustard, the red-legged partridge and the eurasian stone-curlew. In order to determine their realized niche, which can be related to different ecological and evolutionary constraints, variables of vegetation structure were measured both in bird locations (N= 260) and control points (N=178) in 3 different localities. Two Principal Component Analysis factors were extracted, which can be interpreted respectively as a shelter and a food availability gradients. MANOVA and post hoc tests showed the existence of segregation in the realized niche between coexistent species with respect to microhabitat selection in relation to these two PCA factors. Different aspects such as body size, foraging behaviour, reproductive constraints and diet (insectivorous versus herbivorous) can explain this niche segregation between stone-curlew, little bustard and great bustard, thus showing primary partitioning of the considered resources between them. The overlap between red-legged partridge and little bustard's niches could be highlighting the existence of low interspecific competition due to mechanisms of secondary resource partitioning. We discuss these results in the context of the conservation of these high value species, its preferences at microscale and the management of agroecosystems.

S.16-21-O

The effects of agricultural intensification on invertebrate communities in adjacent forest reserves.

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Land-use intensification is increasing worldwide to meet the challenge of feeding a growing human population. The rising fertiliser inputs and stocking rates needed to increase yield in production systems have negative impacts on surrounding native ecosystems. This has important implications for the conservation of small isolated forest reserves on farmland in lowland New Zealand. To test the effects of land-use intensification on biodiversity and ecosystem function in spatially-coupled agricultural and native ecosystems, we compared detritivorous land snail communities across a land-use intensification gradient spanning 11 landscapes, with paired unfenced versus fenced treatments to restrict livestock in each landscape. At higher livestock densities we found a significant reduction in snail abundance and diversity, an increase in the invasiveness of non-native species, and a shift in species trait complexes that affected experimental litter decomposition rates within 20m of edges adjacent to agricultural fields. To discriminate the mechanistic drivers of livestock impacts we conducted an experimental manipulation of litter complexity, litter mass, and soil compaction in 36 plots within a fenced forest reserve using litter removal and a mechanical hoof. Using structural equation modelling we found substantial effects through direct and indirect pathways, with effects of above-ground litter structure being more important than effects mediated by below-ground water infiltration rates (at least for short-term experimental impacts). These results suggest land-use intensification will decrease invertebrate biodiversity and decomposition rates in adjacent forest reserves. Conservation management actions that restrict negative farming impacts into adjacent nature reserves will become ever more important with increasing land-use intensification.

S.16-22-P

Agri-environment schemes as effective stimulators of agrobiodiversity and ecosystem services.

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ILVO Social Sciences Unit. INBO Ecosystem Management Unit. ILVO Plant Unit. INBO Ecosystem Management Unit. INBO Ecosystem Services Unit.

Agri-environment schemes (AES) encourage the reconciliation of (intensive) agricultural production with certain environmental goals by financially rewarding farmers. Doing so, several provisioning, regulating and cultural ecosystem services (ESS) are promoted, whereby agriculture largely depends on agrobiodiversity (AB). Although there are critical knowledge gaps, it is generally assumed that ecosystems with a higher amount of biodiversity have a higher resilience against disturbance and therefore a greater potential to supply ESS. Research on the effect of AES showed no to a positive effect on AB on fields or field margins but fragmented measures in intensive agricultural areas probably have no effect on AB at landscape level. However, limited research has been done to fine-tune the AES with the agricultural practices. Nevertheless, in order to find additional incentives for farmers to (long-term) implement AES, a win-win situation for both agricultural production and the environment has to be demonstrated. An analysis of the relations between AB, ESS and farm management was performed in order to suggest the preconditions of practical measures that stimulate AB and the associated ESS. In contrary to the current monofunctional, rigid and general practices, AES stimulating AB should consist of multifunctional, management flexible and farm type specific practices. Both the effectiveness on the appropriate scale and increased participation by farmers will further depend on the realization of a regional vision on AB, related ESS and AES, through a participative approach.

S.16-23-O

Ecological effectiveness of agri-environment schemes: the role of non-linear and interactive effects of agricultural intensification.

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Agri-environment schemes (AES) of the European Union Common Agricultural Policy are nowadays the main policy instrument for reducing negative effects of agricultural intensification on biodiversity. However, recent work has demonstrated mixed effectiveness of AES for reaching this goal. Potential causes for low effectiveness are broad ecological goals rather than specific and testable aims, deficiencies in their design to fulfil the ecological needs of target species, limitations to cope with landscape-scale effects of intensification due to their field-scale application, and non-linear effects of intensification on diversity. Moreover, interactions of such non-linear effects at local and landscape scales will have strong influences on the effectiveness of AES, even when they are properly targeted and designed, which will thus depend on both field-scale intensification and landscape context in complex ways. We will review current evidences on non-linear effects of intensification at field and landscape scales, and interaction among effects at different scales on the ecological effectiveness of AES. On this basis, we conclude a) that the design of AES should be based on regional rather than on national or continental criteria; b) that AES designs should be considered as working hypotheses, so that they should be evaluated and improved following guidelines of adaptive management; and c) that alternative policy tools such as cross-compliance, landscape planning and support to High Nature Value Farmland (HNVF) areas should be developed prior to, or in combination with, AES when their effectiveness is constrained by non-linear interactive effects of local and landscape intensification on farmland biodiversity.

S.16-24-P

Restoration of Southern Indian Rivers.

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The problem confronting river resource managers in India is analogous to the question of whether economic policy makers in India should be focusing on restoring the fundamentals of capitalism. Pragmatic monitoring and prediction capabilities must also be built to provide further confidence that human impacts are being minimized. There is a need to develop a framework to integrate biodiversity effects methods with risk assessment methodology. Such integration will improve the basis for risk-based assessment of coastal health. In contrast, bottom-up restoration strategies not only simplify planning, but they recognize that basal ecological mechanisms are what define coastal ecosystems. Populations of the majority of fish species showed drastic reduction over the past five decades in west coast of India. We conducted an intensive study of Aghanashini estuary for water quality and fish diversity in southern India. River ecosystems are impacted by many stressors and are continually subjected to threats from multiple stresses imposed mostly by human activities predominantly as a result of increased population growth in India. Due to deteriorated water quality from anthropogenic activities fish diversity has drastically reduced. In complex coastal ecosystems, strategies for restoration can become equally complicated.

S.16-25-P

Irrigation affects plant diversity and community composition in a Mediterranean agroecosystem.

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Vast areas of dry extensive farmland are being substituted by irrigated farmland in Mediterranean countries. The consequences of these agricultural changes on plant biodiversity are poorly known. Here, we compared diversity of vascular plants between extensive dry and irrigated farmland in northwestern Spain. We sampled vascular plants in 80 crop fields (40 in dryland and 40 in irrigated land) along two transects (75 meters long x 1 m wide) arranged one parallel and one perpendicular to one of the margins of each field. Each transect was in turn divided in five contiguous plots (15 x 1 m). Significant lower values of plant richness were recorded on irrigated land, mostly in maize crops. The community composition was also different, with higher rates of exotic, perennial and wind pollinated plants in irrigated land. The pattern of plant diversity in relation to distance to the edge of the field was also different. The 90% of the total species within the transect were found on the field edge (i.e., first plot) in irrigated fields vs 60% in dryland fields. Our study has implications for designing spatial planning and management strategies. The transformation of large extents of agricultural landscapes into a monoculture dominated by maize should be avoided to maintain current plant diversity. If irrigation is established in certain fields, it is necessary to develop the respective environmental assessments that allow minimise the consequences of this aggressive farming management system, such as the increase of exotic plants or the decrease of insect pollinated species.

S.16-26-P

Effects of plant domestication on litter decomposition rates.

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Humans have modified agronomic species for centuries through artificial selection. This plant domestication has changed several plant traits in order to get resistance to herbivores, pathogens, drought or increasing productivity. Although plant domestication has been traditionally studied by agronomist, its ecological significance for processes such as litter decomposition is poorly known. We conducted a growth chamber and microcosm laboratory experiment to assess the decomposition rate of 18 crop-wild relative species pairs. Two soils of contrasted microbial functional diversity were tested. The CO₂ rate, our surrogate of decomposition rate, was different between crops and wild relatives in most of the species evaluated. The pattern observed differed between the two contrasted soils. The domestication of plant species has deeply changed the litter quality, with direct consequences for ecosystem processes such as decomposition.

S.16-27-O

Resistance of subalpine wooded pastures to climate change.

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Silvopastoral ecosystems in the Swiss Jura Mountains are a key component of the local landscape and provide means for both traditional agricultural practices and for recreational tourism. Their traditional management grants high timber yield and summer forage production for livestock. In the light of land use and climate changes becoming evermore prominent in European subalpine regions their historical sustainability has been put at stake. An important aspect of ecosystem functioning is its capacity for carbon and nutrient turnover in soil. As in other cold biomes, warmer and drier climate influences the latter both directly and indirectly, where the magnitude of change depends on the intensity of land management. In our study, which encompasses in its factorial design intensity gradients of both land use and climate warming, we investigate ecosystem resistance to environmental change. Two year treatment effects demonstrate a curvilinear response of leaf litter decomposition in pasture soils to the warming level, possibly driven by moisture availability. Moderate year-round warming stimulates both microbiological abundance and activity in decaying litter and its mass loss. A more pronounced warming and associated soil moisture shortage, however, limit microbial activity and consequently decrease decomposition rates. Furthermore, farming intensity (i.e., cattle stocking and deforestation), resulting in distinct biotic and microclimate conditions, decreases the resistance potential of these subalpine silvopastures. Our results thus provide essential grounds for local policy makers and farmers to continue the historical practice of wooded pastures and refrain from a more intensive agriculture.

S.16-28-P

Contribution of weeds on soil carbon storage in olive oil orchards.

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Residues of cover crops have a significant role in the soil carbon sequestration of agroecosystems. However, the contribution of weeds of fruity perennial crops, such as olive oil groves, in the sequestration of carbon has received little attention. In this study, annual aboveground carbon of weeds of ten commercial olive oil farming (VF) has been quantified. In addition, the pool of soil organic carbon (SOC) and the content of unprotected (NPC) and chemically (CPC), physically (PPC) and biochemically protected carbon (BPC) was assessed at 0-5 and 5-15 cm. For five farming the data were compared with comparable olive oil farming without vegetation (NVF). Annual organic C input into the soil averaged 560 kg ha⁻¹. A high percentage (67%) of the organic C of top 5 cm soil was protected, mainly CPC (silt+clay size fraction) and increased up to 75.5% in the deeper soil layer. All SOC fractions were linearly related to SOC. The SOC in VF was between 2.4-6.2 times higher than the NVF in the top 5 cm soils but between 0.96-3.9 in the 5-15 cm layer. Typically, soil NPC of the top 5 cm was the fraction which most increased in the VF, followed by CPC. However, CPC accounted for the highest increase in the 5-15 cm layer. On average, the deficit of carbon saturation decreased by 18% for the top 5 cm in VF. The presence of natural vegetation in the intercanopy of olive oil farming is a significant strategy to storage carbon in protective pools, especially that associated with the mineral fraction.

S.16-29-O

Relative importance of landscape and field agricultural intensification components on european farmland birds.

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European farmland bird populations have decreased dramatically in recent decades. Agricultural intensification has been identified as the main cause contributing to these declines, but the underlying mechanisms remain less understood. Agricultural intensification is considered a multivariate process whose components are often difficult to disentangle. Identifying which specific pressures are driving those declines seems vital for bird conservation in European farmland. In this large-scale study we investigate in five European countries, covering a north-south and an east-west gradients, the relationships between two groups of agricultural intensification factors, related to either field or landscape management, and the density of ground-nesting specialist farmland birds, seeking to discriminate their relative importance on the variability of bird populations. Through variance partition analysis, we compare the effect of both groups of factors over the density of individuals and breeding territories of 30 farmland bird species on cereal fields. To examine the contribution of particular factors within those groups, we apply an AIC-based multi-model inference approach, weighting the importance of each predictor in a set of several competing linear models. Together, agricultural intensification factors explained 20% of variation of farmland bird densities in the data set, and 42% of variation of breeding territories. In both cases, the most significant group of factors was that related to landscape management, being field size, habitat diversity and number of different crops around the focal field the most important ones. Significantly, factors related to field management increased their importance from 4.6% explained variance in the case of individual bird densities to 17.5% explained variance in the case of breeding territories. We conclude that while management actions aimed at bird conservation taken at landscape level could have a positive effect on overall bird densities, those taken at field level are vital to preserve breeding populations.

S.16-30-P

Improving pest control for sustainable agriculture.

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Pest control by natural enemies' i.e. predatory arthropods and parasitoid wasps is an important ecosystem service and essential for a sustainable agriculture and food production. Intensification of agricultural practices has transformed large areas of natural ecosystem into managed ecosystem. Complexity at multiple and spatial scales has been greatly reduced and biodiversity has declined. To increase the production of biological control it's of great importance to study which management improvements that have the potential to increase the abundances of natural enemies. Three hymenopteran parasitoids controls the pollen beetles (*Meligethes aeneus*), a major pest species on oilseed rape in Europe. Agricultural practices i.e. tillage and pesticide application affects organisms inhabiting the field by causing mechanical injuries, burial and poisoning, resulting in either direct mortality or sub lethal effects. Reduced tillage did not increase the number of emerging parasitoids from the soil in the following spring compared to conventional tillage practice. Insecticide (pyrethroid) application reduced the number of emerging parasitoids. The mechanism behind could be either a direct effect (mortality or sub lethal damages) caused by insecticide exposure or an indirect effect due to reduced densities of pollen beetles (potential hosts) or a combination of those. A consequence of pyrethroid application could be a reduced number of parasitoids in the landscape and a lower level of biological control. Such a scenario would be particularly problematic in regions with a pyrethroid resistant pollen beetle populations as in several European countries.

S.16-31-O

Assessing the effect of the time since transition to organic farming on plants and butterflies.

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Organic farming is used as incentives to farmers to modify their management in favour of the environment. When a farm converts to organic farming, a positive effect on local biodiversity is expected. However, it might take some time before species can respond and for the potential benefits to be manifested, but information about this is scarce. In this study we examined plant species richness and butterfly species richness and abundance in response to the time since transition to organic farming. We used farms that had been under organic management between 1 and 25 years, allowing us to analyse the long-term effects of this change in land use. Plant and butterfly species richness were approximately 20% higher on organic farms and butterfly abundance was about 60% higher, compared to conventional farms. No temporal effect on plant or butterfly species richness was found, indicating that the main effect occurred immediately after the transition to organic farming. In contrast, time since transition affected butterfly abundance gradually with a 100% increase over the 25 year period. These results indicate that evaluation of the effects of organic farming on biodiversity can be valid shortly after the farming system transition, but also that a short term approach may be risky and could underestimate the true benefits. We will also present some preliminary results elucidating if the underlying mechanisms to these responses can be derived from different life-history traits.

S.16-32-P

Optimization of the diversity-ecosystem services linkage in forage crops.

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Under global change, it is necessary to develop management strategies which optimize the provision of agroecosystem goods and services. In this study, we developed an integrated analysis of some of the processes involved in the diversity-function relationship. Monocultures and three species mixtures containing a grass (*Festuca arundinacea*), a legume (*Medicago sativa*) and a forb (*Cichorium intybus*) were sown to test the effects of diversity on sward ecology. GHG emission rates were measured with a photoacoustic sensor and chambers, as a function of sown species identity and diversity effects using a simplex design, before and after irrigation periods. Other variables such as the biomass, specie composition, leaf area index (LAI), soil inorganic N content and leaching were assessed to determine the mixture composition and management which optimize agroecosystem functions. Our preliminary results support the hypothesis that ecosystem services are modulated by plant composition, and environmental and management factors. GHG emission was higher in monocultures, where a higher inorganic N soil concentration was detected. Biomass, productivity and LAI were higher in mixed swards than in monocultures. Therefore a diversity effect was found for the variables studied, with values in mixtures above those expected from the proportions of the sown species. Besides, there was a seasonal substitution of species dominance, thus maintaining overall total yield. Subsequently, mixtures showed a higher stability than monocultures. Conversely, we found a negative effect of total biomass on leaching. Those analyses suggest that diversifying forage-based systems could contribute to climate change mitigation while improving ecosystem productivity and resilience.

S.16-33-P

Ecology and management of multiple ecosystem functions important for crop yields.

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As a consequence of agricultural intensification, functionally important species groups such as natural enemies to crop pests and pollinating insects have declined, but the effects on the ecosystem services provided are still not well explored. In this project we address how local (field) and landscape scale habitat modifications affects communities of beneficial and pest insects and their multiple functions (pollination, herbivory and parasitism) using clover seed production as a model system. Preliminary data highlight the importance of both pollinators and seed predators for crop yields in this system. Further, experimental data show that the levels of pollination and pest control affect crop yield in an interacting manner, which means that there are potential pitfalls linked to inferences made from single service studies. We aim to provide joint management guidelines for pollination and pest control by further analyzing data on how ecosystem services are influenced by (1) measures to improve the local habitat for beneficial insects (altering pesticide regime, providing flower resources for pollinators and alternative hosts for natural enemy parasitoids) and (2) land use on the landscape scale.

S.16-34-O

Seed dispersal by livestock promotes biodiversity conservation in agroecosystems.

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Extensive grazing is a traditional component of many high natural value agroecosystems, but it is now in decline under economic pressure to intensify. The cessation of grazing can accelerate the biodiversity loss in traditional landscape mosaics of crops, fallow land and pastures via numerous processes, most notably halting seed dispersal. Greenhouse-germinated livestock dung samples (3 g dry weight), collected in late spring and early summer from different agrarian landscapes in Central Spain, showed typical densities above 10-15 viable seeds/g and considerable species richness. We also found that these seeds take an average of 24 hours or more to be defecated following ingestion by sheep. Epizoochory was also found to be a highly effective mechanism for plants: the seeds of many species cling to animal fur in movements of barely 50-100 m through species-rich plots, and 23-70% of adhered seed remain in sheep wool for ≥ 2 days. Thus both epi- and endo-zoochory are intense processes that affect many plant species, even though seed size, shape and hardseededness are functional traits that significantly affect dispersal potential. In conclusion, traditional livestock grazing in agroecosystems, characterized by daily movements from the stable through the surrounding fields combined with seasonal long-distance transhumance, gives plants the ability to reach all points of the grazed area. By this means livestock aids the maintenance of plant species richness in a shifting habitat mosaic in which they would otherwise go extinct. Moreover, the presence of livestock and its dung triggers other processes promoting biodiversity maintenance in agroecosystems

S.16-35-O

Diversity patterns and pollination services of wild pollinators in agro-natural gradient.

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Bees provide vital pollination services to crops and wild plants. Modern agriculture relies on a few commercially grown bee species for pollination even though wild bees can provide significant pollination services. The reliance on honey bees as the main agriculture pollinator is inherently risky and they can negatively affect the wild bee fauna. Little is known about the contribution of wild bee communities to crop pollination in the different ecosystems of Israel and how it is affected by land-use practices. In two study systems in Israel, a Mediterranean and an arid agro-ecosystems, abundant and diverse wild bee communities were found in the open landscape surrounding agriculture fields and orchards. In both study systems the activity of wild bees on crops was significantly affected by land-use practices at the field and landscape scales. Nevertheless, commercially grown honey bees were the main visitor in all the Mediterranean sites studied. In the arid ecosystem, in traditionally managed watermelon fields wild bees contributed more visits to crop flowers compared to managed honey bees, while in the intensively managed fields commercially grown honey bees were almost the sole visitor. No correlation was found between visitation rates of honey bees vs. wild bees. Overall, we found that the contribution of wild bees to crop pollination is greatly affected by agriculture practices (intensive vs. traditional) and surrounding land-use. Under the intensive agriculture practices common in many parts of Israel, the contribution of wild bees to crop pollination, especially in the arid zone, might be limited.

S.16-36-P

Field seed production and germination rate of *Pinus canariensis*, a fire-resistant and fire-evader pine species, in a fire chronosequence.

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Forest fire is one of the most common perturbations in the Mediterranean area and the process of regeneration of many Mediterranean species depends on the occurrence of fires. The Canary Island pine (*Pinus canariensis*) is highly adapted to fire, but it is unknown how it affects their long-term regeneration, especially the production of seeds and their germination capacity. We built a forest fire chronosequence in the island of La Palma where seed rain and germination of *P. canariensis* were monitored during 3 years. Data were analyzed using generalized additive and linear models (GAM and GLZ respectively). Seed rain showed no significant differences between ages of fire, while the germination rate did it. GLM showed that the time elapsed after fire, as well as precipitation and density of adult pines influences the seed rain and germination rate. GAM showed that both variables were influenced only by forest parameters such as precipitation, canopy coverage and density of adults. The production and release of *P. canariensis* seeds does not depend on fire although it may have a negative impact. The pattern of seed release seems more adapted to exploit windows of opportunities for establishment or colonization of new habitats. Therefore, it is necessary to study in detail the regeneration process as a whole in this species to fully understand the role played by fire in its regeneration, as well as the impact of a possible change in fire regime due to global change.

The importance of secondary habitats in organic and low-input farms for biodiversity. The case of dehesas and olive orchards in Western Spain.

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Among agricultural land uses, organic and low-input farming systems are expected to be more environmentally sound than intensive agriculture, which is dependent on the standard use of pesticides and inorganic nutrient applications in the production of crops and animals. Organic farming frequently positively contributes to biological diversity, especially with regard to the species-richness of plants and bird abundance. However, for some invertebrates such as earthworms, butterflies, spiders and beetles the trend is not always as clear (Hole et al. 2005). For these latter biological groups, the presence of non-productive or marginal habitats, usually higher in organic and low input farming than in intensive agriculture, can become essential. Here we assessed the contribution of lineal elements and marginal habitats (secondary habitats, hereafter) to overall species richness of plants, wild bees, spiders and earthworms in the two main farming systems (olive and dehesa farms) of northern Extremadura, one of the most High Nature Value (HNV) farming region in Europe. With close to 200,000 ha, organic olive plantations are amongst the most important organic farming systems in Europe. Dehesa, a low-input silvopastoral system, is amongst the most prominent HNV farming system and maintain a high biological diversity including several globally endangered animal species. A large proportion has been included in the Natura 2000 European web for nature conservation and dehesa grasslands are protected by the EU Habitats Directive. In the present study, 10 dehesas (ranged 200-800 ha) and 20 olive farms (10 organically and 10 conventionally managed; ranged 1-25 ha) were monitored in spring 2010. Four biological groups were measured in each of the mapped habitat according to standardised protocol proposed by EBONE project for European landscapes (Bunce et al 2011), following the procedures adopted by the European Project BioBio (Dennis et al 2010). 114 areal habitats and 31 lineal elements were monitored in dehesas, 42 and 11 in organic olive farms, and 33 and 6 in conventional olive farm. They belong to 25 different habitats in dehesas, and 12 in olive farms. A large list of flowering plants was identified in dehesas (439) and olive farms (334). Most of the habitats presented some unique species, which were not found in the rest of within-farm habitats. Main habitats, in term of surface, harbour only around just a third of plant species. Plant community was more diverse in organic than conventional olive farms ($p = 0.10$), what is mostly explained by their higher number of habitats. Secondary habitats, and very importantly lineal elements, revealed even more essential for bees species richness. Up to 80% of 75 species were found in these small patches. Spiders were more abundant in secondary habitats than in large habitats, and around two third of the 172 species were found in the formers. Although with a much lower richness, earthworms (17 and 19 species in olive and dehesa farms, respectively), the pattern was similar. In this case, small wet patches, either natural or artificial, concentrated most of individuals and in a less extent, of species. Overall, our data demonstrate the important role of secondary habitats even in low-input and organic farms for diversity of invertebrates and plants. References Bunce RGH, Bogers MMB, Roche P, Walczak M, Geijzendorffer IR and Jongman RHG. 2011. Manual for Habitat and Vegetation Surveillance and Monitoring: Temperate, Mediterranean and Desert Biomes. First edition. Wageningen, Alterra report 2154. 106 pp. Dennis P, Herzog F and Jeanneret P (Editors), Arndorfe M, Bogers M, Bunce RGH, Bailey D, Choisis J-P, Choisis N, Cuming D, Ehrmann O, Fjellstad W, Franck T, Fraser MD, Friedel J, Geijzendorffer I, Gomiero T, Jongman R, Kainz M, Kölliker R, Last L, Lüsche G. Moreno G, Nicholas P, Paoletti MG, Papaja- Hülsbergen S, Pelosi C, Pointereau P, Sarthou J.-P, Schneider M, Siebrecht N, Targetti S, Viaggi D, Wilkes J and Wolfrum S. 2010. Selection and field validation of candidate biodiversity indicators, including field manual. Handbook for testing candidate indicators of organic/low-input farming and biodiversity. Deliverable D2.2. BioBio Project. Hole DG, Perkins AJ, Wilson JD, Alexander IH, Grice PV, Evans AD. 2005., Does organic farming benefit biodiversity?. *Biological Conservation*, 122, 113-130.

S.16-38-P

Evolution of ecosystem services in intensive and extensive Agricultural Systems.

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CEAMA. CEAMA. CEAMA.

This study assesses the status and trends of ecosystem services provided by biodiversity in two types of agricultural systems: extensive and intensive agriculture, which co-exist locally in Andalusia, Spain. Extensive agriculture is developed on a steep relief, organized by small terraced plots in a region known as Las Alpujarras. Intensive farming, instead, is practiced on low-slope land and usually in greenhouses on the coast of Almeria. On this purpose, the status and trends of selected provisioning, regulatory and cultural ecosystem services were evaluated, in a time span from 1950 to today. The aim of this study was comparing the variation of ecosystem services between two close areas, which have developed differently within that period. In Las Alpujarras, especially the relief has determined that the operating system has been less vulnerable to the intensification process, without changes on its structure or function. On the coast, nevertheless, the process has been reversed, encouraged by agricultural policies. It is therefore an ideal laboratory to compare the evolution of services provided by both agricultural systems. The results show that there has been a trade-off in the intensive agricultural system, with a drastic reduction in regulatory and cultural services to benefit of the provisioning services. This conclusion contrasts with the one obtained about the extensive agricultural area, where the provisioning services have decreased, while regulatory and cultural ones are maintained and even improved.

S.16-39-P

A model for biodiversity in mosaic landscapes - ecology meets economics.

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Many landscapes are a mix of several different habitats. This is certainly true for agricultural landscapes, which are often a mix of e.g. cropland, semi-natural grasslands and other marginal habitats (for example field margins or hedges). An important conservation problem is how to best allocate resources, such as limited agri-environment scheme funds, between different habitats of conservation concern. We have constructed a model to help solve this problem. The model is based on two simple assumptions. Firstly, that a habitat can be characterized by the biological community inhabiting it; i.e. which species occur and at what densities. Secondly, that the probability of encountering a species in a particular unit of land of a habitat is dictated by its density in the habitat, its spatial aggregation, and the size of the land unit. This leads to a multi dimensional species-area relation (one dimension per habitat). If the goal is to maximize species richness at the landscape scale, within a fixed area or under a limited budget, the model can be used to find the optimal allocation of the different habitats. In general, the optimal solution depends on the total size of the species pool of the different habitats, but also their similarity. If habitats are complementary, a mix is usually preferred, even if one habitat is poorer. Also, land prices of the habitats will affect the solution, and the model can be used to estimate the number of species gained per € invested in each habitat. Empirical examples will be given.

S.16-40-P

Distribution of Natural Enemies in intensively managed agricultural landscapes.

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It is known that some species of ground beetles (Coleoptera: Carabidae), rove beetles (Coleoptera: Staphylinidae) and spiders (Araneae) natural enemies of economically significant pests like aphids (Aphididae), and it is also known that predation on aphids by these types of natural enemies can lead to significantly increased grain yields. Knowledge of the dynamics in space and time of natural enemies, like carabid beetles, is crucial for the understanding of how agricultural land use and configuration affects their distribution. Relatively little is known of how distribution and diversity of natural enemies in crop fields in relation to non-crop habitats influence suppression of crop pests. Studying properties of the species composition, from local to regional landscape scales could help reveal interesting information on as to why the distribution of natural enemies like carabids is the way it appears. A large potential benefit of maintaining beta diversity may be as insurance to variable environments. Disentangling the mechanisms for the distribution patterns of natural enemies in the agricultural landscape is a key to quantify their potential as providers of pest control services. How are Carabids distributed throughout the intensively managed agricultural areas? Do properties of the species assemblages mainly change with increasing distance or are factors such as crop and soil type more important factors that determine differences in species composition and distribution patterns of specific species at larger landscape scales? These are questions that need answers if we seek to adopt more sustainable agricultural management practices.

S.16-41-P

Latitudinal species turnover and diversity in grasslands associated to agricultural soils of the Pampas.

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Faced with concerns about the possible effects of global change on biodiversity and ecosystem function it is essential to generate information about the response of native vegetation to abiotic gradients. Mesophytic grasslands, associated with soils without limitations, which spread over large longitudinal and latitudinal gradients are the most extensive and productive pampas vegetation. These grasslands have largely been replaced by crops and pastures as a result of the intensification and expansion of agricultural activity. In order to design guidelines for sustainable management of remaining grasslands, to restore those that were replaced or to protect native populations from rapid environmental change, the identification of main determinants of the heterogeneity of this grassland is required. This paper assesses the floristic and structural changes in a latitudinal gradient spanning a segment of 5 degrees latitude, from the Mesopotamic Pampa to the Southern Pampa. Ninety-four remnant grasslands on deep soils without hydro-halomorphic limitations were surveyed, grouped in five inventories located at different latitudes. The presence of 360 species was recorded, of which 86% are natives. Fifteen percent of native grasses are shared by the five different latitudes studied, while 43% are unique to one of them. The identity of the native species present in each environment reconstructed the approximate geographical location of inventories in the space generated by an ordination computed with Correspondence Analysis. Native species richness decreases with latitude and with the level of fragmentation of the landscape, measured as average size of grassland patches.

S.16-42-P

Effects of irrigation on Arthropod diversity in a Mediterranean agricultural landscape.

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Irrigation is an increasing driver of agricultural intensification in Mediterranean countries where large areas of dry farmland are being transformed into irrigated farmland. The effects of irrigation on biodiversity in agro-ecosystems are poorly known. Here we compare the abundance, richness and diversity of arthropods in a Mediterranean area subjected to two contrasting farming management types (i.e. extensive dry and irrigated) in northwestern Spain. Arthropods were sampled in thirty-seven wheat fields (i.e. 12 in irrigated and 25 in dry land). The samples were taken in July using sweep netting along transects parallel to the field margin. Arthropods were identified at different taxonomic levels: order (all groups), family (Araneae and Heteroptera), genus (Coccinellidae) and species (Aphididae). Contrary to expected, irrigated wheat fields showed higher values of abundance (total number of individuals per field), richness (total number of groups in a taxonomic level) and diversity (Shannon-Wiener index) than dry wheat fields. Irrigated farmland might buffer the summer drought period characteristic of Mediterranean climate, boosting arthropods diversity. These findings suggest that irrigation effects on arthropod biodiversity, and thus the choice of proper agri-environmental schemes, may differ between Mediterranean and central and northern Europe agro-ecosystems. This research has been financed by the projects of Junta de Castilla y León (SEK02B06) and Ministerio de Educación y Ciencia (CGL2006-05047/BOS). O. Pérez Fuertes was supported by a PhD scholarship of Ministerio de Educación y Ciencia (Orden EDU/3083/2009, de 6 de noviembre).

S.16-43-P

Effects of landscape configuration in the occupation of irrigation ponds by waterbirds.

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Human development has produced an intensification of the agriculture to cover the increasing demand. This has undergone several negative effects to the environment such as introduction of exotic species, habitat fragmentation, alteration of hydrologic systems, or decline in the biodiversity associated to agro-systems. Waterbirds are one of the most threatened groups in semi-arid areas because they depend on the presence of water for their survival. Wetlands are affected by agriculture intensification because it may produce the contamination of the water and the drainage of big surfaces. Nevertheless, some avian species have been able to colonize artificial wetlands and use them. In this study we investigate how landscape characteristics influence spatial patterns of waterbird occurrence at irrigation ponds. Also we explore at community and species level, the partial contribution of landscape, pond features and spatial localization. Multivariate models for richness and abundance of waterbirds show that pond characteristics had a higher influence than the landscape configuration. At species level, we found a high variability in the explicative power of the occupation models. The pond characteristics variables have the higher effect in general. Differences in the effect of the variables are probably related to the ecology of the species. Land use and landscape configuration surrounding the irrigation ponds have relatively little influence on species richness and abundance of waterfowl, especially on those species that use them as feeding habitat.

S.16-44-O

Crop genetic diversity benefits farmland biodiversity in cultivated fields.

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Although it is established that the genetic diversity of dominant plant species can influence community composition and ecosystem processes, this phenomenon has never been examined in agroecosystems, where crops constitute a major fraction of the biomass. The use of a few genetically homogeneous crop varieties (inbred lines or hybrids) in intensive farming systems has resulted in a widespread erosion of crop genetic diversity both at the field and landscape scales. This may add further to the loss of farmland wild biodiversity with major consequences e.g. for ecosystem services (pollination, biocontrol or nutrient cycling) in agroecosystems. Here, we tested whether increasing crop genetic diversity benefited farmland biodiversity in bread wheat (*Triticum aestivum*) fields, using an experimental approach in the field where we compared arthropod (springtail, spider and carabid) and wild plant diversity in a genetically homogeneous wheat variety vs. a variety mix. We showed for the first time a positive impact of crop genetic diversity on below and aboveground arthropod diversity at field scale in agroecosystems, which may be caused by a wider variety of food resources or more complex crop architecture. Higher species diversity in genetically diverse fields may promote ecosystem services such as biological control and soil regeneration, but this remains to be tested. Increasing crop genetic diversity could therefore be an easy-to-implement scheme of paramount importance, benefiting farmland biodiversity and, thereby, ecosystem services.

S.16-45-P

Biodiversity, ecosystem services and sustainable farming practice.

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In many developing countries, governments are looking to use improvements in the agricultural sector as a means of lifting people out of poverty. In Uganda, the government has used a series of five year initiatives to reduce poverty amongst smallholder farmers through intensification of farming, improved varieties and better market access. Consequently, many ecosystem services are under threat as farmers move away from natural fallows and shifting agricultural practises to more intensive methods of farming. This intensification of land management is likely to impact on the ecosystem services in the area and trade offs between services may become apparent. We quantified the provision of multiple ecosystem services including provisioning, supporting, regulating and cultural services across an intensification gradient in central Uganda. We determined the trade offs and synergies between them and predicted the consequence for these services as a result of future increases in population density and subsequent agricultural intensification. We show that a cultivation intensity of two thirds cropping and one third fallow is the most sustainable option to maximise ecosystem services and farmers income.

S.16-46-P

Use of allelopathic green covers in abandoned lands: short term effects of phenolic acids in soil n cycling.

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Phenolic acids (PAs) are involved in distinct functions in plants, such as protection and allelopathy, and may account for 20 to 30% of the biological carbon cycling. Nitrogen is a limited nutrient in many ecosystems and its scarcity is expected to increase under a global change scenario. Since the availability of N in soils depends on C pools, PAs could play an important role on it. We analysed the effect of PAs in the soil N cycling of an abandoned agricultural soil, in the presence/absence of an intercrop cover of *Lolium multiflorum*, a high N-demanding grass with allelopathic potential. We sampled in spring and autumn of 2009 and 2010. We extracted 24 cores in bare soil and 24 in cultivated soil, and sprayed them with 10 ml of the following treatments: 1) phenolic mixture of ferulic and p-coumaric acids at low concentration, 2) and at high concentration, 3) *Lolium* aqueous extract and 4) distilled water. After 1-day field incubation, we analysed soil samples for nitrate and ammonium pools, nitrification potential (NP) and microbial biomass N and C. Cultivated soils displayed higher microbial biomass N and C; and lower mineral N pools and NP rates than bare soils. Regarding phenolic additions, *Lolium* extract and high phenolic concentrations diminished microbial biomass N and C, and NP rates after 1-day incubation. Eventually, PA's effect on N mineral pools depended on vegetation cover: *Lolium* extract and high phenolic concentrations diminished N mineral pools in bare soils whereas no effect was detected in covered soils

S.16-47-O

The effect of farming system on invasibility: A study using *Amaranthus retroflexus* in maize crops.

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While the negative effect of invader weeds on crop yields have been widely regarded in agroecosystems, few studies, to our knowledge, have devoted to the role of farming system on invasion process. The aim of this study is to analyse if invasibility could be affected by farming system. To this end, the growth, reproduction, and the predation by slugs and insects of the invader weed *Amaranthus retroflexus* in relation to farming system were evaluated. The study was carried out in maize crops under organic and conventional farming practices within, a long-term experiment [(DOK (biodynamic, bioorganic. Konventionell) trial, Therwil, Switzerland)]. Two organic systems (biodynamic and bioorganic) and two conventional systems (using mineral fertiliser plus farmyard manure and using mineral fertiliser exclusively) were emulated in a replicated field plot experiment. The experiment was based on simulated invasion by *A. retroflexus* through seedling transplant introductions into farming systems. The growth of *A. retroflexus* was significantly higher in conventional systems. The higher mineral fertilisation and its fast release of nutrients lead a greater availability and a more efficient uptake of limiting resources (i.e. N and P). The higher pre-reproductive mortality in conventional systems was mainly related to the higher slug predation (*Arion hortensis*) on soft plant tissues at above and below-ground of *A. retroflexus*. The outcome of the balance between the negative effect of predation by slugs and the positive effect of resources availability on growth of *A. retroflexus* through the different systems reflects that invasibility is enhanced in conventional systems.

S.16-48-P

Traditional syvopastoral systems management and germinative response of leguminous scrublands with hard seeds, according to its age.

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Abstract: We studied the effects of traditional human activities on the germination of four different leguminous scrublands with hard seeds according to the age of the seeds. For this procedure, we experimentally simulated the diurnal changes of the temperature (thermal contrasts), those which seeds in the soil may be subjected during the summer months, as a result of the periodic tillage. The results showed that diurnal thermal oscillations produced a seed scarification, variable depending on the age, for all species. Among them, in *Adenocarpus lainzii* (Castrov.) Castrov., this effect was showed even in the seeds which were recently collected; remain constant with the age; while in the three studied species of *Cytisus*, we only saw this effect when the seeds had a certain age. Other effects, as seed abrasion by rubbing with soil sand, were not observed. Therefore, species of *Cytisus* are more appropriate for silvopastoral management because they initially accumulated a greater proportion of seeds in the soil, whose availability for germination increase after ten or fifteen years. **Key words:** adenocarpus, broom, seed scarification, seed bank.

S.16-49-P

Biodiversity of agriculture mini plots inside cities / conurbations (often within protected landscape areas).

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Free open spaces with vegetation in cities and conurbations have important functions for human health and urban climate. Agricultural areas are "islands" within built-up areas, residential areas a.s.o.; or they are stretching from peri-urban areas into built-up areas of cities and conurbations. Agricultural plots for food production have generally less volumes of living biomass with less bio-climatic effectiveness for human health, e.g. for clean air. Monoculture food plots can need a lot of pesticide spraying (especially vineyards). In cities exists the danger of drifting sprayed pesticides and soil particles by tillage into residential areas (input of air-borne pollution from mini plot viticulture inside cities). The historic pre-industrial urban agricultural landscape was characterized by high biodiversity, species rich ground vegetation e.g. in vineyards, often mixed cultures with fruit trees and vegetable, without problems of air pollution by pesticides. The biodiversity is now strongly reduced by tillage, use of herbicides, partially used short-time grass cover or herbs (a table of rare species). Historic cultural landscape of a specific pre-industrial era can be preserved only if there is carried out also the historic farming system. Some resulting special tasks for town and landscape planning are measures against negative effects like air pollution: distance zones; shelter-belt hedges. Remaining forests on upper slope shoulder, and groves along slope erosion depressions / valleys can protect small agriculture areas from cold air masses. Do not level erosion depressions / valleys with different sites and high biodiversity for gaining plane areas!

S.16-50-O

Biodiversity conservation and the future of agricultural intensification.

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Conversion of natural habitat and agricultural intensification are the most important drivers of global losses in biodiversity and associated processes. Combining efficient agricultural land use with biodiversity conservation is a challenge. Phalan et al. (2011, Food Policy) suggest to separate farming and conservation, segregating land for nature from land for production (land sparing) instead of land sharing for both production and conservation alike (wildlife-friendly farming). These authors argue that agricultural intensification, thereby globally restricting human requirements for land, will be important in limiting the impacts of increasing food production on biodiversity. In my talk, I will provide evidence that this proposal how to maximize biodiversity conservation and yield to feed a growing population do not take a multiplicity of constraints into account. Hunger and poverty mitigation as well as sustainability in food production and biodiversity conservation require different strategies.

S.16-51-P

The effect of agricultural intensification on the quantity, diversity and metabolic footprint of nematode communities.

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Aristotle University of Thessaloniki. Aristotle University of Thessaloniki. Aristotle University of Thessaloniki. Aristotle University of Thessaloniki.

Agricultural intensification is expected to increase in order to cover the raising demand for food, fiber and bioenergy. Sustainable provisioning of these goods relies mostly on soil ecosystem services, i.e. supporting functions of soil organisms. Different management regimes in various climatic regions disproportionately affect soil organisms and their functions. It is important to understand which of the latter and to what extent are influenced by agricultural intensification in order to optimize ecosystem service flow and production in the long term. Soil nematodes are among the most preferred bioindicators as they are directly or indirectly involved to the most important soil functions while presenting a variety of life strategies, food preferences and are sensitive to disturbance and pollution. In this study in two different seasons (autumn and spring) nematodes from three different levels of agricultural land use intensity (grassland, perennial and annual cultivation) at four different regions (Sweden, UK, Czech Republic and Greece) are analyzed in terms of quantity, diversity and regarding their metabolic footprint. Quantitative characteristics (abundance and biomass) of nematodes decrease with the increase of agricultural intensity regardless sampling season or geographical region. The diversity of communities is also influenced by intensity but not regarding number of genera or composition but mostly structure. The nematode metabolic footprint (lifetime amount of C partitioned to body/egg production and C utilization in metabolic activity) decreases with intensity, a pattern that does not change much among countries although higher values are recorded in UK and Czech Republic than Sweden and Greece.

S.16-52-P

Patterns in soil C stocks in naturally reforested areas. Relative importance of time since cultivation stops, substrate and plant species.

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CIFOR-INIA. Ftad de Farmacia, UCM. Ftad de Farmacia, UCM. Ftad de Farmacia, UCM. Ftad de Farmacia, UCM. Ftad de Medio Ambiente, UCLM.

Soils in forested areas are a relevant organic matter stock reservoir in many ecosystems. Land use changes can alter strongly the soil organic matter amount. In this work we analyzed the patterns in the amount and type of the organic matter accumulated in soils in a 2x2.5 km area in the river Alberche valley in the west of the Madrid autonomous community. During the last decades there have been strong changes in the land use patterns of this area. From a vineyard dominated landscape with scattered areas of natural vegetation we have changed to the reverse situation. Most of the area is now dominated by sclerophyll Mediterranean vegetation with scattered vineyards. Objectives of this work are to compare the relative importance of several factors in the patterns of organic matter accumulation in soils. The factors considered are: (a) type of lithological substrate (metamorphic vs. eruptive rocks), (b) the time since cultivation cessation (from 1957 to 2010 and based in an aerial photograph time series developed for this area) and (c) the type of plant under which soils were sampled. We sampled close to 100 points covering natural, recolonized by natural vegetation and cultivated areas.

S.16-53-P

Fungal endophyte *Epichloë festucae* alters grass-host responses to abiotic stresses.

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Endophytes are a group of fungi characterized by being able to infect plants without causing obvious symptoms in their hosts. Recent studies have shown the existence of thousands of species of endophytic fungi, and no plant species free of them is known. *Epichloë* and *Neotyphodium* endophytes infect grasses and they are seed-transmitted. Because of the ecological benefits of infected plants there is a considerable interest in the use of these endophytic species for forage and turf grass improvement. The 'Dehesa' ecosystem is an agrosylvopastoral system with particular characteristics like high floristic diversity. Furthermore, in turn grass species contain a high diversity of fungal endophytic species. Previous studies have shown that 70% of *Festuca rubra* plants are infected by the fungal endophyte *Epichloë festucae*. This high infection rate suggests that infected plants have competitive advantages over non-infected plants. The main objective of this study was to determine the effect of the fungal endophyte *Epichloë festucae* in the growth of *Festuca rubra* plants under abiotic stress conditions like water stress and salinity. For this, nfectd (E+) and non-infected (E-) plants from two different ecotypes of *F. rubra* were grown in pots in a glasshouse. The results showed an important effect of plant ecotype. In one ecotype, leaf biomass decreased under water stress; however, in the other ecotype E+ plants had greater biomass than E- plants and it did not decrease under water stress. Under saline conditions the decrease in leaf dry weight was greater in E+ than in E- plants.

S.16-54-O

Flying and ground-dwelling natural enemies provide effective biological control of cereal aphids across landscapes.

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The ecosystem service of biological control of pests by naturally occurring arthropod enemies may be affected by agricultural intensification of the arable landscape. The contribution to the biological control of aphids by for instance flying specialist and ground-dwelling generalist predators may therefore differ between heterogeneous and homogeneous arable landscapes. We hypothesized that the exclusion of enemies will result in higher densities and population growth rates of aphids and that this effect will be greatest in heterogeneous landscapes. Furthermore, we hypothesized that flying specialist enemies will have a relatively higher impact in heterogeneous landscapes, whereas ground-dwelling generalistic enemies will have a relatively higher impact in homogeneous landscapes. We conducted exclusion experiments and measured cereal aphid densities and population growth in 16 conventional cereal fields in two geographically separated regions in Sweden. We compared the effects of naturally occurring enemies in open control plots with plots where we either excluded ground-dwelling generalist enemies (mainly ground beetles, rove beetles and spiders), flying specialist (mainly parasitoids and ladybirds) or both enemy groups. We found that both ground-dwelling and flying enemies are important for suppressing cereal aphids and that effects were additive. Contrary to our expectations, we did not find a difference in biological control potential by different enemy groups in different landscapes, nor was the overall suppression higher in heterogeneous landscapes. We conclude that naturally occurring predators and parasitoids are able suppress cereal aphids in all landscapes and thereby reduce the need for insecticide applications.

S.17- Population Ecology and Community Ecology

S.17-01-P

Is competition between exotic and native tree species modulated by soil characteristics?

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Plant-plant interactions might be modulated by soil biota, and therefore, the outcome of the interaction between two species might change depending on soil type. Invasive species can change soil conditions establishing positive feedbacks that contribute to invasion and impair native plant growth. *Acacia dealbata* is one of the most invasive species in Southern Europe forming dense populations and displacing, among others, the native *Pinus pinaster*. We conducted an experiment of competition between *Acacia dealbata*, *Pinus pinaster* and *Eucalyptus globulus* using soils from monospecific stands of each species. *E. globulus* was included to check if soil disturbance by plantation of other Australian species promotes invasion. The experimental design included monospecific and mixed cultures of the three species. Plants were grown outdoors in 5-L pots for 1 year. Overall, *A. dealbata* growth was significantly higher in its own soil. The highest values for *A. dealbata* biomass were obtained in monocultures on acacia soil and the lowest when growing with *E. globulus* in eucalyptus soil. Interspecific competition was significantly detrimental for *A. dealbata* in the eucalyptus soil, marginally significant in acacia soil and not significant in pine soil. There was a significant detrimental effect of pine soil on the growth of *A. dealbata* in monoculture. *Pinus pinaster* growth was significantly reduced by *A. dealbata* in the three tested soils. No differences on plant growth were found for *E. globulus* growing in competition with *A. dealbata* or in monoculture, but this species outcompeted *A. dealbata* in mixed cultures in eucalyptus soil.

S.17-02-P

Floristic diversity, composition and their environmental correlates on the coralline islands of the Farasan Archipelago, Red Sea, Saudi Arabia.

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The coral islands of the Red Sea are regarded as having a high national and international conservation value because of the diversity of marine and terrestrial habitat. However, urban development, pollution and increasing pressures of commercial and recreational use of resources pose serious threats to the biodiversity of these habitats. In the present study, the species composition, vegetation structure and several environmental factors were investigated for 210 stands on twenty coral islands of Farasan at the Red Sea of Saudi Arabia. Multivariate statistical analysis techniques in the terms of classification (Cluster Analysis) and ordination (Deternded Correspondence Analysis (DCA), and Canonical Correspondence Analysis (CCA) were employed to identify vegetation types and their relevance to the underlying environmental gradients. A total of 191 flowering plants that belong to 53 families and 129 genera were recoded. Geophytes and chamaephytes dominate the saline habitats, while climbers, therophytes and hemicryptophytes dominated the sandy formations and rocky plains. The cluster analysis and DCA ordination resulted in the recognition of twelve vegetation groups, each of definite floristic composition and environmental characteristics, and could be linked to a specific habitat. The main environmental variables controlling the separation of the vegetation groups on the first two axes of CCA were soil salinity and elevation. The results of this study indicated that the flora of the study area has a transitional character where the Saharo-Arabian Desert, Sudanian and Tropical vegetation interact. These findings should guide conservation efforts to maintain species diversity which is threatened by anthropogenic activities and invasion by the exotic invasive tree *Prosopis juliflora*.

S.17-03-P

Are gypsum species locally adapted? A reciprocal sowing assay.Alonso, Patricia. Sánchez, Ana M.. Albert, M^a José. Rodríguez, Marta. Escudero, Adrián.

Universidad Rey Juan Carlos. Universidad Rey Juan Carlos. Universidad Rey Juan Carlos. Universidad Rey Juan Carlos. Universidad Rey Juan Carlos.

The distribution area of plant species is determined by the sum of places the species is able to reach and in which it is able to establish and persist. As much phenotypic plasticity a species has, the more variable the places it lives would be. The existence of variability on key characters at the individual level allows natural selection which can lead to population local adaptation. The aim of this work is to detect the existence of local adaptation and to measure phenotypic plasticity in order to figure out to what extent these two major processes would have determined the species distribution and could conditioned their response to potential climatic warming. In order to do that, five gypsophytes were selected. All they are common on Central Spain gypsum communities but they greatly differ in their distribution pattern and local abundance. Seeds were collected from six localities located in the northern (above sea level height 900 m; mean annual temperature 12.5°C), middle (700 m; 13.2 °C), and southern Tajo Valley (500 m; 14.4 °C). Seeds from all the species and localities were sown in their original locality and all the others in two consecutive years (2007 and 2008) and germination, growth and survival were controlled till May 2011. Species greatly differed in their ability to germinate out of their distribution range. Some of them showed signals of local adaptation while others presented a very plastic germination response. Plant growth was generally greater in the southern localities and survival, very low, was dependent on the germination moment.

S.17-04-P

Giving back fragmentation its importance on biodiversity dynamics.

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The Seine-et-Marne region, near Paris (France), has recently undergone the conversion of agricultural and afforested areas into urbanized areas. These changes of landscape composition and fragmentation are likely to be two of the main drivers of biodiversity loss. Thus, this study aimed at (i) quantifying the relative importance of local land-cover, landscape composition and fragmentation on present distribution of common bird species and (ii) linking the changes in landscape composition and fragmentation of the last three decades with the temporal variations in bird species distribution to highlight relative effects of these 2 factors. We fitted a distribution model for each of the 57 species, according to the local land cover, landscape composition and fragmentation. Using these models, we predicted the differences in species distribution between 1982 and 2003 in order to examine the relative contributions of landscape composition and fragmentation changes to species distribution variations between 1982 and 2003. The local land-cover and the landscape composition appear to have a dominant and more important effect on species distribution than fragmentation. However, when considering recent land-use dynamics influence on species distribution changes between 1982 and 2003, fragmentation appeared to be as common and influential as composition. In concordance with theory, fragmentation appears to be as important as composition on changing distribution of species given that it's observed in a dynamical context. We emphasized the importance of taking the temporal variations of land-cover into account to obtain a clear view of fragmentation effects on biodiversity.

S.17-05-P

Modelling dual interactions between species: the case of ants and seeds.

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The dynamics of plant and animal populations is influenced by their interactions, which can show feedback effects and long-term coupling. This is the case of secondary seed dispersal, where initially seed predation may have a negative impact on plant population, but which can lead to positive effects at the population level due to the dispersion of the seeds/fruits previously removed. In this context, many plant species strongly interact with seed-harvesting ants that prey on and disperse seeds. We have setup a spatially explicit, stochastic population dynamics model to compare different scenarios characterized by the existence of a) ant predation and seed dispersal, b) only one of the two interactions (predation or dispersal), and c) neither of the two. The comparison among the four different scenarios allows uncoupling the effects of such antagonistic interactions on plant populations. The model was run for three shrub species characterized by different plant attributes (size, seed production, primary seed dispersal, seed size, different vital stages survival). The comparison among the different scenarios suggests that the role of seed-harvesting ants on plant occupation is positively related to secondary seed dispersal in those species with limited dispersal mechanisms (gravity), but negatively related to ant predation in those species with longer-distance dispersal mechanisms (ballistic explosion). The results suggest that the result of double interactions is likely to be highly species-specific, dependent on seed attributes.

S.17-06-P

Identifying intra specific drivers of biotic homogenization through the multidimensionality of ecological niche.

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As an operational product of the niche theory, ecological specialization is an efficient predictor of species' distributional responses to climate or habitat changes, and has been used to quantify variations in the functional structure of communities. In particular, the so-called biotic homogenization, which has been identified as one of the most major threats to biodiversity, is often attributed to a differential dynamics between generalist ("winners") and specialist ("losers"). However, most such studies consider specialization as a fixed and integrative characteristic of species at the timescale of global changes. Considering two leading dimensions of the ecological niche directly linked to global changes, habitat and climate, we test this assumption with more than 70 common European bird species through a large-scale, citizen-science based data set (the French Breeding Bird Survey). We show that a two-dimensional framework accounting not only for specialization but also for position on well-defined niche axes helps identifying heterogeneities in the drivers of the winners-losers dynamics. Additionally, interactions between climatic and habitat niche parameters reveal feedbacks between the coarse and fine-grained drivers of species' distributions. At the intraspecific level, specialization varies according to the particular niche axis considered, and is not stable at short time scales; both these sources of intraspecific variation of the ecological niche affect community-level patterns of biotic homogenization. Overall, we argue that a multi-dimensional framework accounting for intraspecific variations of the realized niche is an insightful approach to the mechanisms underlying species' responses to global changes, from fine grained distributions to coarse range patterns.

S.17-07-P

Effect of habitat fragmentation on the reproductive strategy of *Testudo graeca graeca* in the southeastern region of Spain.

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Habitat fragmentation can influence the physical condition and fertility of individuals. However, not all species respond the same way to this situation. This study compares the reproductive characteristics of *Testudo graeca graeca* females in five monitoring surveys throughout the spring 2010 under different levels of habitat fragmentation (low, medium, high) in nine populations. For each captured female morphometric data and clutch size (CS) were recorded. We used chi-square tests to identify difference of gravid females among the five sampling stages and among fragmentation levels. Analyses of variance were conducted to compare the CS among sampling stages, we use linear regression between the morphometric variables and clutch size. Difference was observed for gravid females in relation to sampling stages. Middle spring showed 71.4% of gravid females, while late spring 4.5%. There was differences the CS throughout the spring; middle spring (mean = 3.45) showed the highest CS. There was a difference in the CS among different fragmentation levels (the highest number was recorded in the high fragmentation level). The strongest relationship occurred between the pelvic amplitude and CS ($R^2 = 0.183$, $P = 0.001$). The results show that *T. graeca* showed the highest number of gravid females and the highest CS in May within the southeast region of Spain. It can be considered that habitat fragmentation is affecting the reproductive capacity of this tortoise in the study area.

S.17-08-O

The functional biogeography of species: distributional roles in Wallacea and West Indies.

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We classify species according to their distributional patterns in a modular network of islands and species, and according to this, assign each species a biogeographical role. This role contains information on how individual species are connected across the entire archipelago. We tested whether habitat occupancy, habitat width, altitudinal range-span, feeding guild, trophic level, body length, and IUCN status were related to species roles. Habitat occupancy was found to be most clearly related to species roles. We argue that our species roles correspond to stages of the taxon cycle, supporting that the distribution of a species is highly related to its ecology.

S.17-09-P

Cause of spatial patterns of seedling emergence in a semi-arid gypsum shrubland community: dealing with replicates in point pattern analyses.

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A central issue in ecology is to explain how species coexist in communities and ecosystems. The spatial distribution of plants within a community is the result of a wide amount of factors, such as dispersal, biotic interactions, environmental heterogeneity and fluctuations. Although recent studies include spatial effects over ecosystems dynamics, the effects of spatio-temporal variation over spatial patterning remains poorly understood. Although we have a panoplia of tools to describe spatial patterns, our ability to infer the underlying causal processes is mainly based on speculative ideas. Our main goal is to determine some of the causal processes underlying the spatial patterns that we found in natural plant communities by specifically modeling the effects of habitat heterogeneity and temporal variation. Our data consist on mapped locations (x,y) of emerging plants in a perennial gypsum shrubland community, in central Iberian Peninsula. We applied a field design consisting on replicate plots, and monitored during four years the field emergence of any perennial plant in the community. We used recent techniques on point spatial pattern analysis, based on K functions and combine with several biologically soundly null models. Our results reveal that the seedlings spatial pattern is govern mainly for first order effects. Moreover, at the species level we detected interspecific segregation, based on microsites and interannual fluctuations. The methods and the sampling design used in this work highlight the importance of including heterogeneity in exploring spatial patterns, as well as, using replicates plots to allow us to infer causality of spatial patterns.

S.17-10-O

When do we expect a negative relationship between biodiversity and ecosystem productivity?

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Our natural environment provides humankind with a wealth of benefits ranging from pollination services to waste decomposition and water purification. In the field of ecosystem ecology there exists a prevailing assumption that the quantity and quality of these ecosystem services are positively affected by an increase in biodiversity even if the precise functional form of this relationship is under debate. Whilst the theory of community ecology has grown substantially over the last decade, we are still lacking a generally accepted mechanistic underpinning for this assertion. Moreover, we would expect that in areas experiencing high immigration of maladapted individuals, often referred to as ‘the mass effect’ or ‘vicinism’, we would observe a reversal of this relationship. Using a mixture of simulation models and field data we show that the nature of the relationship between ecosystem productivity and biodiversity is highly dependent upon the spatial scale of the analysis. Increased dispersal and/or increased environmental heterogeneity both bring about negative relationships through increased mass effect when analysed at fine spatial scales. Contrary to the prevailing paradigm, we demonstrate that positive relationships between biodiversity and ecosystem productivity, far from being the default position, should be considered the exception when analysing data at fine spatial resolutions.

S.17-11-P

Felid community in Yungas of northwest Argentina: distribution and richness through modeling.

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Conicet-UNJu.

In the Yungas or subrtropical montane forests of northwest Argentina; Salta and Jujuy provinces live 8 species of felids in sympatry: Geofroy’s Cat *Leopardus geoffroyi*, Pampa’s Cat *L. colocolo*, Ocelot *L. pardalis*, *Oncilla L. tigrinus*, *Margay L. wiedii*, *Jaguarundi Puma yaguouroundi*, *Puma P. concolor* and *Jaguar Panthera onca*, conforming a hotspot for the group. Nevertheless, their distributions are mainly known through specific records only and in very few cases their range is been identified. We gathered presence points from literature and previous works and generated potential distribution maps using 22 environmental variables and the software MaxEnt. 100 runs were performed using randomly 75% of the data for training and 25% for testing. As a general measure of performance we calculated the AUC or area under the ROC curve, which was greater than 0.88 in all cases. The resulting maps were converted to binary using as threshold the mean of the minimum presence logistic value. We superimposed the maps of the 8 species to obtain a species richness and diversity map for the study area at a scale of one square kilometer. We started field trips in the area to conform the presence of the species. Up to now we visited 6 places recording 1 to 5 species in sympatry. Along the north-south latitudinal gradient of the Yungas we observed a gradual decrease in the number of species. Our study indicates that the sectors of Yungas in the upper basin of the Bermejo River and the foothills of Calilegua are most important for the conservation of these cats, because there would be potential habitat for the 8 species studied.

S.17-12-P

Competitive interactions of *Calluna vulgaris* and *Deschampsia flexuosa* in dry heathlands.

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A novel method for measuring plant-plant interactions in natural and semi-natural plant communities, where it is difficult to distinguish individual plants, is presented. It is assumed that the ecological success of different plant species in the plant community may be measured by plant cover and vertical density (a measure that is correlated to the 3-dimensional space occupancy and biomass). Both plant cover and vertical density are measured in a standard pin-point analysis in the beginning and at the end of the growing season and modelled in a state-space model. The presented method allows direct measurements of the competitive effects of neighbouring plants on plant performance and the estimation of parameters that describe the ecological processes of plant-plant interactions during the growing season as well as the process of survival and recruitment between growing seasons. The method was applied on a dry heathland plot dominated by *Calluna vulgaris* and *Deschampsia flexuosa*. Significant competitive interactions were demonstrated among the two species and using the model it was possible to predict the expected community dynamics in dry heathlands. The predicted plant community dynamics were compared to the observed plant community structure in 5000 Danish dry heathland plots. The presented method is suited for testing different ecological hypotheses on competitive interaction along environmental gradients, investigating the importance of competition, as well as predicting different ecological scenarios. Furthermore, the method allows a meaningful investigation of the plant-plant interactions in plant communities that are dominated by perennial species of variable size and where it is difficult to distinguish individual plants, e.g. most grassland ecosystems.

S.17-13-P

Sketching ground-level triangles: *Cytinus* flowers, ants and yeasts in mediterranean scrubland.

de Vega, Clara. Herrera, Carlos M.

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Plant-pollinator mutualisms often involve a third group of microbial players, specifically yeasts, which have been largely neglected by community ecologists and botanists. The study of plant-pollinator-yeast interactions as an ecological trio will improve our understanding of complex trophic webs occurring in nature, and holds the key to answering many questions on the evolutionary ecology of mutualisms. The scarce information available concerning plant-pollinator-yeast interactions mainly focuses on bees and bee-pollinated plants, while no study has so far examined trophic webs that include ants, ant-pollinated plants and their associated fungal microbes. In this contribution we examine the possible three-way interactions linking the parasitic plant *Cytinus hypocistis* (Cytinaceae), its ant pollinators and their associated microbial community. In six plant populations, 192 flowers were examined for the presence and abundance of yeasts in nectar. Yeasts were also isolated from 127 ants belonging to six species known to pollinate *Cytinus* flowers. Yeast species associated with nectar and ants were identified to species by sequencing the D1/D2 domain of the 26S rDNA. Microscopical examination of nectar samples revealed that 77% of *Cytinus* flowers contained yeasts, being identified 19 yeast species belonging to eight different genera. The incidence of yeasts in nectar samples was similar in the six populations, although a significant trend of higher yeast density was observed in some populations which could be related to variation in features of the physical environment and the surrounding plant community. Ants harboured an unspecific yeast biota that included ten different species in the Ascomycota and Basidiomycota. Four ant species clearly favour dispersal of yeasts, as 70% of yeast species transported by these ants were also found in nectar. One ant species did not carry yeasts on its body, likely due to its nocturnal habit and presence on antibiotic substances. Our data strongly suggest the existence of a tripartite interaction linking *Cytinus*, its ant pollinators and a set of yeasts, an ecological trio that may have been maintained by a long history of co-adaptation.

S.17-14-P

Evidence for two ploidy levels in a relict olive population.

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Polyploidy was recently reported in two endangered olive subspecies from North-West Africa. The origin of this phenomenon remains unclear. In the present study, 107 genotypes of a relict Laperrine's olive population from Hoggar (Algeria) were analysed using eight nuclear microsatellites. Diploid and triploid genetic profiles were observed. A flow cytometry analysis confirmed that trees displaying three alleles at several loci are effectively triploid. This report constitutes the first evidence for the coexistence of two ploidy types in an olive population. The triploid genotypes, probably in mean more vigorous than diploid trees, may be positively selected in the absence of sexual regeneration since a very long time, explaining their relative high frequency (2.8%) in the investigated population. Key-words: Flow cytometry, Hoggar, Laperrine's olive, Microsatellite, *Olea europaea*, Triploidy

S.17-15-O

Using spatially structured population processes to elucidate community functioning: demographic responses of a dominant African Acacia tree mediate community-wide effects of termites.

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Demographic approaches can yield detailed insights into when and why populations fluctuate in time or space, including the ways that populations are altered by, or are buffered against, variation created by other community members. Here we ask how the demographic responses of a dominant tree species serve to magnify -- or to moderate -- the community-wide effects of biologically-generated spatial patterns created by another group of dominant community members, termites. Termites and the structures they create are integral components of many African savannahs. However, the routes by which termite mounds influence plant and animal communities are still not well-understood. These effects are of particular interest in light of the strong spatial patterning termites create in many otherwise highly uniform savanna systems. We have previously shown that proximity to termite mounds strongly influences many aspects of the above-ground community in East African black cotton soil savannas, including the nitrogen fixation rates of *Acacia drepanolobium*, a mono-dominant tree. Here, we use a four year data set to quantify the spatial patterning in *A. drepanolobium* demographic rates created by the highly-overdispersed patterning of termite mounds. In particular, we ask how strongly tree establishment, growth, and survival are influenced by termites, and show that while these effects are strong, compensatory effects in different demographic rates help to dampen termite effects. We also ask how interactions between *A. drepanolobium* with its herbivores and ant mutualists are altered by termite mound proximity.

S.17-16-P

Hard traits of three *Bromus* species in their source area explain their current invasive success.

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We address two highly essential questions using three Eurasian *Bromus* species with different invasion success in North America as model organisms: (1) why some species become invasive and others do not, and (2) which traits can confer pre-adaptation for species to become invasive elsewhere. While the morphology and phenology of the chosen bromes (*Bromus tectorum*, *B. sterilis* and *B. squarrosus*) are highly similar, we measured complex traits often associated with invasive success: phenotypic plasticity, competitive ability and generalist-specialist character. We performed common garden experiments, community- and landscape-level surveys in areas of co-occurrence in Central Europe (Hungary) that could have served as donor region for American introductions. According to our results, the three bromes are unequally equipped with traits that could enhance invasiveness. *B. tectorum* possesses several traits that may be especially relevant: it has uniquely high phenotypic plasticity, as demonstrated in a nitrogen addition experiment, and it is a habitat generalist, thriving in a wide range of habitats, from semi-natural to degraded ones, and having the widest co-occurrence based niche breadth. The strength of *B. sterilis* lies in its ability to use resources unexploited by other species. It can become dominant, but only in one non-natural habitat type, namely the understorey of the highly allelopathic stands of the invasive *Robinia pseudacacia*. *B. squarrosus* is a habitat specialist with low competitive ability, always occurring with low coverage. This ranking of the species' abilities can explain the current spreading success of the three bromes on the North American continent, and highlight the high potential of prehistoric invaders (European archaeophytes) to become invasive elsewhere.

S.17-17-P

Contributions to knowledge of structural and functional dynamics of the populations of medicinal leeches in the Braila Marshes complex / the Lower Danube Wetland System.

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The populations of genus *Hirudo*, in the aquatic ecosystem of the Small Island of Braila, have been less investigated despite the fact they represent a component with an important abundance of the community and that the medicinal leeches are appreciated for the services they offer. The researches on the medicinal leeches in Romania are sporadic and reduced to some taxonomic and anatomical aspects that have been achieved in the twentieth century. This paper presents the first results of a research programme that aims to develop knowledge on structural and functional dynamics of the populations of genus *Hirudo* (Fam. Hirudinidae) in the Braila Marshes complex. This is a socio-ecological system of 1000 km², a Long Term Socio-Ecological Research platform including the Small Island of Braila (24555 ha, between km 175 and 237 of the Danube river stretch), Ramsar Site and natural reserves which still preserve an important part of the inland Danube delta remained in free flooding regime. The research programme is extended for three years (2010 - 2012) and aims at: i) identifying spatial-temporal complexity of organizations and functioning of these populations, ii) differentiating the major natural and anthropogenic driving forces and pressure factors responsible for their dynamics and decline, iii) modeling the dynamics of these populations, identified as heterogeneous units with complex structure and iv) providing scientific information for sustainable use of these resources. Preliminary analysis of samples taken during the first year of research indicates the presence of the species *Hirudo verbana* (Carena).

S.17-18-P

Environmental heterogeneity and natural regeneration in riparian vegetation of the Brazilian Semi-Arid region.

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Despite the great diversity and importance of riverine vegetation, this physiognomy has been vanishing all over the world, and there is a lack of knowledge to promote restoration of these areas. This study addresses the following questions: what are the structure, diversity and composition of the regenerating scrub-tree species community along a stretch of riparian vegetation in relation to environmental heterogeneity? In the Protection Area of Pandeiros River, southeastern Brazil, we performed the sampling of the regenerating stratum on 70 plots (25 m²) divided into four groups according to soil characteristics and natural barriers, including woody plants between ≥ 1 cm DSH and < 5 cm DBH. Observations were made of variables related to several soil properties, canopy openness and flooding regime for each plot. In addition to the traditional calculation of phytosociological parameters and diversity, we performed a canonical correspondence analysis (CCA) to examine the existing relationships between environmental variables and species distribution. We sampled 896 individuals distributed among 108 species with a diversity (H') of 3.83 and an evenness (J') of 0.81. The families with the highest species richness were Fabaceae and Myrtaceae and the species with the highest IVIs were *Zygia latifolia*, *Tapirira guianensis*, *Butia capitata*, *Bauhinia rufa* and *Hirtella gracilipes*. The CCA confirmed the groups originally proposed, except for groups 2 and 4, which showed more similarity. Moreover, diversity differed between all of the groups with the exception of groups 1 and 2. Although there were species common to all groups, many were unique to each group, showing that the stretch of riparian vegetation studied was highly heterogeneous with regard to both abiotic variables tested and floristic structure and composition.

S.17-19-P

Impact of land use, resource dynamics and habitat fragmentation on space use of different mammal species in agricultural landscapes.

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Agricultural intensification negatively affects biodiversity and ecosystem functions due to intensive agriculture and habitat fragmentation. The project AgroScapeLabs (Agricultural LandScape Laboratories) explores impacts of land use and destruction of natural and semi-natural habitats on mechanisms affecting biodiversity patterns and ecosystem functions at large spatial scales in agricultural habitats. In a pilot study started in 2011 we study influences of land use patterns and resource availability on the spatial movement and behavior of multiple species to develop predictive space use models. We apply automated GPS-based radio tracking to monitor movement, activity patterns and acceleration of European hares (*Lepus europaeus*), red foxes (*Vulpes vulpes*) and raccoon dogs (*Nyctereutes procyonoides*). Besides the automated recording of animal behavior we also sample environmental variables, in particular land use, management of agricultural fields, landscape complexity and food availability. The study takes place in the Uckermark region in North-East Brandenburg, Germany, which is characterized by different levels of landscape complexity in a highly intensive agricultural area. We hypothesize that: I. Intensity of animal movement and activity patterns can be related to species traits, allometric relations, landscape complexity and land use variability. II. Disturbances through agricultural practice and resource availability influence movement decisions (e.g. migration, dispersal, foraging) to different extents.

S.17-20-P

Habitat selection by a large Mediterranean herbivore responds to patch palatability.

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Habitat selection by herbivores is often studied in terms of plant community composition, but herbivores may be responding to more subtle plant community characteristics such as the overall palatability of a certain patch, which depends on both its botanical composition and specific herbivore preferences. The aim of this study was to test the relationship between habitat selection and community composition based on palatability for the Iberian red deer (*Cervus elaphus hispanicus*). We hypothesised that plant composition would determine overall palatability, and hence the attractiveness of that patch for deer. The study was carried out in a game estate in Central Spain. A total of 72 sampling points were distributed across three main habitats: scrub; scrub-edge; open-edge. Deer abundance was assessed by pellet counts in pre-cleared 1 x 5 m quadrats, and plant cover and species composition were measured at each point. A palatability index was calculated for each point by taking into account the individual cover of each species and a selection index based on previous dietary and plant availability analyses (Savage Selectivity Index). Results showed seasonal variations in the response of deer to patch palatability. Deer were more abundant in more palatable patches during winter and summer, but did not respond to plant composition in spring, the most resource-abundant period in Mediterranean environments. A high cover of highly palatable species, such as *Cytisus* spp., was positively related to deer abundance. Plant community characteristics other than just species richness or diversity should be considered when addressing herbivore habitat selection studies.

S.17-21-O

Climate, dispersal and biotic interactions influence in local colonizations and extinctions of trees in Spain.

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Climate, dispersal ability and biotic interactions are among the factors that most critically influence species distribution. We investigate how different sets of variables affect local colonizations and extinctions of 30 tree species in mainland Spain. We use a non-equilibrium environment-dependent spatially-explicit patch occupancy model (SPOM) to infer which factor combination better describe these processes using more than 25,000 forest survey plots across the whole region. The dispersal process (included as rescue effect for extinctions) could be either random with respect to habitat, to represent wind dispersed seeds, or directed with respect to habitat, to represent animal dispersed ones. We run different models (including one, two or the three sets of variables) and we compared each model fit (AIC) through all the species to measure each single factor or factor combination importance. Besides, the importance that each variable had on both processes, as well as its positive or negative effect has been discussed. Results suggest that colonization and extinction are influenced by different factors depending on the species, and interestingly, biotic interactions and dispersal ability have a critical role in the metapopulation processes.

S.17-22-P

Size-dependent reproductive-performance of the wild olive tree (*Olea europaea* L.) in populations at its distribution limit.

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It has long been known that beneath the variability on reproductive performance we can find both plant traits and characteristics of the place where the plant grows. Size, for instance, is often a good predictor of current and future reproduction. Climate conditions or availability of resources may also influence reproductive performance. In perennial plants, however, the relationship between size and reproduction is frequently shaped by consecutive trade-offs between allocation to vegetative growth and allocation to reproductive function, and these trade-offs are environmentally modulated. Thus, tree populations located at distribution limits appears to be particularly interesting because tree species encompass broad size-ranges and deteriorating conditions are assumed at those locations. In the present study, we measured, from 2007 to 2009, the reproductive performance of *Olea europaea* in 8 populations at different parts of its distribution limit across the Iberian Peninsula and the Canary Islands. These populations were selected to encompass broad latitudinal, elevation and climatic ranges throughout distribution limits. We found significant differences among populations in the percentage of flowering trees, flower intensity, fruit set and viability of seeds. In addition, larger plants invested disproportionately more resources to reproduction than small individuals. Nevertheless, similar sized trees within populations showed different reproductive performances and the range of tree sizes differed between populations. Our findings suggest that not all distribution limits are equally unfavourable for growth and reproduction, and that resource patchiness may account for part of the variability in reproductive performance within populations.

S.17-23-P

Community shifts in grassland due to more extreme inter-annual precipitation variability.

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Greater intra-annual precipitation variability is predicted for many regions on earth, leading to longer dry periods and more intense rainfall events. Their effects on vegetation and ecosystem functions are widely unknown. Although currently, climate change effects on species distributions are frequently reported, it remains unclear for many regions of the world how local extinction and immigration will be balanced under increased precipitation variability. Here, we present first results from the field experiment EVENT II in which Central European grassland is subjected to increased spring and summer rainfall variability (low, mid and extreme rainfall variability without any change to the annual rainfall amount). Data on aboveground biomass and species abundance was collected since 2008. Relative abundance and biomass production of single species was altered by more extreme variability in spring. Further, we detected deviation and turnover in the dominance of structure of plant communities in response to more extreme precipitation variability. These changes in relative species abundance may serve as an early indicator of long-term climate change effects altering community composition and biogeographic patterns before local extirpations occur.

S.17-24-P

Insect responses to patch size and resource density: theory and empirical data.

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Previous studies suggest that patch size and resource dependent migration rates may explain substantial variation in insect density distributions. These studies, however, treat information as constant, whereas information landscapes in nature are highly dynamic. Substantial data suggest that damage related cues, caused by herbivore feeding, are important both for natural enemies and for other herbivores when searching for suitable resources. Herbivores intensify host search in some cases and avoid competitors in other cases, shaping their interactions with plants, whereas natural enemies may use host cues either for locating suitable host patches or to remain in the vicinity of hosts. We use a basic population model with resource dependent migration rates and expand this model by adding the third trophic level. From these models, predictions are derived on the temporal change in the density-area slope for herbivores and for patch size dependent parasitism rates. Using the scant field data, we show some consequences of behavioural responses for patch size dependent distributions in density and parasitism.

S.17-25-P

Spatial dynamics of tree species populations in the Spanish Western Pyrenees.

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It is widely accepted that the distribution of species is suffering changes due to the effects of current global change. However, evidences of altitudinal and latitudinal shifts of woody species populations and changes in forest composition are still scarce. In this context, we present a study focused on the high altitude belts of montane forests in the Western Pyrenees. Based in the NFI (National Forest Inventory) dataset, we develop a novel multivariable geostatistical model in order to predict regional distribution dynamics and ecological interactions of two important forest species: the Scots pine (*Pinus sylvestris* L.) and the Beech (*Fagus sylvatica* L.) during the last decades. The results show a change in the dominant composition of forests in the area. While the pine species seems to undergo a range retraction and loss of dominance in the woody stands of the area, the beech seems to be experiencing an expansion of its range. Our results provide new detailed data about the complex mountain forest dynamics related with global change during the 20th century and the potential implications for forest ecology and management. On one hand, we show the usefulness of geostatistical techniques to analyze the relationship between vegetation distribution and key environmental variables, and on the other hand, this work highlights the suitability of the sequential and detailed NFI datasets in order to analyze the effects of global change in forests.

S.17-26-O

Climate-driven habitat changes restructure northern lake fish communities.

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Far-reaching ecological effects of climate warming have been observed over a range of temporal and spatial scales. Examining complex biological responses at a community level will capture species interactions, allowing a comprehensive look at broad community shifts. However, not all species respond to climate changes in the same manner, due to differences in phenology and physiological traits, and evaluating communities as a collection of life history strategies offers a method for understanding diverse biological responses. This research used long-term data from an oligotrophic Alaskan lake to relate life histories to climate-driven shifts in littoral zone fish communities. Species abundance data, collected since 1963 through standardized beach seining, were analyzed along with environmental measurements. Nonmetric multidimensional scaling showed a significant directional shift in the fish community structure across these five decades. Linear models indicated significant effects of climate-driven environmental changes on community composition, with ice-free date, surface water temperature, and lake water level of the prior year best predicting these changes. Initial results show that spring spawning, short-lived species, such as three- and nine-spine sticklebacks, represent a larger component of the community over time. Additionally, site-specific differences were observed for rate of community change, driven by fine scale habitat features and original community composition. These results suggest that life history attributes offer a mechanistic way to assess the trajectory of future community changes, and that fine scale habitat heterogeneity is important to mediate the ecological effects of climate change within a system.

S.17-27-P

Multi-scale spatial clustering of earthworm species' assemblages - example from a gallery forest of the Colombian "Llanos".

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Community patterns analysis of soil organisms and the role of biotic and abiotic factors shaping community structure is hot topic in ecology. There is a paucity of data on the scale and the importance of explicitly accounting for environmental heterogeneity in the study of soil fauna community assembly. The objective of this study was to identify the spatial scale at which species and soil environmental factors are related, and the degree of inter-specific competition and species assemblages. We specifically paid attention to the spatial scales by using the PCNMs (Principal Coordinate of Neighbouring Matrices), a new statistical approach that explores environmental heterogeneity and community structure linkages in a multi-scale context. We assessed species spatial distribution patterns, co-occurrence and niche overlap together with the heterogeneity of selected soil properties in a gallery forest of the Colombian "Llanos". At the local scale of our study earthworms the observed co-occurrence of species and species' assemblages when we used raw, spatial and factorial data indicated that earthworm species and assemblages were not structured by competition. Only one epigeic species showed significant spatial structure. Four PCNMs were significant (p

S.17-28-P

The effect of neighborhood composition and spatial extent on patterns of associational resistance and susceptibility.

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Associational resistance, AR (or susceptibility, AS) occurs when plant neighbors increase (or decrease) the amount of damage to a focal plant. Past studies examining AR/AS have traditionally used substitutive or additive experimental designs which confound the effects of total plant density, heterospecific density, and conspecific density on plant damage, and have ignored the effects of neighborhood extent on AR/AS patterns. Using a response-surface experimental design, we examined how total plant density and the density of heterospecific neighbors, *Solidago altissima* (hereafter referred to as “neighborhood composition”) influenced insect herbivore damage on a focal plant species, *Solanum carolinense*. We also examined how AR/AS patterns varied at two spatial extents (neighbors immediately surrounding a focal *Solanum* plant and neighbors within a 1m² quadrat). Our results indicated that the effect of neighborhood composition on damage patterns varied according to spatial extent. In neighborhoods immediately surrounding the focal *Solanum*, we found a positive linear relationship with leaf damage and the proportion of *Solidago* neighbors, suggesting AS. At larger spatial extents (neighbors within a 1m² quadrat), we discovered a unimodal relationship between *Solanum* leaf damage and the proportion of *Solidago*, suggesting AS when *Solidago* neighbors are at low to intermediate densities, but AR when *Solidago* neighbors are at intermediate to high densities. At both spatial extents, we found positive relationship of leaf damage on *Solanum* with total plant density (irrespective of neighbor identity), suggesting AS. Since these relationships varied according to spatial extent, this suggests that different mechanisms are operating to produce AR/AS patterns.

S.17-29-P

The impact of cormorant nesting colonies on plants and arthropods.

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Seabirds concentrate large amounts of marine nutrients on their nesting islands. This nutrient input can have large consequences for island food webs and community structure. The high nutrient load may also cause runoff into surrounding waters and affect marine communities. In my thesis, I studied the effect of cormorant nesting colonies on the stoichiometry, abundance, species richness, and species composition of plants, algae, and invertebrates on land and in coastal waters and investigated if differences in the elemental composition or homeostasis can explain differences in the numerical response among invertebrate groups. $\delta^{15}\text{N}$ analysis indicated that ornithogenic nitrogen provided a significant nitrogen source for plants and arthropods on nesting islands and around high nest density islands also for brackish algae and invertebrates. Furthermore, nutrient runoff created a potential feed-back loop to spiders via chironomids. Cormorant nutrient input changed island vegetation and increased plant P and N content and epiphytic algae:*Fucus* ratio, but decreased plant species richness and vegetation cover. Invertebrates responded indirectly to these qualitative and quantitative changes in their food source and habitat, but also directly to cormorant subsidies. However not all taxonomic and feeding groups were affected and responses were both positive and negative. Differences in the numerical response among taxonomic groups could not be explained by differences in the level of homeostasis, since, generally, all invertebrates were strongly homeostatic. Similarly, consumer nutrient content was a poor predictor for displayed responses. I conclude that cormorant colonies have strong impacts on island vegetation and some consumer groups. However, even if they can decrease the species richness of some organism groups on their nesting islands, they increase the habitat heterogeneity in an archipelago and thus may increase the regional species diversity.

S.17-30-O

Productivity-diversity relationships in lake plankton communities.

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One of the most intriguing environmental gradients connected with variation in diversity is ecosystem productivity. The role of diversity in ecosystems is pivotal, because species richness can be both a cause and a consequence of primary production. However, the mechanisms behind the varying productivity-diversity relationships (PDR) remain poorly understood. Here, we examined the relationships between resource supply and phyto-, bacterio-, and zooplankton richness in 100 small boreal lakes. We studied the PDR locally within the drainage systems and regionally across the systems. Second, we studied the relationships between resource availability, species richness, biomass and resource ratio (N:P) in phytoplankton communities using Structural Equation Modeling (SEM) for testing the multivariate hypothesis of PDR. At the local scale, the PDR showed variable patterns ranging from positive linear and unimodal to negative linear relationships for all planktonic groups. At the regional scale, PDRs were significantly linear and positive for phyto- and zooplankton. Phytoplankton richness and the amount of chlorophyll a showed a positive linear relationship indicating that communities consisting of higher number of species were able to produce higher levels of biomass. According to the SEM, phytoplankton biomass was largely related to resource availability, yet there was a pathway via community richness. Finally, we found that species richness at all trophic levels were correlated with several environmental factors, and were also related to richness at the other trophic levels. This study showed that the PDRs are highly variable across spatial scales in freshwaters. We also documented that the PDR complies with multivariate model showing that plant biomass is not mirroring merely the resource availability, but there is also a pathway via richness. This highlights the need for conserving diversity in order to maintain ecosystem processes in freshwaters.

S.17-31-O

Stochastic trajectories of succession initiated by extreme climatic events.

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Deterministic or rule-based succession is expected under homogeneous biotic and abiotic starting conditions. Effects of extreme climatic events such as drought, however, may alter these assembly rules by adding stochastic elements. We monitored the succession of species composition of 30 twin grassland communities with identical biotic and abiotic starting conditions in an initially sown diversity gradient between one and 16 species over 13 years. The stochasticity of succession, measured as the synchrony in the development of the species compositions of the twin plots, was strongly altered by the extreme warm and dry summer 2003. Moreover, it was independent from past and present plant diversity and neighborhood species compositions. Extreme climatic events can induce stochastic effects in community development and therefore impair predictability even under homogeneous abiotic conditions. Stochastic events may result in lasting shifts of community composition, as well as adverse and unforeseeable effects on the stability of ecological services.

S.17-32-P

Seedling dispersal patterns in two Mediterranean high-mountain species: fitting dispersal kernels along an altitudinal gradient.

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Recruitment capacity can affect considerably the composition and dynamics of plant communities and depends among other factors on environmental conditions and their macroscale and microscale variations. Therefore, a characterization in contrasting environments is necessary to understand natural variation in the processes underlying recruitment of particular species (e.g. population dynamics, dispersal capacity or gene flow among populations). We used an inverse modelling approach to analyse seedling dispersal patterns in five populations of *Silene ciliata* and five populations of *Armeria caespitosa* along an altitudinal gradient in Sierra de Guadarrama (Madrid, Spain). Inverse modelling allows assessing seedling shadows without identifying the maternal origin of each recruit, providing parameter estimates of assumed probability density functions of seedling dispersal distances (dispersal kernels). Preliminary results showed that 2Dt and Log-normal dispersal kernels provided the best fits for both species in all their populations. No relationship between population altitude and the shape and average of the best dispersal kernel emerged. However, the mean dispersal distance (MDD) varied among populations (*Silene ciliata*: 0.29 - 0.80m; *Armeria caespitosa*: 0.28 - 0.97m). These values are congruent with those estimated through direct and indirect methods in other species of the same genera. Estimated MDDs suggest that *Armeria caespitosa* and *Silene ciliata* have low seed dispersal ranges. However, inverse modelling is not suitable to evaluate long-distance dispersal events, the magnitude and scale of which remain to be investigated in these species.

S.17-33-P

Changes in temporal and spatial pattern of tree species in a temperate secondary forest.

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Euskal Herriko Unibertsitatea. Universidad de Valladolid. Universidad Rey Juan Carlos. Euskal Herriko Unibertsitatea. Euskal Herriko Unibertsitatea. Universidad Politécnica de. Euskal Herriko Unibertsitatea.

High-intensity anthropogenic disturbances are usual and frequent in European forests. Different studies have shown that, after anthropogenic disturbances, species restitution along succession is variable and hence not easily predictable. Therefore, long-term demographic studies are needed to better understand this process. To survey the regeneration dynamic of a birch-beech temperate forest, a permanent fenced plot of 2.5 Ha was established in a secondary young forest stand, located in Urkiola Natural Park (Basque Country), and dominated by birch (*Betula celtiberica*), interspersed with beech (*Fagus sylvatica*), pedunculate oak (*Quercus robur*) and Pyrenean oak (*Q. pyrenaica*). The aim of this study was to determine the shift in dominance of the tree species present in the experimental plot. In 1999, every individual trees higher than 1,4 m (or with stem diameter larger than 2 cm) was mapped by its XY coordinates in the plot, and diameter at breast height (DBH) recorded. This sampling was repeated twice, in 2005 and 2010. Annual mortality rate was catastrophic (>5% yr⁻¹) for pedunculate oak between 1999 and 2005, while declined slightly between 2005 and 2010 (>3% yr⁻¹). Furthermore, birch, Pyrenean oak and beech showed similar trends in mortality through the whole study period, moderate for birch and Pyrenean oak and low for beech. Adult spatial pattern changed for birch and beech but not for pedunculate oak.

S.17-34-P

Inter-specific interactions affect the elevational ranges of Arctic alpine plant species: evidence from niche-based modeling.

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Competitive and facilitative interactions are important determinants of fine-scale plant distributions, but the extent to which these interactions influence species distributions at broader spatial scales is uncertain. Fine-scale co-occurrence data for lichens, bryophytes and vascular plants was collected from 234 sites (elevational range = 460 - 1360 m a.s.l.) in a high-latitude mountain region, north-western Finland. We modelled the probabilities of species' occurrence in the presence and absence of dominant species as a function of altitude, simultaneously controlling for the influence of other environmental factors. Comparing the altitudinal range of sites where species were predicted to occur with and without each dominant species provided an estimate of dominant species' effects on other plant species' distribution. A broad range of effects was observed, with the impact of dominants on species' elevational ranges related to the identity of both species. For example, the presence of the common evergreen dwarf shrub, *Empetrum nigrum* spp. hermaphroditum, expanded the mean altitudinal range of lichen species. By contrast, *Empetrum* tended to limit the altitudinal extent of vascular plant species, with the distribution of forbs and graminoids being more negatively affected than other growth forms. These results demonstrate that biotic interactions may affect the range of conditions under which species occur, but that the impact of these interactions can vary strongly between species. Our results therefore support that vegetation responses to climate change may be influenced by local biotic conditions and that attention should be paid to the combined effects of these factors.

S.17-35-P

Scale-dependent effects of an invasive insect on nitrogen cycling and host physiology.

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Invasive insects may dramatically alter resource cycling and productivity in forest ecosystems. Yet, although these changes reflect the responses of individual trees, relatively little is known about physiological responses of host trees to invasive insects. We examined changes in nitrogen (N) uptake and allocation, and needle biochemistry and physiology, in eastern hemlock (*Tsuga canadensis*) saplings, as well as changes in soil N cycling, associated with infestation by the hemlock woolly adelgid (HWA) (*Adelges tsugae*), an invasive insect causing widespread decline of eastern hemlock in the eastern U.S. Compared with uninfested saplings, infested saplings were associated with greater soil nitrification, ¹⁵N accumulation in needles, and needle N and total protein concentrations, but these variables did not covary. Further, within infested saplings, needle N concentration did not vary with HWA density. Light-saturated net photosynthetic rates (Asat) declined by 37% as the HWA density increased from 0.1 to 1.3 adelgids per needle. Asat decreased with stomatal conductance but did not vary with needle N concentration. Photosynthetic light response did not differ among HWA densities. Our results suggest that soil N pools and fluxes, ¹⁵N uptake, and needle N and protein concentrations differed in the factors that drove their relationships with HWA infestation. Further, within-tree variation in HWA densities, and associated effects on Asat, may be independent of needle N concentrations under at least some conditions. Taken together, our results suggest that the mechanisms regulating the responses of host tree biochemistry and physiology, and ecosystem N cycling, to infestation by an invasive insect may be scale dependent.

S.17-36-O

Annual plant communities in the semi-arid: facing all the odds.

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Interactions among plants are dominant drivers of community structure and composition. It has been proposed the existence of shifts between positive and negative species interactions along productivity or abiotic stress gradients (Stress Gradient Hypothesis (SGH); Bertness & Callaway 1994). Plant establishment is affected by light and water availability and these resources may in turn be modified by the presence of neighbors, such as shrubs and the biological soil crust (BSC). Consequently, complex interactions can be expected during annual plant community assemblage. Here we test a priori predictions about the effect of microenvironment and the experimental increase in water availability on annual plant species interactions at 5 x 5 cm fine scale in a semi-arid gypsum steppe, together with the effect of the BSC. This study was undertaken during four consecutive years of contrasting climate and several plant community traits were modeled by means of repeated measures Generalized Linear Models (GLM) such as plant richness, diversity, cover, structure (measured in terms of a plant aggregation index) and plant-plant interactions (measured with SES values of the C-score indices). The association between lichen community, the main component of gypsum BSCs, and annual community was evaluated with bivariate association indices. We observe that, contrarily to expected, competition prevailed in the dry year while it was relaxed in wetter years and under the irrigation treatment. The increase of annual plant productivity (cover) near *Stipa* was not reflected on plant-plant interactions. It has been assumed that in desert environments competition plays a minor role for plant performance however this study joins others that have observed competition in semi-arid environments (Brooker et al. 2008) and highlights the modulating effect of the BSC in the assemblage process of annual communities.

S.17-37-P

Annual communities in the semi-arid: insights of the spatial fine scale formation of the soil seed bank.

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It is becoming greatly important to understand the spatial and temporal scales where biotic and abiotic factors determine plant community assemblage. This knowledge may be strikingly decisive in annual plant communities growing in extreme environments such as gypsophilous semi-arid environments, since they are more sensitive to fine scale changes in water availability, neighbor interactions etc. Soil seed bank has usually been advocated as an essential component of annual plant communities that plays an important role allowing the persistence of species in unpredictable environments. In this study we evaluated the historical effect of aboveground vegetation on seed bank species composition at fine spatial scale (5x5 cm) in a gypsophilous annual plant community together with an experimentally induced water availability gradient at two microenvironments (open sites and under *Stipa*). Twenty four plots of 50x50 cm, each divided into 100 cells of 5x5 cm were located in a factorial design (2 irrigation treatments x 2 microenvironments, and 6 plot replicates). The annual plant community was monitored during 3 consecutive years of contrasting climate at the 5 x 5 cm cells and afterwards 32 soil samples of each plot (TOTAL: 768 soil samples) were collected and let them germinate in the greenhouse for seven months. We used O-ring statistic together with aggregation (Ia) and association (xk) indices (SADIE) and they were modeled by means of GLMM procedure. We evaluated at which spatial and temporal scale act the historical effects and to what extent these effects were modulated by water availability and micro environmental conditions.

Bidirectional cooperative interaction between the liana *Hedera helix* and the tree *Corylus avellana* in a remnant temperate forest in Central Spain.

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Through complex interactions with trees and shrubs, lianas can have a major role structuring forest vegetation. Lianas can increase mortality, suppress regeneration, and reduce growth and fecundity in infested trees owing to mechanical damage and competition for light and below-ground resources. However, the spatial co-occurrence of lianas and trees in a forest stand does not necessarily imply climbing and the ensuing negative impact on tree fitness (host-tree preferences). Consequently, liana-infested trees are in competitive disadvantage with respect to non-infested ones when they occur in the same stand. Given the positive relationship between probability of climbing in lianas and the trunk diameter of hosts, shrubs and saplings are usually free of liana infestation in both tropical and temperate forests. Strong dominance of both the liana *Hedera helix* and the tree *Corylus avellana* in mature stands in a protected temperate remnant forest (Central Spain) suggests a hypothesis of bidirectional cooperative interaction. We hypothesize that *Corylus avellana*, through mechanisms to partially avoid climbing by *H. helix*, profits from the strong negative impacts of *H. helix* on the other infested-tree species of the stand. *Hedera helix*, in turn, profits from high shading imposed by *C. avellana*, which strongly prevents shrubs and tree saplings (direct competitors for *H. helix*). To document this hypothesis we tested three relevant premises: (1) There should be a significant spatial association between the liana and the target tree under relatively homogeneous abiotic conditions; (2) The liana should be able to infest any of the tree species present in the forest but not shrubs in general, (3) the target tree species should have mechanisms to partially avoid the liana infestation, and (4) shrub cover should be negatively affected by *C. avellana*. Both a spatial co-occurrence analysis (Checkerboard Units analysis) and a Canonical Correspondence Analysis confirmed the spatial association between the liana and the tree (assumption 1). We found a significant relationship between the number of tree species in a stand and the number of infested tree species by *H. helix*, suggesting no preferences for specific host trees. Additionally, none of the shrub species were ever climbed (assumption 2). A Generalized Linear Mixed Model shows strong evidence of the relationship between tree stem perimeter and the probability of climbing; the thicker the stems the higher the probability of being climbed. Hence, the dynamic simpodial growth form of *C. avellana* would be a good strategy to elude negative impacts from the liana (assumption 3). Finally, a simple regression model showed an exponential negative response of shrub cover to increasing *C. avellana* cover (assumption 4). Our field results support the hypothesis that a bidirectional cooperative interaction may underlie the strong dominance of both the liana *H. helix* and the tree *C. avellana* in this temperate remnant forest.

S.17-39-P

Vegetation recovery after human disturbance in Mediterranean saline steppes.

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In recent times there has been a massive abandonment of croplands in the Iberian Peninsula, which has promoted deep land-use changes. Information on the recovery of plant communities in semi-arid restrictive-soil environments is particularly scarce. Old-field plant succession in continental Mediterranean saline steppes was studied, analysing vegetation progression throughout the secondary succession and its relationship with the soil seed bank. Those communities consist of tussock grasslands largely dominated by *Lygeum spartum*, accompanied by other halophytes, many of them rare, endemic, and threatened. The study was carried out using a chronosequence formed by 30 different-aged stands. In addition to vegetation and seed-bank data, 19 abiotic factors were also measured. The main factor explaining differences between plots were time elapsed since crop abandonment. Edaphic factors were oppositely involved in vegetation changes. The reduced CCA model including stand age, lime and K significantly explained differences in species composition. The results of soil seed banks are now being collected. Plant recovery process of *L. spartum* saline steppes fits well to the general model of secondary succession described in old fields, where time elapsed from disturbance is the main factor determining the stage of vegetation. High concentrations of phosphorous and nitrogen in the soil slow down colonization by strict halophytes. High concentrations of Mg have the opposite effect. *L. spartum* is a tussock grass with high resilience, being able to regenerate even in early stages of plant succession. Mediterranean salt steppes can regenerate by themselves if they have enough time free of disturbances.

S.17-40-P

Environmental control on exotic herbaceous species in Central Chile.

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The movement of organisms and seeds caused by human activity is the major driver of global change, particularly in Mediterranean ecosystems where it has had large effects at landscape and regional scale. In the Mediterranean-type climate region of central Chile Spaniards introduced many exotic species during the colonization period, associated with their cereal culture and livestock activities. Some authors have related the success of colonization and spread of exotic species in Chile with different selection factors, highlighting the relevance of the physical environment. The aim of this study is to assess the importance of the environmental filters that might have promoted success in the naturalization of Mediterranean species in Chile. We have compared Chilean and Spanish Mediterranean herbaceous vegetation because their great similarity in climate and geomorphology, although different phylogenetic background. Fifteen sites with similar lithology and history of use were selected in each country distributed along a precipitation gradient. In each site we recorded species richness and the number of exotic species -in the case of Chile- or common species -in the case of Spain -. There was a differential environmental control in both regions. Species richness in the Chilean Mediterranean region is mainly determined by differences in climate; both native and exotic species introduced in Chile are positively correlated with rainfall, but the later increase with a rate twice that of native ones. On the contrary, in Spain soil properties exert the main influence on species richness.

S.17-41-P

Assessing plant population dynamics in a fragmented system: the case of the flora around street trees.

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Urban areas provide opportunities for studying plant population dynamics in heterogeneous landscapes. Here, we focused on wild plants which occur around the basis of street trees, i.e. small patches of favourable habitat embedded in a hostile matrix. We inventoried the spontaneous flora around the basis of 1500 street trees in Paris (France) in 2009 and 2010. The data collected were analysed by different approaches. First, we assessed the taxonomic and functional composition of plant communities in patches. Then, for each of the 17 most frequent species, (1) we analysed patterns of spatial aggregation by comparing the barycentre of patches where the species occurred with the barycentre of all patches, (2) we used a metapopulation approach to estimate colonisation and extinction rates and to calculate dispersal kernels. Together, our results reveal different dispersal and life history strategies among the species studied and show for some of the species that high colonisation and extinction rates reshape spatial distribution every year. Last, a molecular approach was used for *Senecio inaequidens* DC., an invasive alien species recently arrived in Paris. All individuals found in the patches were sampled in 2009 and 2010. Added to occupancy data, genetic data suggest that patches are colonised by seeds produced within the study area (other patches or large source populations along railways), not by seeds produced in more distant areas, such as other railways or stations, as it was previously suspected. Our results emphasize the utility of combining different approaches for a better understanding of plant population dynamics.

S.17-42-O

Effects of very frequent fires on resprouting responses of shrubs in the Florida scrub.

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We designed an experiment to explore whether frequent fires or mowing (often used as a fire surrogate) would affect vigor and carbohydrate levels in eight species of resprouting shrubs dominant in Florida scrub, a pyrogenic ecosystem. The experimental design provided equal times-since-disturbance for all plots, but applied prescribed fire or mowing at different disturbance return intervals (DRI: 1, 2, 3, or 6 times in six years, 4 replicates, 32 plots), with all plots disturbed during the sixth year. We measured fire intensities with type-K thermocouples and dataloggers during most burns. For each study species in each plot, we measured stem densities, heights, and crown lengths before and six months after the last disturbances. We also estimated non-structural carbohydrate (NSC) concentrations before and shortly after treatments with the anthrone method. Post-disturbance recovery was inhibited by frequent fire or mowing. Across all species, 6-month stem heights varied significantly among species and were significantly lower in frequently disturbed plots. Plots with taller stems at the start of the experiment produced greater stem heights post-disturbance. The source of disturbance (burn, mow) did not affect stem heights, nor were interactions among factors significant. Analyses of individual species responses varied. For example, in the dominant oak *Quercus inopina*, heights increased with DRI and were higher in mown (vs. burned) plots. Overall, three species had post-disturbance heights significantly related to pre-burn heights, three species had heights related to DRI, and one species had heights related to disturbance type. Although individual species patterns varied in significance, most had the greatest height growth with infrequent fire and the least height growth with annual fire. Responses appear unrelated to measured fire temperatures. However, insoluble and soluble carbohydrate concentrations each varied significantly by species, and by DRI, but did not differ between burning and mowing. Because very frequent disturbances have the potential to affect carbohydrate reserves and inhibit resprouting, and because responses vary among species, very frequent fires or mowing could alter the composition and structure of Florida scrub.

S.17-43-P

Two-year-long exclusion experiments reveal that ants but not birds negatively affect the spider assemblage of an organic citrus orchard.

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Despite their usefulness in revealing interactions in ecological communities, exclusion experiments conducted simultaneously on more than one group of organisms are scarce. Ants, birds and spiders are important predators in terrestrial arthropod-dominated communities. Several experiments of ant and bird exclusion have revealed important effects on spiders, although they vary among geographical areas. In general, spiders have rarely been determined to species, leaving open the question whether these effects depend on spider identity. We thus aimed at discerning the relative effect of both ants and birds on the composition of the spider assemblage of a citrus grove, a relatively simple system that should facilitate the identification of functional relationships. We used a split-plot design to concurrently exclude ants and birds over 2 years, preventing ants reaching the canopies using sticky rings around the trunks, and birds using cages enclosing trees. We sampled spiders from the canopies (beating) and the ground (pitfalls) every 3 months, and we identified them to species. We found a very strong negative effect of ants on the abundance of the canopy spider assemblage, mainly due to the families Araneidae and Theridiidae, suggesting that ants exert competitive exclusion on spiders. Interestingly, this effect was not pervasive across the entire spider assemblage. Bird exclusion did not affect the canopy or the ground spiders, contrasting with previous studies where a marked predatory pressure of birds on spiders was detected. Our findings emphasize that spiders cannot be treated as a single functional group.

S.17-44-P

Regulation of rabbits and partridges by Bonelli's eagles.

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How predators impact on prey population dynamics is still an unsolved issue for most wild predator-prey communities. When considering vertebrates, important concerns constrain a comprehensive understanding of the functioning of predator-prey relationships worldwide, e.g. (i) studies simultaneously quantifying both the 'functional' and 'numerical responses' (i.e. the 'total response') are rare, (ii) predation studies are virtually lacking in warm, complex natural systems, and (iii) these studies usually use relative measures of prey consumption and predator/prey abundance. Here we use a multi-spatiotemporal-scale approach to simultaneously explore the functional and numerical responses of a territorial predator -the Bonelli's eagle *Hieraaetus fasciatus*- to its two main prey species -the rabbit *Oryctolagus cuniculus* and the red-legged partridge *Alectoris rufa*- during the breeding period in a diverse Mediterranean system of southern Spain. The Bonelli's eagle responded functionally, but not numerically, to the rabbit/partridge density changes. Type II functional responses (typical of specialist predators) offered the best fitting models for both prey. Models derived from the 'predation rate' offered a better fit than those using the 'kill rate'. The density of both rabbits and partridges was negatively related to the Bonelli's eagle diet diversity, so suggesting a consistent preference for these prey. The role of Bonelli's eagles as a regulating factor of rabbit and partridge populations seems to be poor in our study area. As a specialist predator, the Bonelli's eagle should be perceptibly sensitive to the disease-mediated crashes in rabbit populations, although the simultaneous preference on partridges would buffer the negative effects. Simple (prey-density-dependent) functional response models may be good descriptors of (single) territorial predator consumption rate variability in complex ecosystems over the short-term.

S.17-45-P

Pollination success of the narrow endemic *Polygala vayredae* when growing with other native species: magnet or competing effect?

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Plant-pollinator interactions are influenced by the population and community context in which they occur. Thus, co-flowering species may affect, directly or indirectly, the reproductive success of each other. This effect can be positive, if co-flowering species attract pollinators to the population, increasing pollinator activity and improving plant reproductive success (magnet effect); or negative, if they compete for pollinators or if strong inter-specific pollen transfer occurs, both decreasing plant reproductive success (competing effect). *Polygala vayredae* is a narrow endemic species with low fruit production that strictly depends on pollinators to produce seeds. Pollinators are especially scarce in exposed rocky slopes where this species grows with other flowering plants that partially overlap their flowering period with *P. vayredae*. Facing this observation, the objective of this study was to evaluate if the co-existing plants were competing with *P. vayredae* for pollinators or if they worked as magnet species attracting insects to the population, improving the reproductive success of this species. For this, flower morphology and flower rewards were characterized for all the flowering species and pollinator activity and reproductive success were assessed in patches with *P. vayredae* only and in patches with *P. vayredae* and co-flowering species. The results revealed that *P. vayredae* strongly competes for pollinators with the other co-flowering species; however, in their absence the pollination services were also highly limited. Thus, despite of pollination competition, with negative effects on seed production, other co-flowering species attract insects to the population enabling some pollinations services for this endemic species.

S.17-46-P

Uncoupled seed rain phenologies of *Quercus pubescens* and *Q. ilex* enhance their successful dispersal by seed-caching rodents in mixed forests.

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CREAF. CREAF. CREAF. IREC. CREAF. IREC.

In temperate areas plants produce seeds only once a year, the seeding season. Seed rain phenology results in changes in the abundance of seeds, what may influence the behaviour of seed dispersers thus shaping the dispersal patterns. The relationship between seed rain phenology and seed dispersal becomes more interesting in multi-specific scenarios, where competing species with different seed rain phenologies coexist and share the same potential dispersers. In Collserola Natural Park (Barcelona, Spain), we analysed how the seed rain phenology of two coexisting *Quercus* species (*Q. pubescens* and *Q. ilex*) influenced their dispersal probabilities by seed-caching rodents. From September 2010 to March 2011, we monitored at 20-day intervals the acorn rain of 20 *Q. pubescens* and 20 *Q. ilex* trees using seed traps. In the same intervals, we monitored the spatial patterns of seed dispersal by seed-caching rodents. We found that seed rain phenology differed between species, and the peak of acorn rain was earlier in *Q. pubescens* than in *Q. ilex*. Their uncoupled phenologies resulted in separate 'windows of chance' for dispersal. *Q. pubescens* acorns were preferentially dispersed earlier in the season, before the peak of *Q. ilex* acorn drop was reached. Then, the acorns of *Q. ilex* were selectively dispersed. Our results put forward that uncoupled seed rain phenologies may enhance the successful dispersal of co-occurring species by the same seed disperser. Interestingly, this process may be dramatically altered if flowering and seeding phenologies are modified by climate change

S.17-47-P

Pollination biology and reproductive success of two common Mediterranean species with contrasting breeding and pollination systems (*Pistacia lentiscus* and *Myrtus communis*) in a fragmented (anthropogenic) landscape.

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Spatial distribution of populations across the landscape is a key factor in predicting viability and the evolutionary potential of populations, particularly in heterogeneous and fragmented landscapes. Moreover, the effects of population connectivity can be more or less influential for the levels of pollen flow regarding the breeding and pollination systems (wind vs. animal-pollination) of species. In this study, our purpose was to assess the influence of the spatial configuration of populations in a fragmented landscape (large vs. small and connected vs. isolated) on the pollination biology and reproductive success of two plant species. We recorded the flowering phenology and fruit set of *Pistacia lentiscus* (dioecious, wind-dispersed pollen) and *Myrtus communis* (hermaphroditic self-compatible, insect pollinated) in six forest patches. We also assessed the community of pollinators in the populations of *M. communis*. In general, both species showed low fruit set, but interestingly, at the population level the two species showed divergent patterns of fruit set across the fragmentation gradient. Our study stress how biotic ecological variables (e.g. pollinator composition, flowering synchrony), combined with the spatial architecture of the landscape, shapes species reaction to habitat fragmentation and the idiosyncratic nature of the species response to habitat disturbance.

S.17-48-P

How broadly applicable is metapopulation theory?

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Metapopulation theory has recently become a paradigm in ecology. One of its classic predictions is that occupancy of local habitat patches is predominantly determined by their spatial configuration, with smaller and more isolated patches being less likely to be occupied, while patch quality is of secondary importance. In order to test the above prediction we analysed occupancy patterns in the metapopulations of the white-clawed crayfish (*Austropotamobius pallipes*) as well as of three large blue butterflies (*Maculinea alcon*, *M. nausithous*, and *M. teleius*). Using multiple logistic regression models we examined the effects of various predictors including (i) parameters potentially reflecting habitat quality ($n = 6$ for butterflies and $n = 11$ for crayfish), (ii) patch size (area for butterflies and stream section length for crayfish), and (iii) patch connectivity. Patch area and connectivity, both having positive effects, proved to be the only significant predictors for the occupancy of all three butterflies investigated. In turn, the white-clawed crayfish occupancy was affected by altitude, oxygen content (positively), and flow speed (negatively). The connectivity approached statistically significant level ($P = 0.08$), but surprisingly it had a negative effect on occupancy, which presumably stems from the fact that isolated sites are less likely to experience crayfish plague. Our results, supported also by an extensive literature review, indicate that while some organisms living in fragmented landscapes fit well into the metapopulation theory, others (like crayfish) definitely do not. Consequently, the theory should not be unconditionally applied in conservation.

S.17-49-O

Soil seed bank recovery after extirpation occurs more rapidly than expected in semiarid environments.

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Seed banks constitute a key compartment in arid ecosystems, which ensure the persistence of species. In spite of its relevance, knowledge about seed bank formation and the extent to which a seed bank can recover after severe perturbation is still scarce. In order to shed light into this question we conducted an experimental approach to evaluate seed bank formation in a semiarid gypsum community. Soil was sterilized in 300 cylinder plots and located in field conditions in an undisturbed community. Seed bank and above-ground vegetation were monitored for three years in paired sterilized and control soil samples. Differences in seed bank density between sterilized and control soil disappeared after 18 months. The composition of sterilized seed banks correlated to that of control plots from the first sampling date, and both were highly correlated to above-ground vegetation. Nearly 24% of the seed bank density could be attributed to secondary dispersal. Most seeds died before emergence (66.41-71.33%) whereas the rest either emerged (14.08-15.48%) or persisted in the soil (14.59-18.11%). Seed bank recovery can be very rapid even under the limiting and stressful conditions of semi-arid environments. This recovery is based mainly on the seed rain at small scales together with secondary dispersal from intact seed banks in the vicinity. These results emphasize the relevance of processes occurring at a short spatial scale in determining community structure.

S.17-50-P

Evidence of facilitation between ungulates and herbivorous insects on *Vaccinium myrtillus* following a clipping and nitrogen fertilization experiment.

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Global change drivers, namely nitrogen (N) deposition and vertebrate herbivory, are increasing in the north of Spain which might lead to changes not only in interactions between plants and herbivores but also in herbivore-herbivore interactions. In this study we examined insect herbivory and damage by fungal pathogens on the bilberry, *Vaccinium myrtillus*, in response to N application and simulated vertebrate herbivory (clipping) in a short-term experiment lasting three years. To examine whether the responses of both these natural enemies were mediated by changes in the plant, we estimated the effects of the treatments on bilberry growth and branching. Clipping increased the proportion of leaves damaged by herbivorous insects regardless of whether it was combined with N fertilization or not in 2008. In 2007 and 2009 repeated damage to the shrub also facilitated herbivory by insects but only under N applications. Regarding fungal disease incidence, clipping decreased the proportion of infected leaves in all the years considered but only in fertilized plots. Clipping increased bilberry growth but decreased the number of branches only in 2009. Our results suggest that vertebrate herbivores facilitate insect activity on bilberry leaves which may in turn be related to a decrease in fungal attack.

S.17-51-P

Influence of mother plant age on temperature-time range affecting seed germination of *Cytisus multiflorus*.

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In Mediterranean ecosystems fire plays an important role in controlling the current landscape, altering its composition and the degree of development of the stand vegetation. This is a very common but random perturbation which causes patches of vegetation with more or less accumulated biomass. In this study we aim to ascertain plant age, closely related to accumulated biomass, effects on shrub seed germination just as on their response to high temperatures of wild fires. We didn't find any references about this topic for shrub species. We focused on *Cytisus multiflorus*, a leguminous shrub native to the NW Iberian Peninsula. We selected plants of this species from Salamanca (Spanish mesa) and we divided them into 4 categories (Young, Middle-aged, Old and Elderly shrubs). The seeds were sown in Petri dishes and placed in a controlled environment cabinet. For thermal shock, we selected different temperatures and times to cover the whole range of the response, from stimulation of germination until lethal effects. Among our results it's worth mentioning that at low temperatures seeds of young shrubs presented better germination than the others, while the opposite occurred at higher temperatures (>100°C) when old and elderly shrub seed germinations presented their better results. However, at 150°C only old shrub seed germination pointed out as the best one, presenting this shrub category the greatest amount of accumulated biomass. We notice a shift in optimal temperature-time range as the mother plant age increases.

S.17-52-P

Emergence of bipartite food webs structure through antagonistic coevolution.

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While recent research described how environmental heterogeneity and coevolution can alter the number of partners with whom a focal species interacts, how patterns of organization in natural communities emerge through the interaction of ecological and evolutionary processes is rather unclear. The uncertainty stems from the fact that ecological and evolutionary processes are often linked by complex feedbacks, the impact of which can be difficult to distinguish especially in fast-evolving organisms. Building on the analysis of a mathematical model and field surveys using a microbial model system (the bacterium *Pseudomonas fluorescens* and its lytic phages), I will synthesize results pertaining to two questions. (i) What is the impact of resources on the assembly and structure of food webs, with and without coevolution? We show that coevolution under different patterns of resource dynamics leads to the assembly of networks that differ by their structural properties (specialization, connectance), and discuss the epidemiological consequences of these patterns [1]. We suggest that the emergence of such networks relies on a simple ecological mechanism, namely that the availability of resources will regulate the contacts between antagonists, thus limiting both the efficiency of coevolution and the establishment of links within the network [2]. (ii) How do we expect the structure of coevolving networks to change through space? We show that local phylogenetic structure of the bacterial host is a good predictor of strategies distribution among the pathogens, and that the similarity of networks through space can be predicted from the phylogenetic similarity between host populations. In conclusion, these results reinforce the necessity to understand the interactions between ecological and evolutionary processes to predict the patterns of interaction network structure in complex environments, and show that understanding the mechanisms behind network assembly can have immediate applications in epidemiology. 1. Poisot T, Thrall PH, Hochberg ME (under review) Trophic network structure emerges through antagonistic coevolution in temporally varying environments. submitted to Proceedings of the Royal Society B: Biological Sciences. 2. Poisot T, Lepennetier G, Martinez E, Ramsayer J, Hochberg ME (2011) Resource availability affects the structure of a natural bacteria-bacteriophage community. *Biology Letters*. doi:10.1098/rsbl.2010.0774.

S.17-53-P

Next generation sequencing perspective on mechanisms of coexistence in cryptic bat species.

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Sympatric cryptic species pose a challenge to the role of interspecific competition in structuring ecological communities because they do not appear to diverge sufficiently in their morphology to allow ecological niche differentiation. New advances in molecular technologies can provide the necessary high resolution for detecting fine-scale differences in resource use. We used next generation sequencing and arthropod-specific primers to study the diet of two cryptic bat species that are sympatric in southern England (*Plecotus austriacus* and *P. auritus*). We identified 142 Molecular Operational Taxonomic Units (MOTUs) in their diet, representing three species of arachnids and at least six orders of insects. The bats appear to have a generalist and diverse diet. Lepidoptera, and in particular eared-moths (of the family Noctuidae), were the main prey consumed by both bats. Interspecific dietary niche overlap was greater than expected by chance ($O_{jk} = 0.72$, $P < 0.001$) and varied seasonally, being significant only in summer when Lepidoptera availability is at its peak. Habitat associations of consumed prey species corresponded to those of their respective bat predator (grasslands for *P. austriacus*, and woodland for *P. auritus*). Overlap in dietary resource use combined with differential prey habitat associations suggest that the two cryptic bat species may primarily rely on habitat partitioning to facilitate coexistence. By providing species-level identification of dietary components, the application of molecular techniques to diet analysis allowed a more comprehensive comparison of the diet of sympatric cryptic species, and therefore can be an important tool for detecting fine-scale mechanisms of coexistence.

S.17-54-P

Studying kelp forests to address fundamental ecological questions.

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Kelps are large brown macroalgae forming marine forests which are emblematic ecosystems of temperate waters. In Brittany, the kelps *Laminaria digitata* and *Laminaria hyperborea* are characteristic of the subtidal rocky seashore and the former species has been exploited for decades whereas the exploitation of the second has started in 1995. Thus, they represent an interesting model from a scientific but also from a cultural and economic point of view. The first question this project aims at answer is the link between genetic diversity of a dominant species and associated species diversity. A theory has been developed (Vellend and Geber. *Ecol. Lett.* 8, 767-781. 2005) hypothesizing that species diversity and genetic diversity should be correlated because these two levels of diversity are affected by the same processes or because of direct effects of one diversity level on the other; however, explicit tests are lacking. By sampling the dominant species *L. digitata* and *L. hyperborea* for genetic diversity and associated macroalgae species for species diversity, this project will test for connections between these two levels of diversity at local and regional scales. The second objective of this project is to better understand how ecosystem engineers modify community organization. Indeed, kelp forests have been described as ecosystem engineers but their exact role remains unclear. Ecosystem engineers (Badano et al. *Oikos.* 115, 369-385. 2006) are hypothesized to enhance species diversity and stabilize species composition. By comparing species composition in patches with *L. digitata* vs patches without *L. digitata* at different times after a perturbation, this project will test these hypotheses.

S.17-55-P

Importance of different belowground mutualisms for plant invasion.

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Belowground mutualisms are of crucial importance to define the structure and dynamics of plant communities, and therefore, can play a key role in the invasion by some exotic plants. Acacia species are involved in many different mutualisms in their native range including belowground interactions with microorganisms such as mycorrhizal fungi and symbiotic nitrogen-fixing bacteria. Australian Acacia species have been widely used around the world in forestry and gardening and, as a result, landscapes in many parts of the world are now dominated by planted or invasive stands of acacias. Two aggressive invaders in Southern Europe, *Acacia longifolia* and *Acacia dealbata*, were selected to assess the relevance of belowground mutualists on Acacia invasion. The presence of root nodules and of mycorrhizal colonization in invasive populations of both Acacia species was assessed in field-collected samples and in pot experiments, nitrogen-fixing bacteria were identified from invasive populations and an experiment using soil filtrates was performed to test the effect of soil microorganisms on plant growth. Plant growth was positively affected by inoculation with soil filtrates containing soil microorganisms. However, more detailed studies show that symbiotic nitrogen-fixing bacteria were more important than mycorrhizal fungi for plant survival and growth. All isolated root-nodulating bacteria belonged to just one genus, *Bradyrhizobium*, and might have been introduced with the exotic Acacia in the new geographical range.

S.17-56-P

The effects of rooting frequency and position of rooted ramets on plasticity and yield in a clonal species: an experimental study with *Glechoma hederacea*.

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Clonal plants produce numerous ramets that can be distributed over a considerable area. Resources are translocated between ramets, especially when they occupy microsites of different quality, or places where leaves or roots cannot be deployed. Commonly, a proportion of ramets lacks roots. We conducted a greenhouse study, using clonal fragments of *Glechoma hederacea*, to examine the effects of differences in the number and position of rooted ramets on yield and plasticity of ramets of clonal fragments. Mean values for measured characteristics of the ramets forming each clonal fragment were compared to detect the effects of differences in the number and position of rooted ramets. We hypothesized that (1) mass of roots and ramet root mass ratio (RMR) would increase as the number of rooted ramets decreased, (2) plasticity in rooted ramets would buffer the clonal fragment against reduction in yield as the number of rooted ramets declined, (3) ramet plasticity in response to the absence of rooting, and the beneficial effects of this plasticity, would be greater when older ramets were rooted. When older ramets were rooted, the ramets of clonal fragments with only 25% of their ramets rooted achieved the same yield as those in clonal fragments with all ramets rooted, because of plasticity in root mass and RMR in the rooted ramets. Yield was not maintained when rooting was confined to younger ramets. These results reflect an imbalance between the benefits of acropetal and basipetal resource translocation. Plasticity was greater in older rooted ramets succeeded by unrooted ramets, than in younger rooted ramets preceded by unrooted ramets. Modular plasticity, involving both direct responses to local conditions and indirect responses to the conditions experienced by connected modules, buffered performance in ramets of clonal fragments against variation in rooting ability.

S.17-57-P

Grass litter is a hazardous natural seed trap in long-term undisturbed grassland.

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Litter is a common organic matter covering the ground in natural plant communities, and its quantity is highly affected by the disturbance regime. It is influencing recruitment from seed of constituent species through different mechanisms. Mechanical effects, as barrier to burial for freshly shed seeds, were the least studied, and there is a serious lack about seed fate and movements through litter. We analyzed seed content of litter and underlying soil collected from grassland sites having different disturbance history and estimated seed production of the above vegetation. Grass litter was proved to represent a natural trap for seeds, since we identified important quantities of seeds of a large number of species within litter samples, and there was a mass effect in the seed trapping by litter. As a long-term consequence, we expected seed bank stores to be gradually depleted in abandoned grassland due to the elimination of seeds by litter, but this was not the case. A higher seed production of the above vegetation found in case of undisturbed sites was very probably compensating for seed losses through litter. Seeds retained by the litter were larger, round shaped and bearing appendages. Especially for those seeds meeting one of these criteria litter represent a hazardous medium, since they may have failed or unsuccessful germination. The role of litter as seed trap is more relevant in grasslands not disturbed since long, where litter seed entrapment can exert a selective pressure on certain species, and by this means drive community assembly in grasslands.

S.17-58-P

Is environmental filtering modulated by stress level on gypsum annual plant communities?

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Central Spain gypsum plant communities support and extremely high abiotic stress level resulting from the restriction imposed by soil properties and a highly continental Mediterranean climate with a semiarid precipitation regime. That should exert an important environmental filtering to plant community assembly, and promote a higher level of between species relatedness than expected by chance. At the same time the level of phylogenetic clustering should decrease when stress does, if environmental filtering losses importance in favour of competitive interactions. In the present work we study spatial and temporal variation on cover, composition and taxonomic and phylogenetic diversity of annual plant communities over gypsum soils, on natural and experimental situation differing in their stress level: plots situated by *Stipa tenacissima* vs. areas without perennial vegetation cover; plots on shallow vs. deeper soils; two level experimentally irrigated plots and control plots (only rain water). The study follow a fully factorial design, with ten 50x50 cm plots for each combination of perennial cover, soil depth and experimental irrigation, and a total of 120 plots. Permanova on species composition showed highly significant effect of all factors. Soil depth, wet years and experimental irrigation were significantly related to higher species cover, richness and evenness (repeated measures GLMs). However, plots just by and plots apart from *Stipa* only differed in species composition (repeated measures GLM). As a general rule it could be said that only gypsophites appear under the more stressful situations, while when or where the stress is in someway reduced a more generalist community appear.

S.17-59-P

Nestedness and species co-occurrence patterns in a high mountain community: the patch scale.

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Evaluation of the processes that determine the structure and community assemblages has gained interest in the last years. In this sense, ecosystems which are more vulnerable to global change, such as high mountain islands, represent an adequate system to study patterns of species co-occurrence and community nestedness. Previous efforts directed to analyse community nestedness at the plot-level but not at smaller scale such as the patch scale where real interactions occur. Our main goal was to evaluate nestedness and species co-occurrence at the patch level in different environmental and structural conditions. For this, we selected 27 psychroxerophilous pasture islands, distributed along a mountain range in Central Spain. In each location, we identified all plant, mosses and lichen species in patches along 4 transect lines, summing up 25 m. Each species per patch represented an entrance in our matrix data set. Nestedness was estimated by NODF index, which quantifies nestedness for rows and columns independently and tested with appropriated null model analysis. Our results revealed greater nestedness among sites where conditions are more severe (steep slopes and higher bare soil cover) and those communities with larger patches. However, high levels of nestedness among species were related to species co-occurrence and greater environmental heterogeneity (high shrub cover). Moreover, co-occurrence of different species in the patches was explained by environmental (altitude=0.09, $p=0.001$; bare soil cover=0.06, $p=0.011$) and structural variables (patches/plot=0.07, $p=0.029$; species/plot=0.05, $p=0.05$). In short, the patterns of ordination (nestedness) and interaction (co-occurrence) among species change along an environmental gradient.

S.17-60-O

To leave or not to leave: tradeoffs between different migrating strategies in the greater flamingo.

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Annual migration is a widespread phenomenon, which plays a central role in the dynamics of mobile populations. It has been recognized as an adaptation to spatiotemporally changing environments whereby all or a fraction of a population move to different grounds outside the breeding season. Migratory behaviors can be triggered by both endogenous (i.e., genetic) and environmental factors. Individual differences in associated costs and sensibility to environmental heterogeneity, as well as density-dependence and differences in reproductive success may promote numerous migratory strategies within a population. The greater flamingo (*Phoenicopterus ruber roseus*) is a long-lived bird presenting a very huge wintering distribution. The survival costs of and the influence of age on flamingo's migratory strategies were analyzed by multievent capture-recapture models using data from 22671 flamingos ringed in the Camargue (France) between 1977-2010 and resighted subsequently in their principal wintering grounds (France, Spain, Italy and North Africa). Four wintering strategies were detected, each corresponding to the predominant use of one wintering ground (around 80% of the time). Age effects on wintering strategies were not found. Survival probabilities increased with age. Young birds with a predominantly sedentary strategy usually showed the highest survival and those with the most distant wintering strategy the lowest. However, under severe winter conditions (extremely cold winter 1984-1985), it was individuals with the sedentary strategy which suffered the highest levels of mortality. These results are of special importance for the understanding of the function of migration, and how migration systems are maintained and evolve.

S.17-61-O

Do cushion plants pay a fitness cost for being facilitator?

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Facilitation in plant communities has become an important topic in plant ecology in the last few years. But even if the importance of facilitation is now well recognised and its mechanisms well understood, the potential feedback effect of beneficiary species on facilitators has hardly been addressed so far. Alpine plant communities dominated by cushion plants are highly suited for studying facilitative systems including effects and feedbacks between benefactor and beneficiary species. In a global study with alpine cushion plants we studied the facilitating effect of cushion plants on species diversity and determined their feedback on the benefactor, measuring its reproductive output as an indicator of fitness. Besides overwhelming positive effects of cushions on species diversity, results showed contradictory feedback effects for facilitators. On the one hand, the number of flowers produced by the cushions significantly decreased with increasing abundance of beneficiary species, indicating that facilitation has a cost for the benefactor. However, the number of fruits produced by cushions increased with increasing abundance of beneficiary species, pointing towards a mutual benefit of facilitation. These results suggest negative effects of beneficiary species most likely on resources but also positive effects on pollination; or, in more general terms, an adapted life history strategy of nurse plants in response to the feedback of beneficiary species. These results indicate potential mechanisms of community evolution in nurse plant systems.

S.17-62-P

Size-selective mortality and the source-sink status of spatially structured populations.

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Most populations live in habitat patches which differ in the viable population densities they can support. This can lead to source-sink dynamics of spatially structured populations where sink habitats have lower population densities especially when closed to immigration from source habitats with high densities. Differences in source-sink status of habitats can for example arise from locally high mortality rates. However, local population level responses to elevated mortality can be complex due to the relaxation of competition between and within life history stages in stage-structured populations with effects on the source-sink status of habitats. Here we show for laboratory populations of soil mites (*Sancassania berlesei*) how stage-selective harvesting alters population regulation, stage-structure and population densities differently in populations closed and open to migration. Egg mortality increased adult densities through relaxation of density-dependent maturation but decreased total and juvenile densities in closed populations. This response was changed by spatial structure. Sink habitats with low egg mortality connected to reserves without harvesting showed the same response as closed populations with no effect on reserves. At high egg mortality, spill-over effects through adult movement removed the positive mortality effects in the sink habitat but increased adult population density in the reserve. Juvenile densities in open populations were, contrary to closed populations, not affected by egg mortality. Our results suggest that the source-sink status of size-structured populations and the functioning of reserves depend on the type and strength of mortalities in sink habitats.

S.17-63-P

Seasonality on the structure and composition of avian communities in montane Mediterranean oakwoods of Central Spain.

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Here we analyze the factors determining the seasonality of an avian community inhabiting montane oakwoods of Central Spain, a Mediterranean ecosystem with large seasonal variation in climate. We sampled 40 oakwood plots showing a broad range of environmental conditions with a triple objective: (1) to compare the determinants of species richness between seasons, (2) to define the factors driving seasonality in community composition, and (3) to compare the predictors of seasonality abundance among three bird guilds. Winter species richness was higher in maturer forests with warmer nights, while in spring it increased in maturer forests of lower altitude with an earlier bud development and lower daily temperatures. Moreover, community composition had an increased seasonal variation in those maturer oakwoods with higher diurnal spring temperatures and an earlier bud development. Finally, we show that seasonal variation in density depends on the guild of study. Density of foliage foragers greatly increased in spring in those maturer oakwoods with less development of non-eatable undergrowth, while density of trunk foragers presented a higher spring increase in younger oakwoods. In the case of ground foragers, spring density greatly increased in maturer oakwoods with an earlier bud development and located at lower altitudes. Our results highlight the diversity of factors affecting seasonality in avian distribution, and how these are linked both to energetic constraints (food and temperature) and species biology (habitat structure and phenology). The variety of patterns found here stresses the importance of considering the energetic, biological and functional context when analyzing biodiversity patterns.

S.17-64-P

Spatial and temporal population patterns in an extremely rare (and Al-hyperaccumulator) plant species.

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Plantago almogravensis is an extremely rare Portuguese endemic hemicryptophyte, critically endangered, surviving in a 7 ha area of the southwest coast, in the Natural Park of "Sudoeste Alentejano e Costa Vicentina". In the effort to understand the species actual population patterns both in space and time in the Natural Park area, the population was followed by means of consecutive photographs, in different years and phenophases, capturing spatial and time trends. The results show that it inhabits patches devoid of other vegetation apparently because of its high susceptibility to competition with other plant species and because those patches are special geochemical islands hostile to most other plant species. The geochemical islands where it survives are Al and Fe hardpans emerging among a podzolic field. *Plantago almogravensis* is able to accumulate more than 3000 µg/g dry weight of Al in its leaves making it an exceptionally tolerant plant and an Al-hyperaccumulator. It is also one of few Al-hyperaccumulators to endure Mediterranean climate. Though the species is not an obligate metallophyte in the physiologic sense of the term, it is in the ecological sense, as such it has difficulties to expand to new areas outside the patches where already is established. Concerning the trends in population patterns the photographic information captured was able to quantify the survival of juveniles, and the growth, flowering and death of the adults. These results will be discussed in the context of land-use changes and of conservation efforts to maintain this rare and endemic plant.

S.17-65-P

A Comparative Assessment of the Floristic Composition of the Vegetation under Mono-and Mix-culture Plantations.

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In order to compensate the fast dwindling forest cover and provide a continuous supply of timber, a range of fast growing tree, particularly exotics, have been planted in India. It has been done primarily owing to their fast growth rate resulting in quick returns and incentives by the private entrepreneurs. However, no consideration has been given to the possible impact of these exotics on the floristic composition, and the ecological status of the floor vegetation in comparison to the native trees. We investigated the impact of monoculture plantation of exotic trees, viz., *Eucalyptus tereticornis*, *Leucaena leucocephala*, *Casuarina equisetifolia*, and *Populus deltoides* on the diversity of the floor vegetation and compared it with that under slow growing native trees such as *Dalbergia sissoo* and *Acacia nilotica* and a mix-culture plantation of native trees. We determined the density, biomass and species types, and diversity, richness, evenness, dominance and Shannon-Weiner index of diversity under these plantations. It was found that the plantations of exotic trees have lower density, number of types of species and lesser evenness, richness, diversity indices in sharp contrast to the native trees. In contrast, the index of dominance was greater under exotic tree plantations compared to native tree and mix-culture plantations. It indicated the homogeneity of the vegetation under exotic tree plantations and thus less stability as compared to the native tree plantations and the mix-culture plantations. It is proposed to discuss all these aspects related to the structure and composition of the vegetation under these plantations.

S.17-66-P

Which environmental and landscape parameters determine population fitness of a common habitat specialist plant?

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Due to habitat loss and subsequent decrease in habitat quality many populations of both rare and common species have become in danger of local extinctions. Although actual loss of species may be delayed due to extinction debt, changes in plant traits and population viability can be detectable prior to loss of species, hence describing the actual condition of populations in altered habitats. We explore whether habitat changes in Estonian calcareous grasslands have an effect on population fitness of a common meadow grass *Briza media*. As a measure of plant population fitness we combined population characteristics - mean seed production, germination success, population density and population size of *B. media* in 21 calcareous grasslands. We used structural equation modeling to test the effect of landscape structure and environmental conditions on general plant fitness, thus providing information on landscape scale processes which influence population viability most significantly. We found that *B. media* populations have most likely already adapted to the changed landscape conditions as population fitness was positively affected by current area of calcareous grasslands, whereas historical area and area loss rate no longer influenced populations. Higher number of non-specialist species was characteristic to sites where *B. media* population fitness was lower, while higher moisture level had a positive effect on fitness. We conclude that although populations of *B. media* are able to adapt to changing landscape conditions and are in no immediate danger of extinction, long-term trend of continuing habitat loss could still have serious consequences to common species, as well.

S.17-67-P

Habitat loss and fragmentation affect reproduction and population growth of *Primula vulgaris* in the Cantabrian forests.

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Habitat loss and fragmentation may affect plant population viability either directly, by affecting individual survival, growth or reproduction, irrespective of population traits, or indirectly, when decreases in individual performance derive from the effect of landscape alterations on population traits. We studied how landscape change affected reproduction and population growth of the perennial herb *Primula vulgaris* in the highly fragmented forests of the Cantabrian range (N Spain). We quantified flower, fruit and seed production along gradients of forest availability and subdivision, and edge length during 2008-2009, relating landscape variables, population traits, and reproductive output with path analysis. We also evaluated how landscape change affected vital rates (survival, growth, fecundity) and overall population dynamics during 2008-2010. Habitat availability and edge amount contributed to increase reproduction in 2008 (mostly by direct effects) and many vital rates for the interval 2008-2009. Highly-forested, but moderately-fragmented areas showed higher population growth rates, especially due to the positive effects of forest cover on seedling survival, reproduction and recruitment, and of forest edge length on reproductive adult survival. As seedling recruitment had a large influence on population growth rate, habitat availability effects on reproduction translated into demographic effects. However, landscape change effects on reproduction occurred in 2008, after a mild winter that favored long-lasting flowering, but disappeared or even changed sign in 2009, when winter harshness shortened flowering. Demographic effects were also weaker for the period 2009-2010, as 2009 reproduction was not influenced by habitat availability, and recruitment no longer contributed to the observed variation in population growth.

S.17-68-O

Climatic vs. anthropic impacts on species spatial networks.

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Network theory has been used to represent species metapopulation spatial structure. Here we use this approach to investigate the particular effect that continent's shape had on mammal species extinction risks. We summarize landscape topography using a spatial network of interconnected nodes. We use this network as the main board where species disperse. Subsequently, we perform a selective removal or modification of certain nodes of the network to explore the consequences of a spatially structured perturbation (proxy for climatic induced changes) vs. punctual deep impacts (as a proxy for *Homo sapiens* impact on the system). We discuss whether conclusions could be drawn to improve biodiversity conservation.

S.17-69-P

Haemosporidian infections in passerines from south-western European reed beds.

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The avian haemosporidiosis (genera *Haemoproteus* and *Plasmodium*) of a community of nine passerine species were investigated using molecular techniques and microscopy, at three Portuguese reed beds. The effect of age, sex, season, site and year in the infection prevalence was evaluated for some of these species. 35% of the sampled birds were infected. *Haemoproteus* spp. was only present in migrant species and was not locally transmitted, while *Plasmodium* spp. infected more species and reached a higher overall prevalence. Prevalence differed among bird species and was affected by different variables for each species: it was associated with age in the Reed Warbler *Acrocephalus scirpaceus*, season in the Cetti's Warbler *Cettia cetti* and year in the House Sparrow *Passer domesticus*. The importance of age for the Reed Warbler is explained because adults had already migrated to Africa and contacted with two different parasite faunas, whereas new borns had not. For the resident Cetti's Warbler, season was more important, perhaps due to lower food availability in autumn and winter, making birds weaker and more prone to infection.

S.17-70-O

Adapt or die: changes in population dynamics across the range of a widespread short-lived herb.

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Populations may arrange their life cycles in different ways across species ranges attending to changes in local environmental conditions. To test this hypothesis, we monitored 11 populations of a widespread short-lived herb (*Plantago coronopus*) during four years, along a latitudinal gradient in the Atlantic coasts of Europe. We compared population performance from the dunes in central locations of S Europe to the coastal meadows in northern peripheral areas. We calculated the main vital rates (recruitment, survival, growth and fecundity), the stochastic lambdas and the stochastic elasticities with respect to the vital rates. We also carried out a Stochastic Life Table Response Experiment (SLTRE), to analyze the contributions of vital rates to the differences among populations in the stochastic lambda. As expected, mean values of vital rates contributed much more than standard deviations to differences among populations. Recruitment was the rate with the highest contribution, followed by fecundity and growth, which agrees with the short life cycle of the plant. In the latitudinal gradient, plant growth and fecundity were higher in central populations, whereas peripheral populations showed higher survival rates. However, populations did not show any geographical pattern with respect to the stochastic lambda. Our findings suggest compensations among vital rates in *P. coronopus*, whereby populations adjust their life cycles to the particular local environment throughout the species distribution area. These results also warn against simplistic comparisons between central and peripheral populations.

S.17-71-P

Are diatoms better reflectors of stream quality than water chemistry at regional scales?

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Diatoms are one organism group used in stream quality assessment in addition to water chemistry analyses. Typically nutrient concentrations in streams vary notably, but diatoms respond to changes with a short delay, integrating the variation in water chemistry. Therefore, diatoms typically do not react to small and short-term changes in water quality, but better reflect the significant and long-lasting changes. As there is regional variation in water chemistry, diatom communities of boreal streams also incorporate a strong spatial component at regional scales. What is not properly known yet, is whether the variation in diatom communities between regions is larger than the variation in environmental conditions. Diatoms were sampled at 40 stream sites located in four regions in different parts of Finland. The samples were collected at each site once in the summer 2010. A total of 500 frustules per sample were identified if possible and counted using phase contrast light microscopy. The statistical significance of differences between the community compositions and between environmental conditions at different regions was tested using Multiresponse Permutation Procedure (MRPP). Then, we studied the relationship between diatom species and environmental and geographical variables of different sampling locations with Canonical Correspondence Analysis (CCA). We also used Mantel test to study the relationship between community dissimilarity and environmental and geographical distance. Our results suggest that the four study regions differed in their diatom species composition more than in their environmental conditions. Concentration of N and P and water conductivity were the most important factors affecting the diatom occurrence. Of physical factors, current velocity seemed also to be significant. However, according to Mantel tests geographical distance appeared to be a minor factor for diatom distribution at this study scale. These results imply that species composition reflect the differences between regions better than measured environmental variables. However, the pure effect of geographical location did not affect the diatom communities. The finding that diatoms are efficient indicators of stream quality at regional scales is also beneficial for stream quality assessment programs using snapshot sampling.

S.17-72-P

Foraging Behavior Games between Egrets and Fish.

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Foraging behavior of a predator depends on what its prey is doing and vice-versa, making their interaction a game. Yet empirical tests of optimal foraging generally take place with only one of the two species free to adjust its behavior. In the present study we put the predator back into behavioral predator-prey interactions and let both players behave and play the predator-prey game. We investigated a behavioral game between little egrets [*Egretta garzetta*] (predator) and common goldfish [*Carassius auratus*] (prey) in an artificial theater containing three fish pools. Two experiments were conducted, one in a homogeneous environment with 15 fish in each pool, and one in a heterogeneous environment with 10, 15, and 20 fish. We tested the hypothesis that the egret will maximize its total capture success by adjusting its foraging strategy (feeding time and return time to a given pool) to the fish's anti-predatory behavior that is influenced by the heterogeneity in fish density/pool. The results support the assumption that egrets and fish are involved in a behavioral foraging game. Egret foraging time in a patch varied among pools with different number of fish as predicted by Charnov's (1976) model. Egrets that timed their foraging time and the return time to a pool to the density and the weariness of the fish were the most successful in capturing fish. The results support Lima's (2002) hypothesis that a top predator should possess and use spatial and temporal cognitive abilities to maximize its capture success.

S.17-73-P

The effects of competition above- and belowground on individual weeds in a wheat crop.

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Larger plants usually have an "over-proportional" size advantage in competition with smaller plants. Germinating crop plants are almost always larger than weed seedlings and have a natural advantage in competition. However, this advantage is not utilised in our cropping systems. New approaches in cropping systems for wheat have shown that an increase in crop density accompanied by a change from rows to a two dimensional, uniform pattern can reduce weed growth considerably by utilising the initial size difference between crop and weed at early stage. To obtain information about the role of above- versus belowground competition between wheat and weeds, we performed a field experiment in which spring wheat *Triticum aestivum* L. cv. Amaretto was sown in two different patterns; high density uniform pattern (722 plants/m²), and medium density row pattern (356 plants/m²). Above- and belowground separators were used to isolate the effects of root and shoot competition on individual *Sinapis arvensis* L. weeds. Preliminary results indicate that the growth of weed individuals is highly affected by competition from the surrounding crop. Belowground competition had a strong effect on weed growth whereas aboveground competition had very little or no effect. There was no evidence for an effect of sowing pattern or crop density on weed performance.

S.17-74-O

Loss of assemblage determinism of phytophages communities on phylogenetically fragmented forest canopies.

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Fragmentation is known to alter community assembly. Specifically, fragmentation of habitats has been reported to reduce species diversity and abundance, and to disrupt deterministic community assembly. Until now, however, fragmentation has only been studied in terms of spatial isolation, often in order to characterize the consequences of anthropogenic impacts. We propose to analyze fragmentation within an evolutionary context, in which phylogenetic fragmentation represents a community where a particular host is surrounded by phylogenetically distantly related neighbors, for instance a host tree surrounded by distantly related trees. Such fragmentation likely occurs in natural landscapes no less than in anthropogenic landscapes. Phylogenetic fragmentation might be of major importance in particular for plant/insect interactions, which are often constrained by the phylogenetic niche conservatism of the plants and the phylogenetic host conservatism of the insects. We characterized phylogenetic fragmentation of host trees of a given species (oaks) as their phylogenetic distance from surrounding hosts, and assembly determinism as predictability of abundance of species from the abundance of other species. We find that increasing phylogenetic fragmentation of hosts reduces diversity and abundance and decreases assembly determinism of a predominantly oligophagous taxon of phytophages, i.e. exophagous Lepidoptera. More specialized taxa in contrast, leaf miners and galls, were only little affected by phylogenetic fragmentation of their hosts. Natural phylogenetic fragmentation may hence produce the same pattern as anthropogenic spatial fragmentation, notably in oligophagous phytophages. Thus, widespread community assembly driven by major fragmentation of habitats could be older than previously thought.

S.17-75-P

Warmer is better for eels? Mixed modeling for individual growth of female temperate anguillid eels in relation with temperature and salinity of habitats.

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Cemagref: National institute for Environmental Science and Technology. Cemagref: National institute for Environmental Science and Technology. Atmosphere and Ocean Research Institute, The University of Tokyo.

Characteristics of reaction norms for growth of freshwater eels in the wild were not well understood yet, while salinity and thermal gradients could affect the demographic traits with the migration polymorphism. It is important to understand how growth dynamics could be affected by diverse environmental effects with their migration trajectories. In this study, we investigated the effect of habitat environments and habitat-shifts on individual body growth trajectories of two temperate anguillid species (*Anguilla anguilla* and *A. japonica*) at locations near the center of their distribution ranges. Mixed-effects model of individual growth for *A. japonica* revealed that age and temperature had a significant effect on individual growth, but there was no significant effect of habitat type. For *A. anguilla*, habitat, together with age and temperature had a significant effect on the individual growth patterns. Annual growth rates of *A. anguilla* were higher for years when habitat shifts from rivers to estuaries occurred, whereas there was no obvious trend in *A. japonica*. These results suggested that the difference in growth potential between habitats for eels might be compensated by the occurrence of habitat shifters. At a river system scale, the individual growth models could detect the influence of habitat and temperature in their growth on a fine spatial resolution. Annual growth rates decreased for highest temperatures only for *A. anguilla*, but not for *A. japonica* even in more warmer environments. The results of the present study would be useful to investigate the effects of climate change on eel growth and distribution area.

S.17-76-P

The relative importance of the life-cycle components for average fitness: a demographic test of the fast-slow continuum hypothesis.

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In demographic theory the relative importance of fecundity, growth, and survival for average fitness has been estimated through elasticity analysis. Elasticities measure the relative contribution of different vital rates to the finite rate of population increase. In this study we tested the hypothesis that the intensity of mortality that populations experience determines the relative importance of fecundity, growth, and survival for average fitness. Based on demographic data for different populations of a viviparous lizard (*Sceloporus grammicus*) and a viviparous freshwater fish (*Poeciliopsis baenschi*) we found that populations experiencing high adult mortality exhibit high elasticity values for the fecundity rates. In contrast, populations experiencing low adult mortality exhibit high elasticity values for the survival rates. These results provide support for a fast-slow continuum of demographic and life-history strategies in which high adult mortality selects for greater investment in fecundity (fast life cycles) and low adult mortality selects for greater investment in survival (slow life cycles). These different patterns of resource investment result in markedly different demographic patterns among populations of single species.

S.18- Dryland restoration: from ecotechnology to people - Ecological restoration

S.18-01-O

Vulturnet. Connectivity of raptors scavengers populations through ecological corridors.

Alvarez, Ernesto. Alvarez, Mario. Galan, Manuel.

GREFA. GREFA. GREFA.

Vulturnet is the network corridor that aims top ut in physical, genetic and ecological communication a kind of users such as scavengers raptors. We refer to the four species of vultures that breed in Europe, and also are considered exclusive necrophagous: Bearded vulture (*Gypaetus barbatus*), Black vulture (*Aegypius monachus*), Griffon vulture (*Gyps fulvus*) and Egyptian vulture (*Neophron percnopterus*). Although, of course, other species which by their eventual consumption of carrion, will also be indirectly involved: Red kite (*Milvus Milvus*) and Brown bear (*Ursus arctos*), for example. It is, ultimately, to develop and consolidate the air and land corridors wich connect the major populations of these species in southwestern corner of the continent (Iberian Peninsula) with relict cores that, fragmented, have survived in the east and major Mediterranean islands. The process is done through the establishment of a new populations in selected points (because their geography, social interest and ecological value) through reintroduction or reinforcement actions that works like bridgeheads or demographic exchangers and facilitate the traffic of individuals a large scale. Currently we are working mainly in the western half of Europe, along the stretch running from southern Spain to southern Italy via France and the Alps. And the forecast is to continue in the coming years with the remaining half, acting along the stretch that runs from the Alps to the south of Greece. With the commissioning role of communication corridor, besides keeping an adequate gene flow between wild populations, we get to safeguard a basic representation of ecosystems and cultural practices of great natural and scenic value, which form the basis for sustainable development local populations.

S.18-02-O

Evaluation of restoration - Learning from science and people.

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There is a consensus on the need for the evaluation of restoration activities, which ultimately can provide essential inputs for decision-making. It is increasingly recognized that evaluation of restoration must simultaneously considers both biophysical and socio-economic attributes. The participation of stakeholders and the incorporation of local knowledge in the assessment of environmental problems and potential solutions have also been increasingly demanded by international institutions. This paper introduces an integrated approach for assessing and monitoring the impacts of dryland restoration and management projects in drylands. Two levels of integration define the assessment protocol proposed here. On a conceptual level, biophysical and socio-economic impacts of dryland restoration are integrated within a coupled human-ecological assessment framework that draws on the concept of ecosystem services. On a practical level, the assessment approach seeks to integrate scientific and local knowledge in attempting to understand the impacts of dryland restoration. One of the most innovative aspects of the proposed approach is its focus on participatory evaluation for promoting social learning within the assessment process. The assessment protocol combines (1) key common indicators that represent overall human-ecological system functioning, (2) site-specific indicators identified by local stakeholders that are relevant to the objectives and the particular context conditions, and (3) stakeholder perspectives on the actions applied. The implementation of the protocol facilitates the stakeholder involvement in the evaluation process, bridging the gap between research and practice and fostering knowledge sharing.

S.18-03-O

Restoring ecosystem services and biodiversity.

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Ecological restoration is becoming regarded as a major strategy for increasing provision of ecosystem services as well as reversing declines in biodiversity. I will demonstrate that restoration projects can be effective in enhancing both, but conflicts can arise, especially if single services are targeted in isolation. Furthermore, restoration trajectories are inconsistent and full recovery can take many decades. Despite this uncertainty, new approaches to ecosystem service valuation suggest that the economic benefits can outweigh restoration costs. Payment for Ecosystem Service schemes could therefore provide incentives for restoration, but require development to ensure biodiversity and multiple services are enhanced and the needs of different stakeholders are met. Such approaches must be implemented widely if new global restoration targets are to be achieved.

S.18-04-O

Ecological knowledge for the restoration of Mediterranean semi-arid lands.

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University of Alicante. University of Alicante. University of Coimbra. University of Alicante. CEAM Foundation. CEAM Foundation. CEAM Foundation.

Restoration programs in the Mediterranean basin have traditionally focused on the establishment of coniferous species, mainly *Pinus halepensis*. Over the last decades, failures to improve ecosystem function, negative impact of pine plantations on other species, high mortality rates and slow growth, although not widespread, gained social visibility, fostered criticism and favored a new shift in paradigm. Recently, there has been an increased effort to use other species. But our knowledge on their ecology and their capacity to withstand climate change is scarce. A re-analysis of the factors controlling seedling establishment in experimental plantations reveals that eco-technological inputs (i.e. improvements in seedling quality, site preparation, tree-shelters...) frequently have a significant effect on seedling survival and growth, but they only explain a small fraction of the variation in seedling performance. Spatial and temporal heterogeneity of environmental conditions appear as the major drivers of seedling establishment. These results suggest that future improvements in planting success may not result from further advances in eco-technological tools, but from deeper understanding of the interactions between seedlings and the environment. Efforts should be directed towards identifying suitable sites and time periods for planting particular species and genotypes.

S.18-05-O

Forest Ecosystem Restoration Standard.

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WWF Spain. WWF Spain. Centro de Estudios Ambientales del Mediterráneo. Universidad Complutense de Madrid. Society for Ecological Restoration International. Universidad de Castilla-La Mancha. Centro Nacional de Educación Ambiental. Universidad de Alcalá de Henares.

WWF Spain is developing the “Forest Ecosystems Restoration Standard” project. This project has achieved its first phase consisting in a draft of standards agreed by a work group composed of 14 renowned experts in ecosystem restoration field. In a second phase the standard will be field-tested to verify its feasibility. Finally, the resulting document will be submitted for first public consultation. The standard goals are two: on the one hand to establish a common and standardized methodology for restoration projects, incorporating procedures agreed by technical and scientific community; and on the other hand to incorporate, in restoration projects, measures to climate change adaptation and channels for public participation. WWF Spain considers that a certification system for forest ecosystem restoration will ensure greater political responsibility for forests and rural area and a growing and stronger social, economic and environmental consensus. This will improve forest ecosystems functionality and will mean an increase in the effectiveness of restoration actions (technically and economically). The standard consists on a set of principles, criteria, indicators and verifiers. Specifically, there are eight principles that comprise the standard. The first is cross-cutting and ensures the implementation of applicable regulations. The second refers to the need of including a diagnostic phase. The third principle concerns the reference ecosystem. The fourth principle reflects the matters to be considered in the action proposal design. The fifth principle refers to the project structure and content. The sixth deals with the key for optimal performance. The seventh refers to the maintenance and the eighth one, to monitoring and evaluation phases.

S.18-06-O

Challenges for restoration and sustainable development of drylands in Mexico.

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Drylands in Mexico cover 50 percent of the territory and deliver life-sustaining ecosystem goods and services to 10% of the population. According to recent assessments 40% of the area are severely degraded as a consequence of multiple interacting biophysical and socio-economic drivers jeopardizing the resilience of these socio-ecological systems. How can these systems be restored? We applied the Dryland Development Paradigm as an analytical tool to identify both the key biophysical and socio-economic processes that cause desertification and the pivotal biophysical and socio-economic strategies necessary to restore Mexican drylands. We compared various desertification-centered case studies in Central/Northern Mexico conducted by the international network ARIDnet, where poverty, food insecurity, migration, dramatic loss of soil, plant cover and biodiversity have converted formerly integrated life-support systems into desertified landscapes. Our analysis highlights that to combat desertification and to achieve sustainable development in Mexican drylands and its socio-ecological systems; a flexible, multi-institutional, multi-strategy approach is fundamental. Restoration is just one key strategy, which needs to be directed towards the most vulnerable supporting and regulating ecosystem services such as perennial plant cover, soil stabilization and soil water retention. Restoration of these services needs to be directly coupled with adaptive landscape management and land use planning programs accompanied by conservation programs of genes, species, and ecosystems. Restoration strategies need to be founded on diverse knowledge systems with the long-term goal to re-establish resilient self-organizing and self-sustaining production and conservation systems as the most reliable basis for sustainable livelihood development.

S.18-07-O

Soil quality improvement in the restoration of limestone quarries.

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Soil quality and water availability are the most common limitations to the success of ecological restoration actions in arid ecosystems. Among these, quarries are the areas with the most extreme conditions, thus hindering the restoration of vegetation cover. Thus, conservation of water and soil nutrients must be one of the main goals in the revegetation process. We tested the effect of (i) municipal solid waste (compost) addition and (ii) hydrophilic gel (Stockosorb) to a poor quality loam substrate used in a quarry revegetation process at Secil-Outão. An experiment was set up with two Mediterranean species: *Arbutus unedo* and *Olea europaea* var. *Sylvestris*. We tested 11 different treatments, corresponding to different combinations of two doses of compost (25% and 50%, v/v) and two different doses of gel (0.18% and 0.03%w/w) applied to two distances from the root. The effects of these treatments were evaluated by physical-chemical properties of the substrate and the growth and physiological status of plants. The results show an improvement in substrate quality with the addition of compost, with increased organic matter content as well as macro and micro nutrients' concentrations. Although the water content of soil has shown a tendency to decrease with compost addition, a greater photosynthetic activity and growth was observed in plants grown in soil with compost mixture, indicating greater water availability. The addition of 25% of compost (v/v) was sufficient for an improvement in substrate characteristics, increasing its quality while minimizing the risk of contamination by certain pollutants. With regard to gel, the response of plants to different treatments was highly variable and the results did not suggest any consistent advantage in its application alone. The application of hydrophilic gel may be inappropriate for clay substrates, such as the marl used.

S.18-08-P

Reforestation in arid lands: some criteria to fix the size of the water traps and microcatchments.

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Water economy plays a most important role when afforesting slopes in arid zones. Convenient water harvesting techniques allow the seedlings to survive, establish and grow much better due to a beneficial microclimate. In this paper we develop some basic criteria to fix the size of the water traps and microcatchments to be created with an adequate soil preparation. These criteria should help forest technicians to choose both planting density and micropond size and combine both for the best survival chances for the seedlings and minimal alterations of the original microtopography of the slope.

S.18-09-P

Regime shifts in Mediterranean mountains: from farmland abandonment to forest regeneration.

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Over the past few decades, agro-pastoral systems in many Mediterranean mountains have been abandoned, a trend that is expected to continue into the future and which has raised concerns on impacts on biodiversity. Here we present a coupled socio-ecological model of this process to ask: (1) How do the social and ecological components of these systems interact and drive the dynamics of farmland abandonment? (2) What are the consequences of forest regeneration for biodiversity? We hypothesize that the social dynamics have a collective decision component (i.e. decisions of one individual are influenced by the decisions of other individuals in the community) and an economic component. We assume that the forest regeneration has logistic dynamics. We found that the social processes behind farmland abandonment are characterized by regime shifts between human occupation and emigration, and that these regime shifts are reinforced by the dynamics of forest regeneration. We show that economic incentives to revert abandonment are likely to fail after the process has started due to the dynamics of the regime shifts. We use the countryside species area relationship to convert the land-use change projections of the model to estimates of biodiversity change, in a case study in Peneda-Gerês National Park (Portugal). We find that the regeneration of forest will lead to a decline of farmland species, but that the decline is smaller than anticipated in other studies. We conclude by discussing the conservation policy implication of our results.

S.18-10-O

Participative tools in environmental decision making processes: examples from Extremadura (Spain).

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Despite the fact that decision-making in the environmental area is under the vigilant eye of the public all over the world, little efforts have been made over decades to ensure effective public participation. On 25th June 1998 the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, was adopted in the Danish city of Aarhus. Since then, efforts have been shown by all Party countries to fully comply with their obligations to actively disseminate environmental information. This paper presents results from two real cases of public participation in decision-making conducted in the Spanish region of Extremadura. The first example deals with a management model in river restoration that has been carried out by the Water Administration Bodies in the Guadiana Basin. The participation process involved representatives of public organisms, associations such as fishers associations, local farmers, aggregated mining associations, environmental associations as well as land-owners. The second study case is an example on how the Regional Administration of Extremadura conducted the Strategic Environmental Assessment of the Integrated Regional Plan for Residues Management. Here the participation included Majors of all 383 municipalities in the region, as well as most associations, and the general public. The results show that the participants were able to reach agreement on the prioritization of the alternatives for both cases. There were evidences of the need of a more intense participation from the general public. A more professional contribution from associations, especially the environmentalist ones would also be necessary.

S.18-11-0

Mutualistic interaction between shrubs in an arid ecosystem.

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EEZA-CSIC. EEZA-CSIC.

Plants modify their local environment in many different ways, often improving growth conditions for neighbors despite potential resource competition. One-way facilitation interactions have been found in many harsh environments and their role as structural forces governing species composition in plant communities is well established now. However, reciprocal positive effects benefiting two interacting species have seldom been reported. We tested the existence of such reciprocal positive effects in an arid environment in SE Spain using spatial pattern analysis, species removal, and a natural experiment. We found that the spatial association between *Maytenus senegalensis* and *Whitania frutescens*, two shrub species of similar size intimately interacting in our community, resulted in mutual benefit for both species. Benefits include improved water relations and nutritional status or protection against browsing, and occur despite simultaneous competition for other resources. Such data suggest a facultative mutualism among higher plant species, a process that may be under-reported and which could be a significant driver of plant community dynamics.

S.18-12-0

"Farmland manicure" to restore biodiversity and ecosystem services on agricultural land.

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Agriculture is a major cause of destruction and degradation of natural ecosystems throughout the world, and agricultural land currently extends over nearly half of the Earth's surface. We face the challenge of maintaining provisioning services and, simultaneously, conserving or enhancing other ecosystem services and biodiversity in agricultural landscapes. There is a range of possibilities within two contrasting types of intervention, namely "land sparing" - restoring or creating non-farmland habitat at the expense of agricultural production- and "wildlife-friendly farming". Wildlife-friendly farming may incorporate "farmland manicure" techniques, which involve restoring or creating target elements to benefit wildlife and particular services without competing for land - e.g. introduction of living fences, "woodland islets", ponds and shelter for wildlife. "Woodland islets", an intermediate approach between secondary succession following land abandonment and farmland afforestation, are an alternative to designing ecological restoration in extensive agricultural landscapes. This approach allows reconciliation of farmland production, conservation of values linked to cultural landscapes, enhancement of biodiversity and provision of a range of ecosystem services. It can be used to trigger passive forest restoration as a form of land-sparing in the farmland context. Although further research is needed, action is desperately needed. Restoration projects within agricultural landscapes are essential if we want to halt environmental degradation and biodiversity loss. Financial support, public awareness, education and training, particularly of farmers, are necessary to meet these goals.

S.18-13-O

Foliar fertilization as an approach to assess nutrient limitation in semiarid Mediterranean ecosystems.

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Low soil fertility and water availability often co-limit plant productivity in semiarid ecosystems. It is difficult to evaluate plant response to fertilizer addition to soil in semiarid Mediterranean ecosystem due to nutrient immobilization caused by high soil pH and high free CaCO₃ contents. Foliar fertilization, used in agronomy, could overcome these experimental difficulties but its usefulness in wild plants has not been evaluated. We studied the response of *Stipa tenacissima* and *Rosmarinus officinalis* to foliar fertilization in the semiarid catchment of Cárcavo (SE Spain). We used phosphorus (KH₂PO₄), iron (FeSO₄.7H₂O), manganese (MnSO₄.H₂O) and zinc (ZnSO₄.7H₂O) foliar spray treatments. Foliar fertilization was applied twice in spring (May of 2008) on plants grown in nutrient-poor soils (Haplic and Leptic Regosols). A large rainfall event (54 mm) took place three days after foliar fertilization, and then the physiological changes in plants were assessed. Non-fertilized plants (controls) showed reduced foliar nutrient concentrations (N, Ca, Mg, Fe, Cu, Mn and Zn), raised epoxidative status of photosynthetic pigments associated to xanthophyll cycle (higher violaxanthin and lower zeaxanthin) and increased both the effective and maximum efficiency of PSII (Fv/Fm and ΦPSII), thus indicating stress alleviation and rapid photosynthesis activation. Foliar fertilization increased the foliar concentrations of applied nutrient compared to control plants. Fertilizer sprays also improved the status of other non-applied nutrients, such as N concentration when P was applied. The P and Zn treatments increased photo-protective pigment concentration (neoxanthin, carotenoids and AZ/VAZ ratio) relative to control plants in *R. officinalis*. This higher protection improved photochemical efficiency by decreasing the loss of absorbed light energy as heat (low NPQ in P fertilization) or by improving the performance of PSII (high ΦPSII in Zn fertilization). The Fe and Mn treatments increased chlorophyll a and b and reduced the AZ/VAZ ratio compared to control plants in *S. tenacissima*. The higher concentration of chlorophyll likely made unnecessary an overprotection of PSII and its efficiency decreased (lower Fv/Fm and ΦPSII in Fe fertilization). The results suggest that P and Zn fertilization enhance leaf growth in *R. officinalis*, while Fe and Mn fertilization stimulated a physiological reactivation in *S. tenacissima*. Foliar fertilisation reveals as a useful tool to study plant nutritional deficiencies in an ecological context.

S.18-14-O

Influence of microhabitat in the natural regeneration of *Quercus petraea* in restored coal mines (Northern Palencia, Spain).

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Microhabitats are capable to determine the spatial regeneration pattern of plant species. The aim of our study was to characterize the natural regeneration of pedunculata oak in three microhabitats in restored coal mines of Northern Palencia (Guardo): the adjacent oak forest edge (B); the restored mine area close to forest (M1); and the restored mine area away from forest (M2). Some characteristics of *Q. petraea* natural regeneration were monitored in twenty 2x2m permanent plots for each microhabitat. Results showed a decreasing trend in density (16.3, 3.1 and 0.7 ind./m², in B, M1 and M2 respectively) and age of oak regeneration as abiotic stress increased. Moreover, the presence of moss around of oak individuals increased through this environmental gradient (B, M1, M2). Individuals of M1 showed the highest height (15.5 cm) and diameter (3.3 mm), but not differences for both dimensions were found between the other two microhabitats. Individuals of M2 showed the lower total number of branches and branch mortality (%), increasing both parameters as abiotic stress decreased. We conclude that micro-environmental differences within the restored coal mines have a great effect on early *Q. petraea* natural regeneration by affecting survival and individuals' development.

S.19- Ecological Models and their applications in forest management

S.19-01-P

Modelling habitat suitability of Hazel Grouse (*Bonasa bonasia*) in French sub-Alps: An operational approach to conservation planning.

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CEMAGREF. CEMAGREF. CEMAGREF.

Cemagref Institute for Agricultural and Environmental Engineering Research, Mountain Ecosystem Unit, 2 Rue de la Papeterie, 38402 Saint-Martin d'Hères, France We face the challenge to monitor not just changes in natural systems but also the impact of these changes on the health and persistence of the species that depend on these environments. In order to reach this goal and learn more about habitat quality for forest dwelling species, we conducted research based on the evaluation of changes in structure and composition at the forest landscape level within a temporal framework of twenty years. The approach helped to understand changes in forest structure and to reach an operational level in monitoring biodiversity. The approach is illustrated by a case study in the French sub-Alps region. The study site is a land dominated by forest, with different degrees of protection, in the middle of an axe between Grenoble and Chambéry, two important urban centres in the Alps facing an accelerating suburban sprawl. The forestland is an anchor in the heart of a Regional Natural Park (Chartreuse) with arising objectives of sustainable development. The region present a complex socio-economic situation due to the presence of a ski resort in mid-mountain and several other related tourist attractions that jeopardize conflicting conservation objectives. We modelled the species-habitat relationship within a spatio-temporal framework, to derive key habitat features in the Natural Park. We evaluated factors and critical threshold for monitoring the species, in order to assess the predictive power of models based on field surveys, ancillary information and high resolution infrared aerial photographs. We tested Maximum Entropy (Maxent) algorithm (Philips et al, 2006), in order to predict the distribution of Hazel Grouse species, in the complex mountain landscape within the study site. This presence-only modeling method has showed numerous advantages over many other approaches. It is based on a function that links the fitness of individuals to their environment. Our results were highly consistent with field knowledge, showing that habitat modeling generated using spatial statistics and GIS can effectively help in the characterization of habitat requirements and the localization of the species suitable habitat. The approach developed seem to be a promising operational tool for local and regional managers interested in species monitoring in the long term Philips, S. J., Anderson, R. P., Schapire, R. E., 2006, Maximum entropy modeling of species geographic distributions, *Ecological Modelling* 190:231-259.

Evaluation of logistic nonlinear model of three parameters, in the study of growth in height, using the methodology of linear approximation.

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Regression is one of the main tools to establish a functional relationship between variables. This association is achieved with the use of regression models which can be linear or nonlinear. In formulating the linear model is one that seeks to better explain the relationship, already in the nonlinear case formulations are based on considerations inherent in the phenomenon, thus non-linear models have a greater wealth of information and in many situations such as those of study of growth, productivity and others, they must be preferable to linear models. The fit of linear models by the least squares results in parameters that determine the lowest mean squared residuals and they enjoy the properties of being independent, normally distributed and of minimum variance, but for nonlinear models these properties can be guaranteed only asymptotically, ie for very large samples, but no one knows the minimum sample size needed. Some nonlinear models can have what is called "linear approximation" and even when adjusting data of small samples to allow convergence adjustment without loss of that properties. The known measures of Bates and Watts called "intrinsic nonlinearity (IN), which measures the effect of curvature and measure non-linear due to the effect of the parameters" (PE) which measures the effect of parameters on the nonlinearity, allow information to enable us to accept the existence of the "linear approximation". This study aimed to evaluate the nonlinearity and adjust the height of eucalyptus grandis using the nonlinear logistic three-parameter ($a / (a + b \cdot \exp(-c \cdot \text{age}))$), where a, b and c are parameters). The properties of the parameters were evaluated through the moments of asymmetry (AS) and excess kurtosis (k), that provide information that allow us to evaluate how the distributions of the parameters are close to normality, beyond the measure of bias that allows us to asymptotically say if the parameters have variance approaching the minimum variance. The parameters were set as follows: $a = 23,842381$, $b = 6,502726$ $c = 0,071993$. We also obtained $PE = 0,2803$, $IN = 0,0064$, with the cutoff for rejection given in the literature of 0,3 is accepted the linear approximation of the model with data. We also determined the ratio of fixed adjustment coefficient ($R^2 = 0.9807$) and by bootstrap simulation we obtained the asymmetry coefficient, the coefficient of excess kurtosis, confidence intervals and bias were obtained in all patients, results which lead us to accept the parameters as approximately normal, and variance minimal, concluding that the methodology of the linear approximation, the bootstrap technique and measures of Bates & Watts validate the accuracy of the inferential results.

S.19-03-O

Bringing ecology into forest management through ecological models: examples from the Northern Hemisphere.

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Forest ecosystems play a critical role in the maintenance of biodiversity and provide key ecosystem services. Forestry is a technical discipline in which ecological, engineering and socio-economical knowledge is integrated to effectively design and implement sound forest management practices. However, it must be under continuous readjustment in order to incorporate scientific advances and to respond to new societal demands. Over the last decades sustainable forestry takes into consideration functional and structural ecosystem components such as biodiversity or biogeochemical cycles not included under traditional timber-oriented forestry. Current advances in Ecology allow us to develop models to properly evaluate the consequences of different management actions on ecosystem structure and function. Ecological models are being gradually incorporated into sustainable forest management around the world. In this talk we discuss several examples in which ecological models are used to assess potential tradeoffs among conflicting goals faced by managers when addressing sustainability at several scales. For example, in Europe, the model PINEL has been used to estimate long-term effects of timber removals in nutrient cycling. In Asia, the ecosystem-level forest model FORECAST has been used to simulate the combined effects of acid rain and N deposition on Chinese fir plantations in Southeast China. This model has also been used in Canada to design reclamation plans after mine closure in the Oil Sands region, and how successful these plans are to bring back a functional forest. Guidelines and current trends on implementing ecological models for forest management will be discussed.

S.19-04-O

Improving forest management practices through science: pest control in Mediterranean pine woodlands

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Insect pests are a major threat to many forests worldwide, from boreal to tropical forest ecosystems. Some pests exhibit periodical outbreaks, after which their populations often crash as a result of natural biological control. To offset such outbreaks, several management techniques are used, including aerial spraying of insecticides. The question remains whether pest decline following an outbreak is the result of management practices or a natural consequence of the insect's population cycle. In this study, we assessed the performance of aerial spraying of insecticides on pine woodland stands to control pine processionary moth *Thaumetopoea pityocampa* (PPM) outbreaks in Andalusia, southern Spain. To achieve this, we compared the degree to which a forest stand recovers from defoliation from one year of severe damage by PPM to the following year (infestation index) in stands that were treated (i.e. subjected to aerial spraying) and untreated using a 4-years database from the Regional Environmental Council. The results revealed a significant similar recovery from infestation after a PPM outbreak of both sprayed and non sprayed pine woodland stands, for the four most representative pine species (black, Aleppo, maritime, and stone pine). It is concluded that insecticide spraying cannot be considered a prevention for outbreaks if it is applied once the outbreak explodes. Management practices that can help control PPM outbreaks include promoting spatial heterogeneity at the landscape level, fostering biodiversity in pine plantations, and reinforcing parasitoid insect and predatory bird populations that negatively affect the PPM. This study illustrates how simple sampling designs and statistical tests can be useful decision-making tools and can help improve the environmental viability and cost-efficiency of forest management practices.

S.19-05-P

On tree density estimation for forest inventories: a case study in the Central Catalonia, North-East of Spain.

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Knowledge of population size has a great importance in forestry, wildlife ecology and in general many environmental studies. Usually, complete censuses of biological populations are not feasible and only abundance estimates can be obtained based on sampling methods. For instance, the estimation of stand current conditions such as timber volume and the number of stems per hectare are central issues in forestry. Several approaches have been developed to estimate the intensity of point patterns including quadrat sampling methods, and inter-point distance approaches. Although quadrat sampling methods are simple to analyse, they require the counting of the number of trees in large forest areas, which is usually either expensive or nonviable. Distance methods are an alternative to quadrat techniques where distances between trees are considered instead of massive tree countings. However, most of the national forest inventories carried out in Europe consider the estimation of tree density based on quadrat methods. Usually in these sampling designs, the estimation of tree density is based on the counting of trees in circular plots. Given that the shape, number, size and spatial position of these plots are defined systematically and independently of the spatial structure of tree point patterns, the sampling error committed is very heterogeneous and fully dependent on forest point configurations. Here, we want to study the effect of the sampling design on the sample variance for a case study involving several pure and mixed forest stands of *Pinus sylvestris*, *P. nigra* and *P. halepensis* in the Central Catalonia (North-East of Spain).

S.19-06-O

Interactions of bark beetle outbreaks with fire, windthrow and drought.

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Bark beetles, fire, windthrow and drought are key factors influencing forest ecosystem services by modifying stand structure and species composition. Climate change is expected to affect these disturbance regimes, both through changes in mean values of e.g. temperature and precipitation, and through an increase in extreme events. A better understanding of the disturbance regimes and their mutual interactions is indispensable to assess the future development of forest ecosystems and the associated risks and opportunities. Here, we specifically focus on bark beetle outbreaks because the life history of bark beetles is sensitive to temperature and therefore susceptible to climatic change. Further, their population dynamics is linked to other disturbances, rendering estimates of shifts in severity and frequency of bark beetle outbreaks particularly interesting. We quantify the interaction strengths of bark beetle outbreaks with other disturbances and assess to what extent they influence forest structure. For this, we developed a conceptual model of disturbance interactions that we test with simulation studies using the landscape model LandClim. Estimates of interaction strength and relevance are compared to empirical data from disturbance events in temperate forests.

S.19-07-P

Productivity and growth of some wood species in the mangombe's forest plantation.

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Mangombe's forest plantation is among the silvicultural experiences realized in Cameroon since the years 1960. Many species from dense humid forest of Congo basin (*Heritiera utilis*, *Terminalia ivorensis*, *Pycnanthus angolensis*, *Lovoa trichilioïdes*, *G. arborea*, *A. klaineana*) and some exotic species (*Pinus caribea*, *Dipterocarpus alatus*) were tested. These research aim to capitalize ecological and silvicultural knowledge needed for the sustainable management of forest ecosystem notably to determine the optimal density and identify the more adapted species in the field condition. The best yield were observed in *A. klaineana* and *P. caribea* parcels, planted at the density 3 x 3 m between the trees (1111 trees/ha). The productivity in these plots with less than 38 years old are respectively estimated at 728 m³/ha; 66.17 m²/ha and 792.20 m³/ha; 89.08 m²/ha concerning the volume and diameter. The density of 5 x 4 m between trees (500 trees/ha) permit to obtain good diameter increasement in *G. arborea* plots while there is no significant difference for this parameter in some plots such as *L. trichilioïdes* with density 625 - 1111 trees/ha; *H. utilis* (500 - 400 trees/ha), *T. ivorensis* (817 - 715 trees/ha), *A. klaineana* (500 trees/ha) and *A. cunninghamii* (1111 - 833 trees/ha). Despite the lack of silvicultural treatment to improve the dynamic of regeneration, some growth parameters (increasement, mean diameter) remain closer of the value observed in some African plantation and sometimes interesting than those of natural forest. The high mortality in few plots and disproportional value between the diameter size of trees show that the survey of the plantation could ameliorate the growth potential of planted specie. Key words : Forest plantation, silviculture, dense humid forest, Mangombe - Cameroon.

S.19-08-P

Tree architecture variation among the dominant species of Continental Spain.

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Tree architecture has important consequences for tree performance as it determines resource capture, mechanical stability and dominance over competitors. In this study we analyzed architectural relationships between stem diameter versus height and crown dimensions for 13 dominant canopy tree species of Continental Spain belonging to the Pinaceae and Fagaceae, and related species architecture traits to wood density, shade tolerance and climatic factors (rainfall, drought, and frost). Across species we found a trade-off between the intercepts and slopes of the relationships, reflecting different tree strategies to optimize current or future light capture. Fagaceae had, compared to Pinaceae, denser wood, taller saplings with wider crowns, and adults with larger maximal crown size but smaller maximal height. In combination these traits enhance light acquisition and persistence in the understory, thus contributing to their shade tolerance. Pinaceae species had opposite traits thus contributing to their light demand. Wood density had a strong influence in tree architecture, with dense-wooded species having taller saplings because of stiffer stems and wider crowns probably because of cheaper branch expansion costs. Across species, the relation between stem length-stem diameter, and between crown length-stem diameter became shallower with an increase in length of the drought period. Species from drier areas had therefore shorter stems and shallower crowns for a given stem diameter, probably to reduce hydraulic path lengths and assure water transport. Wood density is the main driver of variation in tree architecture between species and the two dominant families, with implications for their light foraging strategies and shade tolerance.

S.19-09-P

Data model synthesis to evaluate the long-term supply of base cations in Swedish forests.

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Base cations are important macronutrients and essential for buffering soil and water acidity in terrestrial and stream ecosystems. Soil reservoirs of exchangeable base cations, however, may be declining in Europe, eastern North America, and other regions of the world following historical or current atmospheric deposition of sulfur and nitrogen anions, and also from forest management practices. Forests play an important role in mitigating climate change through carbon sequestration and fossil fuel substitution, but intensive forestry operations can remove large quantities of base cations from the soil. This raises questions regarding the long-term supply of base cations in the soil and the consequences of changing base cation availability for future forest production. This study uses annual exports of Ca, Mg, K, and Na from 60 forested catchments in Sweden between 1985 and 2010 and modeled estimates of weathering inputs to evaluate the long-term supply of base cations in Swedish forests.

S.19-10-P

Effects of silviculture on tree species richness: interactions between management, landscape context and regional climate.

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Patterns of forest biodiversity are shaped by a complex set of processes operating over different spatial scales. While climate may largely determine diversity at regional scales, numerous biotic interactions and disturbances affect diversity more locally. However, the likely interactions between these processes across different scales complicates efforts to understand their relative importance. For example, the response of biodiversity to a local disturbance may depend on regional productivity and species pools available at intermediate scales. In this study we quantified the interacting effects of silvicultural disturbance and regional climate on tree species richness in an area of 152,000 km² in central Spain. We used data from the Spanish forest inventory, together with hierarchical Bayesian models, considering different management types and intensities both in the focal stands and in the surrounding landscape. Results suggest that intermediate disturbances as selective cutting may allow the coexistence of a higher number of tree species both in coniferous and broadleaved forests. However, this did not occur in regions subject to severe water stress, suggesting that the benefit of increased resources in canopy gaps may be outweighed by the reduced protection from desiccation. Further, we showed that the species richness within individual forest stands was significantly influenced by the pool of available species in the surrounding landscape. Forest stands within landscapes dominated by dehesas, forest plantations and clearcut forests showed reduced richness relative to those with surrounding riparian or unmanaged forests. Overall, these results highlight how the responses of individual forest stands to silviculture depend on interactions that need to be evaluated in a broader climatic and landscape context.

Is it possible to obtain high resolution and reliable species distribution models using an opportunistic sampling along roads?

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Species distribution modelling (SDM) is a powerful tool in biodiversity studies. However, there are still several key issues to resolve, such as the use of data collected by means opportunistic sampling and modelling at landscape scale. In this work, we have addressed these issues by generating SDMs for twelve species at a landscape scale with a very detailed resolution (25m x 25m), and using two different samplings schemes: opportunistic sampling along roads and regular sampling. The aim was to establish whether it is possible to obtain reliable models using sampling along roads. This sampling strategy was far cheaper and faster than the regular one. The study area was a large fire in which we established a regular grid to sample during two consecutive years a total of 303 locations. The roads crossing the area were travelled by car and every 500 m a sample was taken some meters away from the road to avoid direct impacts from them. A third sampling scheme was used to validate the models, consisting in 61 samples in locations selected at random. In the regular sampling data collected included abundance of the main species. These were later transformed to presence/absence data. All the other sampling schemes were based on presence/absence data. All data collected were similar among them based on species composition. The SDMs were generated using Maxent. This method was selected based on previous experiences in ecological modeling. Ten independent variables were considered; these represented lithology, topography, indirect measurements of climate and historical factors of land use, and were selected on the basis of preliminary multivariate statistical analysis. All the original models were transformed into binary maps (presence/absence) applying the “maximum training sensitivity plus specificity” rule. To validate the models we calculated the AUC statistic from an independent data set based on our third sampling scheme. The models generated from regular and road sampling schemes were then compared using the Pearson correlation coefficient. Our results show that models generated from the regular and road sampling schemes are not comparable with each other. Thus, all the models constructed using data from the regular-sampling can be considered reliable, unlike several of the models generated using data from the road-sampling. Only seven of the 24 binary maps obtained an AUC value better than that obtained with the original models. Therefore, when designing the sampling strategies, the ecological niche of the species, the possible environmental bias in the sampling strategy should be taken into account in order to optimize the use of logistical resources and to achieve reliable models. Furthermore, converting the original values to binary maps (presence/absence) involves a risk of introducing additional errors.

S.19-12-O

Bayesian calibration and Bayesian model comparison of two process-based model versions.

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In the context of global climate change, the quantification of carbon fluxes in forest ecosystems and how they vary inter-annually are important issues. Process-based models are flexible tools that permit assessing ecosystem productivity at different spatial and temporal scales and for different management and environmental conditions. On the other hand, carbon and water fluxes at the ecosystem scale may be measured using eddy covariance techniques, thus providing useful data for testing and validation of models. The principal aim of the work was to calibrate and evaluate two versions of a process-based model that differ in the autotrophic respiration (RA) modelling. The original version (3PGN) is based on a constant ratio between the net primary production (PN) and the gross primary production (PG), while, in a new version (3PGN*), developed by the authors, RA was modelled as a function of temperature and biomass. The two model versions were calibrated and evaluated using a comprehensive dataset consisting of forest growth experimental data and eddy-covariance measurements. The calibrations and the evaluation of model structures were achieved by means of Bayesian calibration (BC) and Bayesian model comparison (BMC). These methods rely on expressing modelling uncertainties as probability distributions. The BC showed that the data were informative for almost 70% of the parameters. BC also allowed identification of the parameters to which the models were most sensitive and to assess parameter correlations. Key parameters were those for carbon allocation, some of the parameters related to water stress and site fertility. BMC showed that, in the light of the data used, the new version of the model has 95% probability of being the superior model. Furthermore, in 3PGN, canopy quantum use efficiency resulted highly correlated to the GPP-NPP ratio, while in 3PGN*, the new RA modelling allowed to significantly reduce the correlation between photosynthesis and respiration parameters.

S.19-13-P

Lesson from the Habitat Suitability Models to evaluate the environmental variability of *Pinus nigra* Arnold. and *Pinus sylvestris* L. in the Iberian Peninsula.

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In recent years, ecological modeling has become a powerful tool allowing the generation of species distribution models (SDMs) to predict the suitability of a given organism. These models establish a relationship between environmental variables and available distributional data for species. The SDMs can be applied to explain the spatial and temporal evolution of species under different climate scenarios. However, the different results shown by the various existing modeling techniques reveal the importance of their validation. In this work we produce and discuss the present potential distribution of *Pinus sylvestris* and *Pinus nigra* in the Iberian Peninsula by using the MaxEnt and BIOCLIM models, and evaluate the influence of the different environmental variables in their potential distributions. Our intention is to select different models and project them to the past climatic conditions, to compare the outputs with existing palaeo-ecological data, to evaluate their accuracy. Natural occurrences from presence data of the Third Spanish Forest Inventory produced the best performance of the SDMs tested with these species. Predictions obtained from the 1x1 km Worldclim database, the Digital Spanish Climatic Atlas and the Spanish Fitoclimatic Atlas have been compared.

S.19-14-O

Long-term carbon loss in fragmented Neotropical forests.

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Tropical forests are one of the crucial components of the global carbon cycle, as they store most of the carbon contained in terrestrial vegetation. There are, however, substantial uncertainties surrounding the processes that contribute to the global carbon balance of tropical forests. Deforestation of tropical forests and selective logging have both been identified as major sources of CO₂ emissions. In contrast, the fragmentation processes that act on forests, causing increased tree mortality at fragment edges, have been largely overlooked as CO₂ source. To investigate the importance of fragmentation processes, we present the first biome-wide estimation of long-term carbon loss due to fragmentation of tropical forests by combining remote sensing and process-based forest modelling. This study suggests that above-ground carbon loss due to fragmentation may reach relevant numbers per hectare for the Brazilian Atlantic Forest; upscaling this information to whole biomes and longer time-scales, we show how much carbon the Brazilian Atlantic Forest and the Amazon Basin might have lost after fragmentation using present spatial distributions of forest fragments. A comparison of these estimations with other reports of recently discussed carbon sinks/sources suggests that fragmentation-induced carbon loss may act as a globally relevant carbon source. We show that ecological changes at forest edges following fragmentation of tropical forests magnify carbon loss and contribute considerably to global carbon dynamics, even when making conservative assumptions for estimating loss. This study contributes to the understanding of global carbon sinks and sources related to vegetation and can help to reduce uncertainty surrounding this question.

S.19-15-O

Forest succession models on the way to decision support tools.

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A strength of forest succession ("gap") models is that they are able to simulate forest dynamics under changing climatic conditions, thus being suitable for exploring future forest dynamics. There are, however, still some areas in need of improvement before these models can be applied as decision support tools in forest management. One such example is the formulation of height growth, as in most gap models every growing tree approaches a fixed maximum height regardless of site conditions; in addition, tree height as such is only approximated via tree diameter. Another area is the incorporation of forest management into the model framework. Since most temperate and boreal forests are intensively managed, management is an important feature to incorporate for assessing the influence of climate change on forests. It is also important for model evaluations, as long-term data on forest dynamics are almost exclusively available for managed stands. We demonstrate how the height growth formulation in the ForClim model can be improved, and also the capabilities of the extensive management submodel we implemented in this model. The new model version was tested against forest inventory (NFI) and long-term data from growth and yield research plots, and proved its ability for simulating stand structure accurately while not losing its general applicability. Lastly we present how the ForClim model may be used for the assessment of changing forest dynamics under climate change, and how forest management can be used to influence these developments.

S.19-16-O

Can we optimise forest management strategies under a changing climate? Linking GOTILWA+ process based model with Swarm Particles Optimization algorithm to support forest managers' decisions.

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Climate affects forest growth patterns. If climate changes as projected, by increasing temperatures but not water availability, growing conditions will get worse for Mediterranean forests. Can we do something about it? Would it be possible to counteract adverse climate change effects by changing management strategies? How can we decide the best option beforehand? These questions don't have simple answers. The long-term run of forest management and the multiple combinations of management decisions to be considered over the whole forest stand live-cycle makes it difficult. Modelling forest growth in relation to environmental conditions, including forest management, offers a good opportunity to explore some particular conditions, but not enough to ensure that we are providing the optimal solution for a given goal. In order to progress on that way, we have integrated the process based model GOTILWA+ with the Swarm Particles Optimization algorithm. Our main goal here, is to analyse how changing a multiple set of forest management decision variables, can we come close to an optimal value of a given objective function (e.g. Soil expectation value, Biomass production, Carbon fixation, Water use efficiency, Risk of fire....). This approach allows us to rethink and test forest management objectives to address new demands and risks (i.e. water, forest fires) given the current and projected climate conditions. In this presentation we present this forest management modelling approach and examples of its application. We also discuss how this new decision support platform may help to explore the feedbacks between forest management strategies and climate change.

S.19-17-P

Will European beech be able to follow its climate optimum during the 21st century ?

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Many distribution models have been developed to predict species distribution shifts due to climate change, most of which are habitat models, i.e. correlative models. One of the key questions concerning distribution shift projections remains: will species be able to migrate fast enough to track their future climate optimum? So far, no study has been able to tackle this question because at large scale (spatial and temporal), dispersal mechanisms have never been taken into account into such predictions. In this study we investigated how the distribution of the European beech shifts due to future climate change considering both plant traits responses to climate change and the species dispersal abilities. We used a process-based species distribution model coupled with a new kind of phenomenological dispersal model based on the Gibbs point pattern process, both of which have been parameterized using species specific modern ecological data. The model has been validated on paleo-environmental data, and was able to reproduce accurately beech migration rate and routes from 12k years BP. Using two IPCC scenarios, our results showed that beech dispersal abilities should allow the colonization of a large part (20% to 40%) of the newly suitable area in the northern Europe by 2100, which limits the contraction of its range to 5-15% depending on the scenario by the end of the 21st century.

S.19-18-P

Herbaceous productivity in forest edges of NW Chilean Patagonia.

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In NW Patagonia, extensive areas of original forests have been converted into grasslands. Nowadays remnants of lenga (*Nothofagus pumilio* [Poepp. et Endl.] Krasse) forests coexist with open grasslands and both are used for grazing. In this work we analysed the spatial and temporal variability of the herbaceous net primary production (NPP) in the grassland-dense forest ecotone, in order to set the scientific basis for silvopastoral management in the region. Herbaceous NPP, soil nutrients and structural variables were measured in four 80x10m sites (40m into forest and 40m into grassland), in two years of different annual precipitation and mean temperature. Grasslands had higher and more even NPP values compared to forests, at all spatial scales. In the warmer and drier year NPP in grasslands was more affected than in forests. However, NPP in forests depended on the amount of light (photosynthetically active radiation; PAR) transmitted through the canopy. The NPP in some forests was as high as in the adjoining grasslands, even if those did not differ in vertical canopy cover; higher PAR, and therefore NPP, would attract animals whose consumption and droppings increase NPP values. We propose a conceptual model of the response to PAR, soil fertility and grazing. Our results indicate that remnant forests are important resources for grazing and also a silvopastoral management will help to maintain the original forest by farmers.

S.19-19-O

Landscape scale modelling of adaptive forest management for multiple ecosystem goods and services under climate change.

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Developing suitable adaptive forest management strategies will be essential in order to maintain, and ideally enhance, the provisioning of ecosystem goods and services (EGS) under future climate change. However, the development of strategies that balance the need to simultaneously maintain multiple, and often competing, EGS remains a challenge. Here we support decision making by assessing how climate change and forest management affect forest development and the concomitant changes to EGS. Using a process based forest model (LandClim) we simulate forest dynamics and associated EGS under a range of climate change and management scenarios in the Black Forest, Germany. We evaluate EGS provisioning at the landscape scale and focus on the interdependencies between timber production and biodiversity, which are the most valued EGS in this region. Our results indicate that timber production can only be maintained under climate change if current even-aged Norway spruce forests are converted to more drought adapted forest types. Also, our results suggest that future biodiversity is best promoted by applying a medium intensity uneven-aged management regime. However, the temporal development of timber and biodiversity provisioning differs among alternative adaptive management scenarios. As a consequence, trade-offs between EGS, which change through time, need to be taken into account in adaptive forest management. We finally discuss how the temporal development of timber production and biodiversity is influenced by individual management prescriptions, climate change and the current state of the forest.

S.19-20-O

Patterns of structural response to simulated partial harvesting of boreal mixedwood stands.

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Partial harvesting has been proposed as an approach for maintaining late-successional structure within managed boreal mixedwood stands. Although little long-term data is available to evaluate its effects in this stand type, recent advances in individual-based stand modelling provide an opportunity to simulate post-harvest stand development following different retention harvests. Using the stand dynamics model SORTIE-ND, we examined 80-year patterns of structural change in response to different intensities (30%, 50%, and 70% removal) and spatial patterns (uniform, small patch, large patch) of harvesting in mixedwood stands. We assessed structural dynamics through a suite of variables representing the distribution of tree sizes, understory development, regeneration, standing and fallen dead wood characteristics, and within-stand heterogeneity. Partial harvesting induced a reciprocal increase in understory and downed woody debris development and decrease in overstory structure over the first 25 years after harvest, with this effect subsequently reversing as harvest-induced regeneration reached the canopy. Densities of large trees and snags were reduced by harvesting, and did not recover to pre-harvest levels within the simulation period. Harvesting promoted within-stand heterogeneity in the short and long term, and also produced transient increases in early-decay downed woody debris and ground exposure. These effects largely increased in proportion to harvest intensity. Although spatial pattern was of lesser importance than intensity, aggregated harvests induced somewhat less pronounced impacts on structure (with the exception of heterogeneity) than dispersed harvesting. These simulation results can form a basis for more detailed hypotheses regarding maintenance of late-successional stand structure and function through partial harvesting.

S.19-21-P

Bringing ecology into forest management through ecological models.

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Forest ecosystems play a critical role in the maintenance of biodiversity and provide key ecosystem services. Thus attaining a sustainable use and conservation of forest resources under new global change conditions is an urgent need. Forestry is a technical discipline in which ecological, engineering and socio-economical knowledge is integrated to effectively design and implement sound forest management practices. Similarly to other technical disciplines, must be under continuous readjustment in order to incorporate scientific advances and to respond to new societal demands. Over the last decades multi-objective forestry paradigm has shifted towards sustainable forestry, which takes into consideration functional and structural ecosystem components such as biodiversity or biogeochemical cycles not included under traditional multi-objective forestry. Moreover, uncertainty derived from global change scenarios requires the development of specific diagnoses and risk assessment models. Current advances in Ecology allow us to develop models to properly evaluate the consequences of different management actions on ecosystem structure and function. In this talk we discuss several examples in which ecological models are used to assess potential tradeoffs among conflicting goals faced by managers when addressing sustainability and global change adaptation goals at several scales.

Sustainable Forest Management in a Disturbance Context: A Case Study of Canadian Sub-Boreal Forests.

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Understanding the ecological difference between human (e.g., forest harvesting) and natural (e.g., wildfire) disturbance can greatly support designing sustainable forest management strategies. In this study, a combined of research strategy including field investigation and ecosystem simulation by FORECAST was employed to compare some ecological impacts of natural disturbance (wildfire) and timber harvesting in lodgepole pine forests in the central interior of British Columbia. The purpose of the field survey was to quantify the differences immediately following wildfire disturbance and harvesting, while the ecosystem modeling was to evaluate the long-term implication of those difference in site productivity. For the field investigation, we quantified the difference in wood debris, nutrients, decay and associated nitrogen fixation between harvested and wildfire-killed sites. For the simulation approach, we defined three fire severity categories (low, medium, high), three fire return intervals (40, 80, 120 years), two utilization levels (including stem-only harvesting [SOH] and whole-tree harvesting [WTH]), and three timber production rotation lengths (40, 80, 120 years). Differences in simulated productivity, decomposing litter mass, total available soil nitrogen and nitrogen removals were compared for all 15 combinations of the five levels of disturbance at the three frequencies. Our key results show that both measured and simulated nutritional impacts of timber harvesting were within the simulated range of impacts caused by the wildfire defined in this study. They were similar to the simulated long-interval, low-severity wildfire regimes. Simulations also suggest that ecological rotation lengths for long-term site productivity for lodgepole pine forests in the study area would be 80-120 years. These rotation lengths are close to the average wildfire return intervals (100-125 years) in the study area, supporting the idea that the present harvesting strategies should sustain tree growth at this frequency and severity. Both WTH and SOH are acceptable harvesting methods for the maintenance of long-term site productivity in these lodgepole pine forests if harvest intervals are 80 years or longer. However, SOH is a more nutrient conservative harvest method, and should be used instead of WTH for rotations less than 80 years. The usefulness of the ecological rotation concept for sustainability of long-term forest productivity is also discussed. In addition, the paper will summarize critical researches contributed to understanding of the effects of recent large-scale mountain pine beetle infestation and management implications in the study region.

S.20- Ecosystems evolution during early successional stages: How can we link pattern and processes for the understanding of ecosystem dynamics?

S.20-01-O

Restoring vegetation in open-pit coal mines: short-term influence of abiotic factors.

Alday, Josu Gonzalez. Marrs, Rob. Martinez-Ruiz, Carolina.

University of Valladolid. University of Liverpool. University of Valladolid.

Open-cast mining is often accompanied by large-scale environmental disturbances that leave a landscape with no vegetation and very poor soil-forming materials. In such damaged systems the aim of the ecological restoration should be to develop a healthy, self-sustaining ecosystem with some stable plant cover. In this way, the initial re-vegetation phase is crucial, being the starting point for succession. However, little is known about the abiotic factors that control vegetation dynamics during the early establishment phase, which are very important to improve restoration success. Here, we use a set of short- (1-8 years) and medium-term (1-20 years) successional studies to characterize the main factors that influence vegetation dynamics. The results indicate that the main factor influencing the revegetation phase is the soil-forming material; however this problem is easily solved using topsoil to ameliorate the substrate base constraints of coal wastes. Slope aspect (north- south- and flat) also influenced significantly the revegetation during the early-establishment phase, mainly through its effects on microclimate, which reduced the water availability in most exposed aspects as south. Clearly, colonization is easier where the area to be restored is a short distance from seed source, so distance to seed sources affected the outcome of revegetation. In contrast, there were some extremely events as intense summer drought (stochastic factor), which were able to redirect the revegetation process and succession. Our results suggest that the combination of compositional responses to aspect, distance to seed sources and stochastic factors (climate variability) creates complex successional patterns, which reveal the frequency of multiple trajectories in early successions even in adjacent locations.

S.20-02-P

With moss or without moss, that is the question! Ecosystem development in proglacial environments of SE Iceland.

Bechberger, Oliver. Thórhallsdóttir, Thóra Ellen. Svavarsdóttir, Kristín.

University of Iceland. University of Iceland. Soil Conservation Service of Iceland.

On the vast glacial outwash plain of Skeiðarársandur in SE Iceland, a mosaic of early successional ecosystems is developing with minimal human interference. Although the physical environment appears highly homogeneous, diverging successional processes are clearly operating on the sandur. In the uppermost part, mosses form discrete patches of varying size on an otherwise sandy/gravelly plain. We propose that moss patches may function as habitat islands for vascular plants and arthropods, facilitate vascular plant establishment and direct ecosystem development along a different path from the moss-free areas down on the plain. Moss patches may influence vascular plant establishment and growth by 1) acting as physical barrier and trapping seeds, 2) creating safe-sites for germination, 3) improve growth conditions through ameliorated microclimate, and 4) increasing substrate nutrient status by trapping wind-borne particles. To distinguish these potential roles, we compared seed rain and seed bank in moss patches and surrounding areas. Arthropod species composition was compared in moss islands and adjacent bare sites. To test the effect of moss on vascular plant establishment and survival we transplanted homogeneous *Racomitrium ericoides* moss mats on two sites with different grain size distribution in the central part of Skeiðarársandur in 2010. A seedling transplant and sowing experiment started in spring 2011 to compare germination rates, seedling establishment and plant survival for selected species. Preliminary results indicate that vascular plant species richness and density is higher in the moss patches. Arthropod species composition of moss patches differs from the surrounding plain.

S.20-03-O

Re-thinking the role of consumers in primary succession.

Bishop, John.

Washington State University.

Interactions of plants with consumers are considered relatively unimportant for primary succession. This talk will review evidence for extraordinary impacts of insect consumers on keystone and foundational plant colonists of volcanic deposits from Mount St. Helens' 1980 eruption. Three cases will be examined: 1) several guilds of lepidopteran herbivores greatly reduce the spread of the principal plant colonist, *Lupinus lepidus*, a keystone species that facilitates soil development, thereby altering succession. 2) Sitka willow (*Salix sitchensis*) is the first colonist to provide three-dimensional physical structure on these sites, thereby forming habitat for several mammalian and avian trophic guilds. We show that a non-native curculionid weevil and a native sesiid moth dramatically diminish willow's rate of biomass increase. 3) *Vaccinium membranaceum*, though few in number, is a key food resource for animals and the first animal-dispersed shrub to colonize the Pumice Plain whose rate of population increase in primary succession is heavily impacted by seed and leaf consumers compared to secondary succession. We propose that these examples represent an expected phase of early succession during which the effects of mutualists and consumers on colonizing plants are greatly amplified relative to their effect in more mature systems, owing to the temporary absence of buffering species or the increased demographic importance of propagules. These results serve as a reminder that successional communities will not exhibit the distribution of interaction strengths characteristic of stable communities, and suggests the potential utility of modeling succession as the consequence of an unstable distribution of interaction strengths.

S.20-04-O

Early phases of succession on the desiccated floor of the Aral Sea.

Breckle, Siegmund-W. Wucherer, Walter.

Department of Ecology Bielefeld. Michael Succow Stiftung.

The Aral Sea, once the fourth largest lake on earth, is no more existing. A huge new desert area, the Aralkum, has developed on the desiccated sea floor. The first years after desiccation primary succession starts. A rather rapid change in vegetation cover is observed. This is governed primarily by substrate conditions and water availability. Two main directions are prominent, the succession on clayey-loamy and on sandy substrates. However, it is still an open problem, why a rather high percentage of the area develops to an open, bare desert, being the main source of harmful salt-dust storms, where other parts exhibit a strong successional sequence with a rather high biodiversity of halophytes and psammophytes.

S.20-05-0

Title: Spatiotemporal dynamics during succession: linking the surface to the soil.

Cutler, Nick.

XS.

Succession is a fundamental ecological process that has been the focus of research efforts for over a century. In terrestrial systems, most attention has been focussed on vegetation dynamics. Broad temporal trends are now well-established for many habitats, and researchers are beginning to address the development of spatial structure in vegetation during succession. However, changes in above-ground communities are only half the story: the spatiotemporal dynamics of below-ground microbial communities are also of critical importance to ecosystem function. Until comparatively recently, the study of soil microbial dynamics during succession prohibitively difficult, and despite technological advances, answers to key questions are still lacking. For example, do orderly successions analogous to those observed in vegetation also occur in the microbial world? How do microbial communities vary at different spatial scales? How closely coupled are the spatial configurations of above- and below-ground communities? These questions have major implications for our understanding of ecosystem function, e.g. modelling the cycling of soil carbon in high-latitude locations, and for the emergence and persistence of spatial patchiness in terrestrial ecosystems. My talk addresses these issues, with reference to primary succession on an 850-year chronosequence of lava flows in Iceland. I will describe long-term (multi-century) spatiotemporal dynamics in the vegetation of these sites, before outlining ongoing work on microbial community structure.

S.20-06-0

Small scale spatial heterogeneity of biological soil crusts during initial ecosystem development.

Fischer, Thomas. Veste, Maik.

BTU Cottbus. CeBra e.V. Cottbus.

Remote sensing and field methods often give an averaged signal on a centimetre to meter scale. Biological soil crust (BSC) patches may have smaller sizes, and ecophysiological, hydrological as well as pedological processes may be heterogeneously distributed within this level of resolution. A ground-based NDVI imaging procedure using low-cost equipment was developed to fill this gap at the level of field research. The correlations between NDVI values retrieved from these images and NDVI values determined by conventional field spectrometry as well as net photosynthesis were close ($r^2=0.91$ and 0.78 , respectively). Using a pixel resolution of $200\ \mu\text{m}$, geostatistical analysis of four successional stages of biological soil crusts revealed increasing variability of the NDVI with crust development. The variogram range was

S.20-07-O

Pioneer invertebrates on barren ground close to a receding glacier.

Hågvar, Sigmund.

Norwegian University of Life Sciences.

Pioneer invertebrates on barren ground close to a receding glacier Sigmund Hågvar, Norwegian University of Life Sciences Due to climate change, many glaciers are shrinking. Studies at a receding glacier in central, south Norway showed that invertebrates colonised the pristine ground rapidly. Collembola and Acari were typical pioneer groups. Two Collembola species colonised immediately, and at least eight species were present after three years. The microarthropod community changed markedly during the first decades. After 70 years, 72 % of the Collembola species in the area had colonised, while oribatid mites colonised slower, with 40 %. A three year old moraine without visible vegetation contained several species of surface active predators among Araneae, Opiliones and Coleoptera. Sticky traps and pan traps showed that various Diptera were transported by air into the pioneer ground, supporting the “predator first-hypothesis”, where pioneer predators are assumed to feed on airborne invertebrates. However, I want to challenge this model since chlorophyll-based food chains were working already after 3-4 years in the present site. Inblown moss fragments started small, nearly invisible colonies among stones and gravel. On a three year old moraine, gut contents of the Collembola *Bourletiella hortensis* showed that it ate both moss leaves and rhizoids. This large Collembola might be eaten by predators. Larva of terrestrial Chironomidae and of the moss-eating beetle *Simplocaria metallica* (Byrrhidae) were found in moss after four years. If glaciers melt away, certain cold-stenotopic invertebrates could go locally extinct (e.g. the carabid beetle *Nebria nivalis* and the Collembola *Agrenia bidenticulata*).

S.20-08-P

Drivers of vegetation succession in proglacial environments in SE-Iceland: Deterministic or stochastic?

Magnúsdóttir, Ólöf. Thórhallsdóttir, Thóra Ellen. Svavarsdóttir, Kristín.

University of Iceland. University of Iceland. Soil Conservation Service of Iceland.

On the southern slopes of Vatnajökull ice cap in SE-Iceland, numerous outlet glaciers descend into a mild and humid lowland environment. They all reached maximum extent at the end of the Little Ice Age (LIA) ca 1870-1890 and have been retreating since, at greatly accelerated speed in recent years, even >100 m/yr. We consider these outlet glaciers as a replicated natural experiment which provides a unique opportunity to test hypotheses on ecosystem development and the importance of deterministic vs. stochastic factors in determining successional rates and direction. If succession is a deterministic process, vegetation development should follow the same pattern at all glaciers. Although the abiotic environment is comparable at all sites, neighbouring species richness and degree of isolation varies. We propose that differences in successional patterns can be explained by stochastic factors related to the seed rain composition and distance to seed sources. We analysed vascular plant communities at three seral stages (deglaciated in 2001-2005, 1945 and LIA maximum) at six outlet glaciers. Some are close to birch forests and rich species pools while others are bordered by species-poor vegetation dominated by graminoids. We measured cover and species composition of vascular plants and the cover of cryptogams. Seed rain and soil seed banks were estimated at all sites. Preliminary results indicate extremely rapid colonization of deglaciated terrain. They also suggest differences in functional group composition between glaciers and variable colonization of bryophytes and mountain birch which may be acting as ecological engineers directing ecosystem development along different pathways.

S.20-09-P

Does the use of topsoil in restoration projects accelerate litter decomposition?

Martinez Jauregui, Berta. Rivera García, Desirée. Peco Vázquez, Begoña.

Obrascón Huarte Lain, S.A.. Universidad Autónoma de Madrid. Universidad Autónoma de Madrid.

Topsoil used in restoration projects provides organic matter, seeds and greater microbial activity than soil from deeper horizons, which should accelerate the litter decomposition rate. The decomposition rates of four grasses and four legumes were compared after 3, 6 and 12 months of roadslope revegetation on two types of slope: roadfills with spread topsoil and roadcuts with no topsoil input. To isolate the potential influence of soil micro-organisms from other effects, a complementary greenhouse experiment was conducted using the same species for periods of 2, 4 and 6 months. At the end of both experiments, the % of organic matter remaining (OMR) of legumes was lower than that of grasses (0.33% and 0.47% respectively in the field experiment, and 0.42% and 0.53% in the greenhouse). This parameter decreased exponentially with time in all cases. Roadslope type did not influence the OMR in the field experiment. However, in the greenhouse experiment, OMR at the end of the experiment was lower in samples with no topsoil than with topsoil, although these small differences were possibly due to the emergence of algae on the surface of the topsoil trays, replacing litter as a substrate in the decomposition process. After analyzing the chemical characteristics of the litter and the OMR, we conclude that legume litter decomposes more quickly than grass litter due to its higher N, P and lignin content, and its lower hemicellulose and cellulose content. *This study is part of the CENIT-OASIS project funded by a consortium of companies supported by CDTI-MICINN.

S.20-10-O

Agricultural activities and biological soil crust succession in semiarid environment.

Zaady, Eli. Arbel, Shemuel.

Gilat Research Center, Agriculture Research Organization, Israel. Soil Erosion Research Station, Ministry of Agriculture, Emek Hefer, Israel.

In the semiarid of the northern Negev Desert more than two third of the soil surface is covered by biological soil crusts (BSC's) composed of cyanobacteria, algae, and dense moss and lichens (about 10-15mm thick). The landscape in this region comprised a series of discontinuous shrub mounds within a matrix of biologically crusted soils. The sub-circular shrub mounds supporting *Noaea mucronata* and *Atractylis serratuloides*. Rainfall occurring only during the winter months has a long-term annual average of 200 mm. The 200 mm isohyet is considered to form the transition zone between arid and semi-arid deserts. In Sayeret Shaked long-term ecological research site, located in this area, we applied five agricultural activities common to this area: a) Scarping - the topsoil was scraped off by motor grader to a depth of 2 cm. b) Spraying - the plots were sprayed with herbicide (photosynthetic inhibitor). c) Mowing - using lawn mower machine that cut and dispersed the vegetation. d) Car track - using heavy roller to produce car track to mark cracks perpendicular to the slope direction. e) Control - unharmed plots. The agricultural activities had influenced the BSC's and their related soil surface properties; overland runoff production; hydraulic conductivity and vegetation pattern. Sixteen years after the applications of the agricultural activities, most of these human made disturbances showed increase with the soil surface properties related with the BSC succession. Our results may contribute to a proper ecological management and restoration in this resource-limited ecosystem.

S.21- Involving Citizen Scientists in Ecology

S.21-01-0

Volunteer data validation for forest dynamics plot inventory.

Bebber, Daniel. Parker, Geoffrey. Riutta, Terhi. Slade, Eleanor. Haibao, Ren. Murthy, Indu. Capretz, Robson.

Earthwatch Institute. Smithsonian Environmental Research Center. University of Oxford. University of Oxford. Chinese Academy of Sciences. Indian Institute of Science. Sociedade de Pesquisa em Vida Selvagem e Educação Ambiental.

Permanent sample plots are a widely-used tool for understanding forest structure and ecological processes. Citizen Science often involves short fielding periods, in which volunteers are employed for a few days or weeks. The degree to which volunteers can usefully (in terms of quantity and quality) contribute to data collection in short fieldings is not well understood. The Earthwatch Institute has established a network of 1-ha permanent sample plots in five locations (USA, UK, Brazil, India and China). Teams of 10-12 volunteers have been involved in data collection at these sites over the past 4 years. Tasks include tree diameter measurement, species identification, mapping, leaf litter sorting, and dendrometer band measurement. In some cases, measurements on animal groups (small mammals, insects, lepidoptera) have taken place. Data validation has taken place at all sites by re-measurement of a subsample of datapoints, either by scientific staff or other volunteers. Differences between repeated measures are attributed to outright mistakes (e.g. measuring the wrong tree, mis-entering data on datasheets or during data entry) or error taking measurements. The number of mistakes varies between 5-10% depending on the research task. The number of mistakes declines significantly with time spent in the field. Error variation in tree diameter measurements is small, and unlikely to affect estimates of biomass or carbon storage significantly. The data show that volunteers can provide good data for forest dynamics plots during short fieldings, but that adequate training and supervision is critical.

S.21-02-0

L'Observatoire Des Saisons: a French citizen science program designed to help scientists assessing the impact of climate change on biodiversity and ecosystems services.

Chuine, Isabelle. Roche, Violette.

CNRS. Tela-Botanica.

L'observatoire Des Saisons (ODS) has been launched in 2007 by a group of scientists working on phenology and more generally on environment, with the help of associations working in the field of education to science and collaborative production of scientific knowledge. This program is thus a tight collaboration between the scientific community, and the public. The program consists in providing precise phenological observations of particular species through the Internet, following a protocol produced by the scientific community. Data produced are freely accessible in different types of format. Four years of activity revealed a growing potential of the use of the data produced by the society either for education, management of natural and urban areas, and even health issues (e.g. allergy to pollen), and also an enormous importance of the means dedicated to communication and animation of the program to reach a critical amount of participation to ensure the valorization of the data produced.

S.21-03-O

The practices, benefits and challenges of conservation volunteering as a mechanism for assisting conservation.

Cousins, Jenny.

Earthwatch Institute, UK.

Successful conservation management requires long-term monitoring of biodiversity, but funding for data collection from traditional government sources is severely limited, and there is a shortage of labour to carry out such work. The development of mechanisms to ease this shortfall will be crucial to the effectiveness of conservation initiatives in the future. The growing sector of international conservation volunteering represents one possible mechanism, which may be able to help reduce this deficit by offering both funding and labour. It also offers the opportunity to engage people with nature and thus to engender support for its protection. This paper explores the practices, benefits and challenges of conservation volunteering as a mechanism for assisting conservation research through an exploration of the organisations (and volunteers) involved, including a case-study of Earthwatch Institute's public volunteer programme and employee engagement programme. It considers the type, locality and quality of conservation work that is supported by volunteers; the motives and expectations of volunteers; the demands on scientists in terms of training, suitability of tasks, and volunteer expectations; the accuracy of data that volunteers collect. Such an understanding may offer insights into the effects of conservation volunteering on conservation practice, and will have implications for the design and day to day running of volunteer programs.

S.21-04-O

When thousands of citizens monitor common species: the French Garden Biodiversity Observatory.

Fontaine, Benoît. Bergerot, Benjamin. Julliard, Romain.

Muséum national d'Histoire naturelle. CEMAGREF. Muséum national d'Histoire naturelle.

The Observatoire de la Biodiversité des Jardins is a nation-wide common species monitoring scheme relying on non-specialist citizens. Following a light protocol, participants identify and count butterflies, molluscs and beetles species/species groups in their garden. The scientific aims of the program are the assessment of the impact of gardening practices and broader-scale landscape on common invertebrate species, and long-term monitoring. Since 2006, more than 9000 gardens have been monitored all over France, and two million abundance data have been gathered. This network of observers is punctually asked to take part in experimental studies. Error rates were ca. 5%, and the reliability of the approach was confirmed by the accurateness of checkable results such as species phenology or range. Species diversity and abundance were significantly negatively correlated with urbanization. At a local scale, gardening practices, measured by garden naturalness and plant diversity, also impacted butterfly or mollusc populations. Interactions between urbanization and garden characteristics showed that species having the steeper negative response to urbanization were the most sensitive to gardening practices. This holds a strong message for park managers and private gardeners: provided that they are informed of the results they have contributed to build, they should modify their practices. The potential drawbacks of monitoring performed by non-specialists, raised by professional entomologists, are outnumbered by their advantages: if observers are numerous enough, data reflect biodiversity trends. The large involvement allows analyses which would be impossible with professional observers, at a low financial cost, and should induce awareness raising.

S.21-05-P

A gis based model to estimate the species-specific biogenic volatile organic compounds (BVOC) emissions from some italian terrestrial ecosystems.

Kemper Pacheco, Claudia Justina. Fares, Silvano. Loreto, Francesco. Ciccioli, Paolo.

Institute of agro-environmental and forest biology, National Research Council (CNR), Rome, Italy.. Department of Environmental Science, Policy, and Management,, University of California, USA.. Plant Protection Institute, CNR, Florence, Italy.. Methodological chemistry institute, CNR, Rome, Italy..

A GIS model has been developed to estimate of the BVOC-specific emissions from plant species dominant in Italian forest ecosystems. BVOC play an important role in climatic changes because they are capable to produce tropospheric ozone and secondary organic aerosols (SOA), when exposed to the UV radiation in the presence of sufficient amounts of nitrogen oxides (NO and NO₂). SOA can act as cloud condensation nuclei (CCN), that affect the radiation balance of the earth by promoting cloud formation. The model allows to estimate the emissions of individual components formed by the plant through different photochemical pathways. The model is unique because until now, biogenic emission has been expressed only in terms of isoprene and total monoterpenes. By expressing the emission in terms of individual components, it is possible to account for the different reactivity they have in the atmosphere. The model introduces also emission algorithms of BVOC in which the phenological changes of the plant are taken into due account. The method provides high-resolution maps (daily or hourly) of BVOC-specific fluxes providing that adequate vegetation and meteorological maps are available.

S.21-06-O

A network of botanists to develop and spread knowledge in a changing world.

Mathieu, Daniel.

NGO Tela Botanica.

Created in 1999, Tela Botanica brings together French-speaking botanists, researchers and professionals who wish to exchange their knowledge about flora. The network's activities are based on sharing and mutual cooperation, in order to diffuse information about environmental issues and to develop collaborative projects at national and international levels. Designed to be a global citizen's science project, Tela Botanica contributes to the monitoring of climate changes, to biodiversity knowledge and to keeping the general public informed. It unites scientists and professional or amateur botanists who contribute to a vast pool of knowledge : enriching databases such electronic flora and library, herbarium index and pictures collect for automatic plant identification ; contributing to citizen science project about phenology or the monitoring of common flora, etc.

S.21-07-O

Participatory Resource Mapping and Biodiversity Assessments: involving the Samburu communities in conservation programmes in northern Kenya.

Oguge, Nick. Mwangi, Peter. Oroda, Ambrose.

Earthwatch Institute, Nairobi, Kenya. University of Nairobi, Kenya. Earthwatch Institute, Nairobi, Kenya.

Effective management of biodiversity and other natural resources need reliable information on spatial distributions and statuses. Resource mapping and biodiversity assessments is resource-dependent activities in time, personnel and financially. In remote Drylands of northern Kenya, the unique yet delicate landscape teams with wildlife among pastoral communities. Extensive and severe degradation of land coupled with persistent drought is leading to rapid desertification here. Sustainability of this environment will require active community participation that is strategically linked to the conservation of the nation's biodiversity and its land use planning. Over the last eight years, we engaged with the Samburu communities to undertake an array of studies to provide baseline databases of biodiversity and other resources. Our studies involved use of both indigenous knowledge and scientific methods in data gathering. Outputs include community-inspired resource maps showing distribution of medicinal plants, wildlife corridors, water sources etc. We have improved our knowledge of biodiversity statuses for different taxa. We demonstrate loss of forest cover by 35% between 1986 and 2000, and of open woodlands by 22% during the same period. This indicates general ecosystem degradation to less robust habitats leading to loss of ecosystem services. The Resultant maps may be used for development and management planning by the locals, conservation managers, researchers and policy makers. These may include provision of water, schools, health centres and other social amenities; or delineating grazing and wildlife areas. Our study provides further evidence of importance of community involvement in resource assessments land use planning for effective conservation Drylands.

S.21-08-O

Online and face-to-face participation - articulating stakeholders' voices.

Vasconcelos, Lia. Caser, Ursula. Sá, Rita. Pereira, Maria.

IMAR - Institute of Marine Research. Mediarcom. CCMar - Center for Sciences of the Sea. CESAM - Center for Environmental and Marine Studies.

Governance is gaining grounds in search of new ways to implement more inclusive participatory models assuring sustainable management. This challenges specialists to take advantage from new tools and information technologies, enlarging participatory processes and involving wider diversity of stakeholders with uneven access to knowledge and technology. In this paper the authors report a participatory methodology aiming at an expanded stakeholder involvement supported by information technology and informal meetings created as a parallel process to assure integration and involvement of the info-excluded. The mixed methodology provided the basis for structuring the face to face expanded dialogue forums. The Online Interaction Methodology (OIM) one of MARGov Project components aimed earlier active public outreach, targeting to include stakeholders with difficulties in attending meetings due to time restrictions or unwillingness to be exposed to face to face dialogue. The project team categorized and organized in three catalogues the more than two hundred questions received from the ones involved in the OIM: two sets referring to normative and regulatory issues were responded by jurists and environmental managers on the base of the legislation and park regulation; the other set contributed substantial to support the structuring of the participatory process. The authors in this paper focus in the methodology used, presenting results and debating issues to be considered in overcoming participative processes limitations. They also explore how to use information technologies for collective brainstorming and initial structuring of issues, an important asset for the participatory process that makes it more efficient in time and scope.

S.21-09-O

We are all Citizen Scientists.

Vogel, Johannes. Carter, Lucy. Tweddle, John.

The Natural History Museum, UK. The Natural History Museum, UK. The Natural History Museum, UK.

Surveys of European publics show repeatedly that people know less and less about nature. In the same surveys c.70% of all participants say that they would like to learn more about wildlife, nature and the environment, but do not know how to. Thus, the general public is keen to be engaged in learning activities that have a Natural History focus. Natural History is an eminently accessible science that touches and connects to people's everyday lives and experiences - it is a science open to all. Everybody observes their surroundings and environments on a daily basis and this curiosity can be readily channelled to work in a more scientific way, that is mutually beneficial to participants and to scientific knowledge production. This talk will highlight experiences and approaches to Citizen Science and local knowledge production that have been successful in the UK. We will also propose ideas for how we can work together to make Citizen Science the leisure pursuit of choice and in doing so strengthen science - from amateur to professional.

S.22- Ecological indicators of environmental change

S.22-01-P

Field measurement of leaf traits covariation for 2 weedy species in France.

Assémat, Louis. Thiébaud, Mélanie. Thévenard, Frédéric.

INRA (Institut National de la Recherche Agronomique). Université Claude Bernard Lyon 1. Université Claude Bernard Lyon 1.

In search for possible detection of a climatic signal between geographical distinct populations of a plant species, we measured different leaf traits of significant populations of *Solanum nigrum* and *Chenopodium album* within sunflower fields in 4 places in France (Dijon, Montpellier, Toulouse, Tours). We concentrate on 3 types of leaf traits that would not be too much linked with growth components at a single point of time: morphometric measurement (shape, leaf margin, tooth dimensions), spectral measurement (diffuse and specular reflectance), morphological measurement (stomatal and trichome densities). This first year experiment was mainly used to devise a field methodology adapted to an efficient data sampling. Nevertheless, we found covariation of these traits explained by climatic data obtained from nearby meteorological stations (averaged for the last 10 years). All these leaf features define a leaf physiognomy perspective already used by paleobotanist for past climate studies that may prove very linked with actual global changes questioning. Our ability to easily measure leaf traits in the field would greatly help the monitoring of the current changes and enable long-term studies.

S.22-02-P

Changes in Incidence-Abundance pattern as an indicator for environmental changes.

Baessler, Cornelia. Groner, Elli. Boeken, Bert. Shachak, Moshe. Krauze, Kinga. Klotz, Stefan. Parr, Terry, et al.

Helmholtz Centre for Environmental Research - UFZ. Ben-Gurion University of the Negev. Ben-Gurion University of the Negev. Ben-Gurion University of the Negev. International Institute of Polish Academy of Sciences Lodz. Helmholtz Centre for Environmental Research. Centre for Ecology & Hydrology (CEH), Lancaster Environment Centre.

The incidence-abundance meta-analysis is one example for the integration of a wide range of data sets into a cross-site comparison within the framework of LTER-Europe. Ecosystems predictably respond to changes of an essential input (energy, materials, organisms) in terms of community reorganization. The reorganization follows a predictable sequence of three levels with increasing rate of change: reshuffling - turn-over - mass extinction. To test this Input change and Community ReOrganization (ICRO) Hypothesis changes in incidence-abundance pattern of long-term vegetation data sets across Europe were analysed. Vegetation data are available, however, they were originally gathered for different purposes and lack harmonized methodology. To overcome the difficulties inherent to post-hoc collations and comparisons of data of different origin, we used a simple linear regression of incidence against abundance. Regression slope and explained variance are a measure of community structure and should be independent of the method used for plant species sampling. In total we analyzed proximately 6000 vegetation records from 87 site/year combinations. The analysis gives the opportunity to compare organisation patterns of different habitat types (ecosystems) across large time and spatial scales.

S.22-03-P

Riparian nutrient cycling in the Western Amazonia, Brazil.

Cabianchi, Giovana Mendonça. Krusche, Alex V.. Leite, Nei K.. Ballester, Maria Victoria R.

Centro de Energia Nuclear na Agricultura - CENA/USP. Centro de Energia Nuclear na Agricultura - CENA/USP. Centro de Energia Nuclear na Agricultura - CENA/USP. Centro de Energia Nuclear na Agricultura - CENA/USP.

The objectives of this study were to estimate litterfall production and decomposition and macronutrients, evaluating the nutrient recycling of a varzea forest in a region under strong anthropogenic influence in southwest Amazonia. Knowledge about these processes is extremely important, since they provide information on ecosystem net production, nutrient cycling and can serve as basis for degraded areas restoration based on adequate management strategies. Litter was sampled biweekly from September 2005 to August 2007, while decomposition was measured during one year. Average annual litter production was 12.7 t ha⁻¹, with strong seasonality and higher production during drier months. In terms of different litter fractions production followed the order leaves>>branches>miscellaneous. Average annual C deposition via litterfall was 5.4 t ha⁻¹. Proportionally, almost twice as much C returns to the forest ground in the drier season. Average annual N deposition was 199.6 kg ha⁻¹, which is related to relatively high litterfall deposition. Nutrient use efficiency (NUE) was 57.9, a value that can be considered relatively low, indicating that nitrogen supply is not a limiting factor in this forest. C:N ratios were high in both seasons, with maximum (40) occurring at the beginning of dry season, which probably influenced and promoted low decomposition rates, specially during drier months. Average annual k was 0.9. During decomposition N immobilization and slow C release predominated. Partial carbon budget indicates that around 342.3 kg C ha⁻¹ are cycled via litterfall, representing 34.2% of net ecosystem exchange.

S.22-04-P

Rapid evolution of seed dispersal in an urban environment in the weed *Crepis sancta*.

Cheptou, Pierre-Olivier.

CNRS.

Dispersal is a ubiquitous trait in living organisms. Evolutionary theory postulates that the loss or the death of diaspores during dispersal episodes (cost of dispersal) should select against dispersal. The cost of dispersal is expected to be a strong selective force in fragmented habitats. We analysed patchy populations of the heterocarpic weed *Crepis sancta* occupying small patches on pavements, around trees planted within the city of Montpellier (South of France) to investigate the recent evolutionary consequences of the cost of dispersal. First, we showed that, in urban patches, dispersing achenes have a 55% lower chance of settling in their patch compared to non-dispersing achenes and thus, fall on concrete matrix unsuitable for germination. Second, we showed that the proportion of non-dispersing achenes in urban patches measured in a common environment is significantly higher than in surrounding, unfragmented populations. Third, using a quantitative genetic model, we estimated that the pattern is consistent with short-term evolution that occurs over approximately five to twelve generations of selection which is generated by a high cost of dispersal in urban populations. This study provides a demonstration that a high cost of dispersal following recent fragmentation causes rapid evolution towards lower dispersal. Cheptou, P.-O., Carrue, O., Rouifed, S. and Cantarel, A. 2008 Rapid evolution of seed dispersal in an urban environment in the weed *Crepis sancta*. Proceedings of the National Academy of Sciences USA 105, 3796-3799.

S.22-05-P

Effects of native and exotic tree leaf litter decomposition on an understory plant species growth.

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Invasion of plant exotic species has become a global concern. They can alter ecosystem properties, including relevant soil functions. It is often quoted a relevant role of allelopathic substances from invasive species that could affect the presence and growth of native plant, microbial or animal species. Leaf litter decomposition is the most important process that takes place on the soil because regulates the nutrient availability for other species. Litter decomposition may have an effect on other processes such as the release of allelopathic substances from the death leaves to the soil. It is unknown whether the allelopathic effect is continuous or variable depending on the litter decomposition phase. In recent years a remarkable increased of the occurrence of invasive tree species in riparian ecosystems has been detected. A greenhouse experiment was carried out to study the effects of litter from invasive and native riparian tree species at different decomposition phases on the growth of a native understory plant species (*Trifolium pratense* L.). The results indicate that all treatments reduced the growth of roots and shoots of *T. pratense* when compared to control treatment without litter. The effect of the litter decomposition phase was similar for aboveground and belowground biomass production but showed different pattern according to tree species. *Ulmus pumila* produced a growth reduction not affected by litter decomposition phase. *Ailanthus altissima* and *Populus alba* produced lower biomass inhibition when litter was more decomposed. *Populus nigra* and *Ulmus minor* litter produced higher growth reduction when litter was less decomposed.

S.22-06-P

Intra-annual patterns of tracheid size as an indicator of seasonal water stress in conifers.

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Climatic conditions can affect xylem cell anatomy and hence series of intra-annual cell anatomical features have the potential to retrospectively supply seasonal climatic information. In this study we explored the possibility of extracting information about water stress conditions from tracheid features (lumen diameter and cell wall thickness) of the Mediterranean conifer *Juniperus thurifera*. Wood cores were sampled in three climate contrasting sites in Spain and Morocco and tracheid features were measured from xylem radial files of four selected years. Tracheidograms (a curve showing variations in tracheid features as a function of the cell position within an annual ring), built with the tgram R-package, were used to evaluate whether it is possible to link intra-annual pattern of tracheid features to seasonal climatic conditions. Results indicated site-specific anatomical adjustment, such as smaller and thicker-wall tracheids at the dryer sites, suggesting structural adjustments to avoid cavitation failure. Results also showed that the intra-annual pattern of tracheid size responded to seasonal changes in water availability, with smaller (larger) and thicker-wall (thinner-wall) tracheids formed under drought (wet) conditions. Thus wood cell anatomical features of conifers such as *J. thurifera* could be potentially used to reconstruct intra-annual changes in water availability.

S.22-07-O

The High Nature Value farmland as a large scale conservation tool to prevent further biotic homogenization.

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Common agricultural practices over large geographical areas drive biotic homogenization and demand the use of effective and informative indices in order to monitor and manage present and future changes in farmland biodiversity. Through widely used indicators in Europe, the Farmland Bird Indicator, the Community Specialization Index and the High Nature Value Indicator, we examined spatial and temporal ecological changes linked to agricultural activities in France. We found that low intensity agriculture in High Nature Value farmlands favor specialized bird communities at the national level and may prevent further biotic homogenization. Past landscape use may explain present species distributions in different farmland categories that we examined. We identified areas that should be given conservation priority as further biodiversity loss should be expected in some agro-ecosystems, especially those where agricultural production has been recently intensified. We conclude that given the global biotic homogenization through the replacement of specialist species by generalists ones, High Nature Value farmlands constitute an efficient spatial network to prevent further biotic homogenization.

S.22-08-O

The invertebrate-temperature relationship revisited: implications for their use as paleoclimate indicators in aquatic ecosystems.

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Fossils of aquatic invertebrates preserved in lake sediments are well-established paleotemperature indicators which, with the aid of inference models (transfer-functions), can provide quantitative estimates of past temperature change. Among these, chironomids (non-biting midges) are the most powerful and widely used. Chironomid-based paleotemperature reconstruction relies on the strong relationship between air and lake surface water temperature and the distribution of individual chironomid taxa that has been observed in different climate regions (arctic, subarctic, temperate and tropical) and both the Northern and Southern hemisphere. A major complicating factor for the use of chironomids as paleothermometers is that the exact nature of the mechanism responsible for the strong relationship between temperature and chironomid assemblages in lakes remains uncertain. Here, we review the chironomid-temperature relationship based on the presently available ecological evidence. We show that, even though a direct influence of water temperature on chironomid development, growth and survival is well described, chironomid paleoclimatology is presently faced with the paradoxical situation that the relationship between chironomid distribution and temperature seems strongest in relatively deep, thermally stratified lakes in temperate and subarctic regions in which the benthic chironomid fauna lives largely decoupled from the direct influence of air and surface water temperature. Using available studies assessing the chironomid distribution in lakes, we discuss the previously published hypothesis that climatic effects on lake nutrient status and productivity may be largely responsible for the apparent correlation between chironomid assemblage distribution and temperature. We conclude by summarizing the implications of our findings for chironomid-based paleoclimatology.

S.22-09-O

Urbanisation promote high developmental instability: variation in body condition of ground beetles in differently urbanised habitats.

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Environmental stress can lead to a reduction in developmental homeostasis, which could be reflected in the change of animal's physiological state. Physiological condition (PC) is one possible estimator of such a stress. Three generalist predators, *Carabus nemoralis* Müller 1764, *Nebria brevicollis* (Fabricius, 1792), and *Pterostichus melanarius* (Illiger, 1783) were studied based on their estimated PC along an urbanisation gradient (forest-suburban area - forest fragments in urban park) in and near Sorø, Denmark to test whether urbanisation created stress is reflected in the condition. The body mass was regressed on the elytra length to estimate a PC index based on the residuals of the regression model. The correlation between the condition and the true asymmetry was also considered through a local polynomial regression model. The PC index of the *C. nemoralis* and *N. brevicollis* was higher in the urban habitats than the other sites, while *P. melanarius* showed better condition in the suburban forest fragments than the urban and forest habitats. Females showed consistently better condition than male for all studied species. The significant negative correlation was found between condition and asymmetry for *C. nemoralis* and *N. brevicollis* in the suburban forest fragments and in the urban park. For *C. nemoralis*, the negative correlation was also revealed for sexes.

S.22-10-P

Simulation of Land Use Change Patterns on Coastal Sites: A Case Study on Cesme District.

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Coastal sites have attracted for human activities because of their biophysical and climatic conditions together with the ease of communication and navigation opportunities. Rapid land use / land cover changes have taken place in many coastal areas of Turkey over the last decades due to human activities, specially tourism and urbanization. Land-use / land cover changes have direct impacts on soil, water and atmosphere and is thus directly related to many environmental issues of global importance. For that reason, these changes have become a central component for managing natural resources and monitoring environmental changes. However, land use / land cover changes are complex, dynamic processes that link together natural and human systems. Hence, tools for understanding and explaining the causes and consequences of land use dynamics are needed. Land use simulation models can serve as a tool to understand these dynamics in more detail and assess the impact on ecosystem functioning. In this study, land use/land cover changes in Cesme District of Izmir Province were modelled by using CLUE-S (the Conversion of Land Use and its Effects at Small regional extent) model. Although big part of Cesme District is covered by Important Nature Area it is one of the most important touristic centre of Turkey. In the study, land use / land cover changes between 1984-2010 were detected by using LANDSAT TM images. The calibration of the model was performed using historical data describing the land-use and land-cover patterns between 1984 and 2010. The validation process is based on multiple resolution procedure to show the ability of the model to predict the land-use changes at the study area. Future land use scenarios were analyzed during 2010-2025.

S.22-11-P

Combined effects of anthropogenic (copper) and natural (eucalypt leachates) stressors on *Athyaephyra desmaresti* in a warming environment: implications for ecosystem functioning.

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Freshwater systems are among the most stressed in the world. Mining, afforestations and the expected global increase in water temperature may determine shifts in water quality with potential consequences on invertebrate's ecophysiology, streams structure and functioning. Here, the combined effects of a common environmental contaminant (copper), and natural stressors (eucalypt leachates), on the crustacean *Athyaephyra desmaresti*, in relation to water temperature were investigated using single and mixtures toxicity bioassays based on mortality and stress biomarkers. In single stressors bioassays, the increment of temperature from 10°C to 20°C was found to significantly increase the toxicity of both copper and eucalypt leachates. In the mixtures bioassays, the increase of temperature by itself resulted in increased levels of lipid peroxidation (LPO), possibly enhancing oxidative damage, and decreasing the activity of glutathione S-transferases enzymes (GST), reducing the capability of animals to face chemical stress. Furthermore, at 20°C the toxicity of both stressors was higher, as indicated by a higher mortality and alterations in biomarkers. Toxicological interactions between stressors were also found. These results suggest that mortality may increase due to oxidative damage and inability of dealing with endogenous/ xenobiotic toxic chemicals, while neurotoxicity due to disruption of cholinergic transmission may potentially interfere with growth, reproduction and increase mortality (difficulties with predators/food), therefore, with high probability of reducing populations. This may indicate that the functional role of *A. desmaresti* can be negatively affected in streams with low flow (accumulation of leachates) or metal contaminated (i.e. copper) and even more disturbed at high temperatures.

S.22-12-O

Assessing biodiversity with sound: what do acoustic diversity indices measure?

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Measuring biodiversity is challenging. Biodiversity sampling method based on community acoustic activity was recently proposed (Sueur et al., PLoS One 2008, 3:e4065) as a promising alternative. In Rapid Environmental Change context, this non-invasive method aims to provide a rapid animal diversity assessment over large time and spatial scales. Acoustic complexity of sound emitted by animal communities is globally analysed without any species identification. Previous analyses revealed that the acoustic complexity increases with the richness of bird communities (Depraetere et al., Ecological indicators, in revision). The aim of this study is to test whether, beyond species richness, other aspects of biodiversity could be measured through acoustic indices. We used data collated by the French Breeding Birds Survey describing spatial and temporal variations in community structure and composition across France since 2001. For each community (n=19420), phylogenetic, functional and acoustic diversity indices were first calculated using Rao's quadratic entropy from species pair-wise distance matrix and species abundances (Rao 1986 Encyclo. of Sci., 7:614-617; Pavoine et al. 2005 Oikos, 118:391-402). Each of these indices was analysed and then compared using spatial statistics. This work sheds light on three original research axes: i) the analysis of correlations between acoustic diversity and other diversity indices, ii) a comparison between different acoustic complexity indices, and the development of a new index presented here and based on the number of peaks on averaged spectrum (NP) and iii) a better understanding and definition of "Acoustic Diversity" (AD) and how it can be used in biodiversity monitoring.

S.22-13-P

Non-invasive techniques to measure the effect of climate change on vegetation.

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"INCREASE" infrastructure is funded by EU (7th Framework Programme) and designed to study long-term effects of climate change on shrublands. Climate manipulation techniques involve experimental drought and warming treatments in field using sensor-controlled curtains. Night-time warming is achieved by covering the vegetation with IR-reflective curtains at night (controlled by a light sensor). Plastic curtains controlled by rain sensor are used for extended summer drought. The emphasis is given to non-destructive sampling techniques and visiting scientists from EU countries can apply for transnational access to conduct own research on one or several of the facilities. We visited the experimental site in Denmark, Mols to measure the residual effect of treatments on *Solidago virgaurea* leaves in early autumn. Some parameters of leaf-level chlorophyll fluorescence (for example Genty yield) were still able to detect the treatment effects. Some vegetation indices from leaf-level reflectance measurements were also able to detect the treatment effects. Reflectance and chlorophyll fluorescence measurements show that *Solidago virgaurea* plants seem to benefit from modest drought and warming treatments in humid northern climate.

S.22-14-P

Nutrient loads from six minor coastal watersheds (Algeria). Do dams export dissolved organic nitrogen and phosphorus?

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In spite of inexistent data in Algeria on nutrients loads from the river watersheds to the shelf, no study has been performed until now on the distribution and retention of dissolved nutrients in coastal watersheds. The objectives of the present study were to estimate dissolved nutrients loads (nitrogen N, phosphorus P and silicates Si) from six minors coastal rivers and to assess how much dams construction influenced the geochemistry of that nutrients. Freshwater flow, dissolved inorganic nitrogen DIN (NH₄⁺, NO₃⁻, NO₂⁻), dissolved organic nitrogen DON, dissolved inorganic phosphorus DIP, phosphate (PO₄³⁻), dissolved organic phosphorus DOP and silicates [Si(OH)₄] were measured twice a month in three stations for each river at the entrance and the exit of dam and at the mouth. Total dissolved nitrogen TDN loads vary strongly from 44 to 587 kg/km²/y where DIN forms 66 to 87% while loads of total dissolved phosphorus TDP varies only in the range of 22-152 kg /km² /y. The DOP forms according to the river 30 to 78% of the TDP. The minimum loading occurs in the relative large basins that are excessively regulated by dams such as Kebir-Rhumel and Soumam rivers. In small basins as Kebir-ouest and Safsaf, loads of Si were more than 10 fold higher (1117 to 2694 kg/km²/y respectively). If great dams reduce inorganic nutrient by 10 to 90% they however export large rate of organic forms (POD: 20 to 89%; DON: 36 to 61%). The loading ratio of nutrients (Si:N:P) were extremely imbalanced as a consequence of dams effects and human activities behind dams.

S.22-15-O

How do lichens respond to forest disturbances in Mediterranean Spain?

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Most forest landscapes in the world have been transformed into a mosaic of fragments of different sizes and degree of isolation within a matrix of vegetation with various states of degradation. Besides, the quality of each fragment is different in relation to structural characteristics of the forests. This transformation of the landscape has affected the population dynamics and species richness and diversity of communities. In this context, the knowledge we have of the status of populations of organisms "not charismatic", such as lichens, is very low. The few studies conducted so far indicate that the habitat quality of forest fragments and the type of matrix are crucial to the distribution, fertility, abundance and genetic diversity of species and communities of lichens growing on trees and not the size and degree of isolation of forest fragments. Our results may suggest that perhaps the lichen species populations are not yet responding to loss of genetic diversity or changes in abundance of individuals to changes in the configuration of the landscape they inhabit, and that we need more time to see a response. However, the intensity of the forest management has a clear influence on lichens communities. This study was funded by 'Comunidad Autónoma de Castilla-La Mancha (POII09-0286-4849)', 'Ministerio de Educación y Ciencia (CGL2007-66066-C04-04)' and 'Ministerio de Ciencia e Innovación (CGL2010-22049)'.

S.22-16-P

Spatial and temporal changes in lichen functional diversity as an ecological indicator of climate change.

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Climate change is one of the greatest challenges facing conservation and it is predicted that its impact will be most significant in areas with Mediterranean climate. We used lichen functional diversity, related to water availability in different areas of the south of Portugal, with the aim of detecting climate change conditions both in space and time. This region is characterized by a Mediterranean climate, with heterogeneous conditions in terms of humidity and precipitation. Coastal areas have higher humidity due to the predominant northwest winds that come from the sea, whereas the inner part of this region is much dryer and can be classified as semi-arid. Moreover in one of the studied areas a big dam was built changing the climatic conditions in the region. Lichen biodiversity was divided in groups of hygrophyte or xerophytes lichens classified on the bases of expert knowledge. They were also classified on the basis of the genus of the alga involved in the symbiosis. Lichen diversity value (LDV) was calculated using a standard methodology. Data on functional groups showed to be significantly related with macroclimatic changes in space and also the ones that occurred along time in a 16 year period. We found that the number of lichen species, with photobionts of the genus *Trentepohlia* has been increasing along time in a semi-arid area and this correlates well with increasing levels of relative humidity in the region. Lichen functional diversity showed to be a good candidate for an ecological indicator of climate change. Acknowledgments to DesertWarning (PTDC/AAC-CLI/104913/2008)

S.22-17-P

Ground level ozone bioindication in Latvia.

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The increase of ground level ozone concentration in the atmosphere is one of the most important environmental problems nowadays. It is a phytotoxic air pollutant that causes more damage to vegetation worldwide than all other pollutants combined; ozone reduces plant growth and productivity and causes changes in crop quality. The study deals with tropospheric ozone bioindication in Latvia by using Scots pine (*Pinus sylvestris* L.). The data obtained by passive biomonitoring methods is used in assesment of ozone damage. Needle injuries were studied in Scots pine trees growing in natural conditions in Latvia. Dynamics of ozone damage on pine needles were analysed. The level of ozone injuries on pines is about 15-25% in Latvia. The effects of some environmental factors on ozone bioindication are discussed. The extent of damage depends on air temperature and humidity, because it shows characteristic gradient, caused by the increase of cotinentality of climate of Latvia.

S.22-18-O

Performing old tricks with new tools: building biotic indices for river assessment from macroinvertebrate trait descriptions.

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While trait analysis has been hailed as a new frontier in river bioassessment, it has yet to be employed in routine monitoring. This reflects both the conservative nature of assessment authorities and the perceived limitations of the trait-based approach. Despite enthusiasm for their multivariate perspective, concern has been raised over “trait syndromes” that can cause individual traits to appear decoupled from environmental conditions. Biotic indices, in contrast, have a long and accepted use by river managers but are often bemoaned for their over simplification and their restricted regional applicability. We proposed that trait-syndromes could be exploited as complex indicators by assuming that contrasting trait states would result in synergistic, antagonistic (and null) interactions that would serve to reinforce or diminish an individuals’ adaption to environmental conditions. Employing this principle of complementarity we constructed index scores for macroinvertebrate families. Our additive, trait-based indices were significantly correlated with established empirical and expert-derived biotic indices. They provided a mechanistic (trait-based) explanation for the regional adaptations that have been applied to widely used biotic indices and suggest why families differ in their reliability as environmental indicators (the ‘indicator value’ incorporated in some biotic indices). Because trait-based biotic indices are built from a priori knowledge they can be applied to the detection of novel stressors, provided the mechanism of ecological impairment is known. Transcending taxonomic boundaries, trait-derived biotic indices are universally relevant and can thus be directly applied in new regions and, furthermore, offer the potential for harmonized interpretation and the standardization of assessment criteria.

S.22-19-O

Contrasted ecological responses to scenarios for public agricultural policies.

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Agriculture intensification was identified as main driver of biodiversity loss in farmlands. Numerous agri-environmental policies have been implemented to counter these negative impacts. However most published studies focused on land-use scenarios only, thus neglected the economic dimension. We develop a bio-economic spatially-explicit modelling across 620 French small agricultural areas, which couples a public decision maker under budgetary constraint, regional economic agents in uncertainty context and bird dynamics. We analyse the impacts of economic scenarios of the Common Agriculture Policy on bird communities through 5 ecological indicators, all related to breeding populations of birds in farmlands: the Farmland Bird Index (FBI), a Generalist Bird Index (GBI), the Shannon diversity index, a Community Specialization Index (CSI), a Community Trophic Index (CTI). We considered these indicators to scan various functional traits of bird communities. Trends in the different indicators are significantly contrasted pending on economic policy scenarios. Promoting extensive grasslands appears essential for the sustainable management of bird communities and agriculture. But we revealed more complex economic effects and synergies between public incentives which appear as an interesting leverage to enhance the bio-economic effectiveness of agricultural policies. Moreover reducing current incentives, while keeping beneficial effects for bird communities, seems possible and leaves many paths for a budget re-allocation to other environmental strategies. Finally evaluation of agricultural policies should not rely on a single indicator per taxonomic group. In the context of potential reversal of current bird declines, bio-economic modelling is proposed as a relevant support for decision making about sustainable agri-environmental policies.

S.22-20-O

Growth response to climate of Mediterranean pines along a latitudinal gradient in Portugal.

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Climate influences physiological and phenological processes in trees namely stem radial growth. The aim of our study was to identify growth responses of Mediterranean pines (*Pinus pinaster* and *Pinus pinea*) to climate variables along a latitudinal gradient in Portugal, from a typically Mediterranean climate in the South to a Temperate climate in the North. Across the latitudinal gradient, trees contained common climatic signals suggesting that trees are responding to climate similarly from south to north. However, climate-growth relations also showed a gradual shift from south to north. Radial growth at the southern latitudes was mainly dependent on the precipitation from November to February, while at the northern latitudes correlation with precipitation started later (January-February). This could be an indirect indication that trees in the southern latitude start the growing season earlier, as part of a phenological and/or genotypic adjustment to a drier area. Trees from the southern latitude also showed a positive correlation with precipitation in October, indicating a second growth flush after the summer interruption, while this was not observed at the northern latitudes. In terms of climate change scenarios, in the northern latitudes a warming-up could induce an earlier start of the growing season. If spring precipitation is actually declining, especially in the south, no major shift in the growth of pine trees is expected, mainly because the 'most important water' for growth is from November to February.

S.22-21-P

Developmental instability as an index of stress adaptation and stress responses thresholds: *Quercus faginea*, a study along an altitudinal gradient.

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The increase of temperatures and droughts intensity in the Mediterranean region due to the ongoing climate change could compromise the survival of many plants species. With the objective of analysing the sensitivity of *Quercus faginea* Lam. to climatic change, we have studied the stress response of *Q. faginea* along an altitudinal gradient in two climatic contrasting years, 2008 and 2009 in the Pre-Pyrenees (NE Spain). We performed developmental instability analyses to quantify stress conditions: fluctuating asymmetry and translational asymmetry. We also measured branch biomass and fractal complexity of branches as indicators of species performance. The results showed that the individuals inhabiting the most xeric area presented larger developmental stability after a drought period and less biomass production than the individuals from mesic areas. That point out the capacity of *Q. faginea* to adapt to those stressful conditions and the trade-off between maintain homeostasis and biomass production. Thus, although the external situation is stressful in the most xeric area, the individuals had more stable development due to their capacity to buffer the environmental stress. Traditionally developmental instability has been understood as an index of stress, but we demonstrate that is rather an index of the degree of adaptation to specific environmental conditions. A stress agent can be assumed as normal if the organisms became able to deal with it. Two processes are taking place, the external stressful agent and the capacity of organisms to deal with it. Finally, we show that developmental insatiability measured in several years can detect the plasticity of plants to develop this adaptive response, it can serve as index of response threshold.

S.22-22-P

Nitrogen deposition effects on phosphatase activity in *Cladonia foliacea* (Huds.) Willd., a common terricolous lichen of semi-arid Mediterranean shrublands.

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We evaluated the potential use of *Cladonia foliacea* phosphomonoesterase (PME) activity as biomarker of N (nitrogen) deposition by means of a fertilization experiment. In order to do this, we continuously added N (NO₃NH₄) to a semi-arid shrubland at 4 rates: 0, 10, 20 and 50 kg N ha⁻¹ yr⁻¹ starting in October 2007. After 2.5 years of the experiment, tissue PME tended to increase with 10 kg N ha⁻¹ yr⁻¹ over the background, which was attributed to an induced N to P imbalance. Above this threshold, PME started to decrease, most likely as consequence of toxic effects of extra N. However, these effects depended on soil properties experienced by *C. foliacea* individuals, mainly pH, Ca, Mg, Fe and Cu. The response of *Cladonia foliacea* in terms of percentage of cover change between years clearly showed a lag phase when compared to the immediate response of PME, as no significant N effects were found in this case. Our data also suggests that changes in cover could be mediated by potassium availability and organic matter. Finally, further *C. foliacea* and soil surveys conducted across wide N deposition gradients will confirm the potential use of this species as biomonitor of N pollution and also the importance of soil properties on its ability to respond to atmospheric reactive N.

S.22-23-P

Effect of riverine invasive species in germination and radicle growth of understory species.

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The production of allelopathic substances by exotic plant species increases their competitive success over other coexisting species within the same habitat by inhibiting their germination and growth. In riparian forests it has been detected the presence of invasive tree species but their effect on native herbaceous species is unknown. The aim of this work was to study the effect of aqueous extracts of litter from invasive tree species (*Ulmus pumila*, *Robinia pseudoacacia*, *Ailanthus altissima*) and native (*Populus alba*) on the germination and radicle growth of six common understory herbaceous species of Henares river (Madrid). Several experiments were conducted under controlled conditions where seeds of herbaceous plant species were grown with litter extracts of tree species. The results showed that the germination of some species (*Dactylis glomerata*, *Brachypodium phoenicoides*, *Coenopodium album*, *Trifolium pratense*) was not affected by the presence of invasive or native tree species. However *Brachypodium sylvaticum* and *Trifolium repens* showed remarkable differences in germination according to the tree species extract. The germination rate showed also different response patterns depending on the host and the donor species. Radicle growth showed different responses: *Trifolium* species were greatly negatively affected by the presence of both indigenous and native trees. *C. album* and *D. glomerata* showed lower root length with some tree species. In summary the results indicated species-dependent patterns in responses to leaf extracts and the radicle length is more affected than germination.

S.22-24-O

Using lichen functional-diversity as ecological indicator in a changing Mediterranean environment.

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The ongoing global-change affects many planetary systems functioning. Although the environmental factors associated to global change work at a planetary scale, their effects on ecosystems must be assessed locally. This assessment is complicated by the need to provide information with high spatial resolution and taking into account the different spatial scales of analysis and potential co-occurrence of environmental factors. The use of ecological indicators can fulfill the gaps left by physical-chemical measures, helping in the identification of the critical areas under the influence of the factors associated to global change in order to ameliorate the impacts or rank priorities. The general aim of this work is to provide a general framework for the use of lichen functional-diversity as an integrating ecological-indicator of environmental changes in Mediterranean type ecosystems. This was supported by the analyses of the lichen community responses to environmental factors in order to select of lichen-variables as potential ecological indicators. The selected indicators could then be modeled against the key environmental factors, such as eutrophication, climate and air pollution. For that, a spatial explicit analysis was used in order to disentangle the response of lichen communities to multiple environmental factors and ultimately to apply the selected ecological indicators to monitor the complex Mediterranean-type ecosystems in a changing environment. Acknowledgments to DesertWarning (PTDC/AAC-CLI/104913/2008), GISA (private funding) and FCT-MCTES (SFRH/BPD/75425/2010).

S.22-25-P

Seagrass response to in situ experimental trace element contaminations.

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The Mediterranean seagrass *Posidonia oceanica* (L.) Delile has been widely used since the mid-seventies as bioindicator to monitor trace element (TE) coastal pollution. However, there is a lack of knowledge regarding to that seagrass contamination and decontamination kinetics. For the first time, *Posidonia* were experimentally in situ contaminated in 2009, at 10m depth in Calvi Bay (Corsica), by a mix of 15 TE (Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Mo, Ag, Cd, Pb and Bi). Trace element concentrations were measured by DRC-ICP-MS in leaves, rhizomes and in overall shoots sampled at regular time intervals. *P. oceanica* immediately accumulated pollutants from the beginning of experiments; once contaminations ended, TE concentrations came back close to their original levels within 2 weeks, or at least showed a clear decrease. *Posidonia* leaves exhibited different uptake kinetics for many elements (Cr, Cu, Zn, Ag, Cd, Pb and Bi): the younger growing leaves incorporated chemicals more rapidly than the older ones. Rhizomes did not show any clear trend, except for Cu, Zn and Bi. These results demonstrate that *Posidonia* is a very sensitive sentinel to immediately delineate punctual pollutions similar to what might be measured in contaminated Mediterranean waters. The very good response of *Posidonia* leaves to pollutant short term expositions suggests their routine use in regularly scheduled monitoring programs. Nevertheless, to by-pass *Posidonia* leaves deciduous character and their capability to detoxify rapidly, long term accumulation recordings would also necessitate below-ground tissues analyses.

S.22-26-P

The System for the Integrated Assessment of Protected Areas (SIAPA).

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Protected areas (PAs) are currently the most widespread and effective means to preserve biodiversity. However, little work has been developed to systematically, integrally and scientifically assess how these biodiversity reservoirs are performing. Lack of adequate management in PAs results in “Paper Parks”, largely unable to meet their conservation objectives. Additionally, lack of sound and periodical assessment inhibits effective prevention and adaptation to global change by PAs and jeopardises their conservation. The SIAPA is a site-level assessment system which can be easily applied to different types of terrestrial PAs, regardless of their extent or category, making comparison among them possible. It is based on common indicators which are integrated into six indexes defining the environmental sustainability of a PA: state of conservation, planning, management, social and economic context, social perception and valuation, and threats to conservation. These indexes are subsequently integrated into a super-index representing the Sustainability of the PA through a single, comparable value. The SIAPA tries to identify the main strengths, weaknesses, opportunities and threats to individual PAs in order to enhance management and, therefore, conservation. It also seeks to improve accountability as well as the quantity, quality, and understanding of available information on PAs, through an symbolic result-representation system. The SIAPA has been implemented in the ten PAs of the Autonomous Region of Madrid to conduct the first such assessment in the Region and the second in Spain. Its results are presented as a case-study.

S.22-27-P

Estimation of conservation status of *Abies religiosa* forest landscape units in a basin located in Mexico City.

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The Magdalena river basin is one of the few remnant forest areas in México City; it is characterized by a high environmental heterogeneity and a high specific richness. Nevertheless, due to its proximity to one of the biggest cities of the world, it is an area that is constantly exposed to anthropogenic disturbances. This project diagnosed the conservation status of an *Abies religiosa* forest through the determination of several environmental indicators. We determined 11 landscape units in which the following biodiversity status indicators were registered. These indicators evaluated the three main emergent attributes of biodiversity: a) structure; (understory and tree cover species) such as; cover, density, dbh, height and age, forest cover area, degree of forest density and fragmentation degree; b) composition; species richness, importance value, diversity indexes and the presence of native and invasive species; and c) function; natural regeneration level, seed rain and seed bank, reproductive phenology, disturbance effects and the particular effects of invasive species. Using the variables of these attributes we generated a monitoring model that involves environmental indicators through the elaboration of a synthetic index that allowed the determination of differences in the degree of conservation among the landscape units. This systematic recognition of environmental indicators of conservation status will be useful for decision making in forest conservation and management.

S.22-28-O

Body size parameters as a tool for bioindication and taxonomical identification.

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It is in general known that size and form of an organism influence almost all aspects of its biological and behavioral characteristics. Nematodes present a typical morphological pattern. They have in general long cylindrical bodies tapering towards both ends. Their numerous species however show a relatively wide range of morphometric adaptations and significant differences in size and body proportions. Nematodes present a variety of characteristics (trophic diversity, variety of life strategies, sensitivity to pollution and disturbance) that have posed them among the most preferred bioindicators. Very few studies though have devoted attention to the ecological meaning of their striking morphometric diversity. In this study biometric parameters of nematodes are tested: a) regarding their bioindicator potential and b) as a tool for the development of an automatic method of nematode taxonomy. For the first subject various body size parameters of nematodes like length, width, volume and surface etc. were used to explore differences among three levels of agricultural land use intensity (grassland, perennial and annual cultivation). Indeed the length/width as well as the surface/volume ratio of nematodes decreases significantly with increasing land use intensity, and thus the bioindicator potential of these parameters is highlighted. As regards the second subject, it is based on the correlation of biometric characteristics combinations to certain genera. Unknown individuals are compared to templates of known genera by Gower similarity index and allocated to the most probable one. The development of this procedure will allow easier, less time consuming and more massive taxonomical identification of nematodes.

S.22-29-O

Sphagnum-dwelling Testate Amoebae in Subarctic Bogs are More Sensitive to Soil Warming in the Growing Season than in Winter: the Results of Eight-year Field Climate Manipulations.

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Sphagnum-dwelling testate amoebae are widely used in paleoclimate reconstructions as a proxy for climate-induced changes in bogs. However, the sensitivity of the proxies to seasonal climate components is an important issue when interpreting proxy records. Here, we studied the effects of summer warming, winter snow addition solely and winter snow addition together with spring warming on testate amoeba assemblages after eight years of experimental field climate manipulations. All manipulations were accomplished using open top chambers in a dry blanket bog located in sub-arctic Sweden. We estimated sensitivity of abundance, diversity and assemblage structure of living and empty shell assemblages of testate amoebae in the living and decaying layers of Sphagnum. Our results show that, in a sub-arctic climate, testate amoebae are more sensitive to climate changes in the growing season than in winter. Summer warming reduced species richness and shifted assemblage composition towards predominance of xerophilous species for the living and empty shell assemblages in both layers. The higher soil temperatures during the growing season also decreased abundance of empty shells in both layers hinting at a possible increase in their decomposition rates. Thus, although possible effects of climate changes on preservation of empty shells should always be taken into account, species diversity and structure of testate amoeba assemblages in dry subarctic bogs are sensitive proxies for climatic changes during the growing season.

S.22-30-O

The Ecological Footprint Indicator - analysis of the biocapacity.

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The Ecological Footprint Indicator is used to assess environmental sustainability and it is obtained from the comparison between two components, the ecological footprint and biocapacity. Generally, the ecological footprint represents the actual human consumption of biological renewable resources, and the biocapacity gives the biosphere's capacity of production. Nowadays, the most applied methodology is the one presented by the Global Footprint Network and this is the base of our work. We analyse the biocapacity component. According to the results, as presented by the Global Footprint Network, the world is in a situation of overshoot, which means that humanity needs more than 1 planet to support the consumption and assimilation of wastes. Regarding the biocapacity calculation and as it is done by the Global Footprint, there are less productive areas that are not considered and there is no set aside area to provide for biodiversity. Using the 2006 data, we propose the consideration of all the world area and set aside area for biodiversity (14% of total world area). The new results indicate an increase of 15% in total biocapacity but still a situation of overshoot. Although there isn't a change in the main conclusion, the results are relevant and indicate the importance of these assumptions on the final results. Our future work includes the analysis of the biocapacity of Portugal and its relation with the agricultural practices. Agricultural practices that increase the organic matter of the soil (such as the reduction of tillage) increase the productivity of soils, and, consequently, the biocapacity.

S.22-31-P

Quantifying differences between leaf and air temperatures during various meteorological conditions.

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The 40 to 50 °C temperature range is a general threshold for heat stress in plants. Heat stress influences leaf metabolism in multiple ways, affecting mainly photosynthesis. Because of climate change, air temperature extremes will become more likely. Ecologists and agronomists assume that leaf temperature (TL) will be broadly equal to air temperature (TA). However, as it is TL that determines the extent of the heat damage in plants, we cannot rely on the assumption that physiology is driven by air temperature. Indeed, more precise estimates about the effect of a future climate on TL are needed. Using an energy balance model we examined the effect of various environmental conditions on the difference in temperature between TA and TL. At low temperature, TL generally surpasses TA, while at high TA, leaves can be cooler than the air. This suggests homeostasis of leaf temperatures, implying that plants are able to cool themselves even during extreme air temperatures. This cooling effect was lower during windy days, however, as wind enhances the coupling between leaf and air. Plants were not able to lower TL at high relative humidity and radiation. Therefore, a heat wave with humid air is bound to be more stressing than a heat wave accompanied by dry air. In conclusion, TA is not the right variable to convey whether plants are stressed during heat waves. The most important variable to determine the stress response is TL, and through its dependence on environmental factors, it can buffer or exacerbate heat stress.

S.23- Drought-induced forest dieback: causes, scope and implications

S.23-01-O

An updated global overview of patterns and emerging climate change risks for forests due to drought-induced tree mortality.

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Ongoing climate changes (increases in mean temperatures as well as frequencies, durations, and severities of extreme drought and heat) can amplify tree physiological stress, and may drive increases in both background tree mortality rates and episodes of rapid, broad-scale forest die-off. Updates are presented to a recent global synthesis of documented tree mortality episodes attributed to drought and/or heat, demonstrating the vulnerability of all major forest types from tropical moist forests and savannas to temperate and boreal forests. Climatic drivers of forest die-off are analyzed for case studies from every forested continent. Emerging research efforts are discussed to address the large knowledge gaps that currently hinder our ability to predict forest mortality in response to climate change.

S.23-02-P

Spatio-temporal variability of soil respiration in a Mediterranean forest subjected to climate change driven succession.

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CREAF.

Soil respiration (SR) represents the largest CO₂ efflux from terrestrial ecosystems and plays a crucial role in the carbon cycle at a global scale. However, due to the limited knowledge of the mechanisms underlying its variability, it is still unclear how SR may change under different climate change scenarios. Understanding the factors that drive SR variability at the spatial and temporal scales is essential to understand terrestrial C emissions and its sensitivity to climate change. We investigated spatial and temporal variability of SR in a mixed and heterogeneous Mediterranean forest where pine population (*Pinus sylvestris*) is gradually being replaced by holm-oaks (*Quercus ilex*) due to several episodes of drought-induced dieback during the last decades. Spatial variability of SR was recorded in 2 plots of 250m² using a static close chamber method (soda lime technique). Temporal variability of SR was recorded at high frequency (every 15 minutes) during nine months using solid-state sensors (GMT220, Vaisala, Finland). Results indicated forest-structure as the best explicative variable at the spatial scale, being SR under pines 20% higher, on average, than under oaks. High frequency SR data further revealed that both the magnitude of SR and its response to abiotic (climate) and biotic (productivity) drivers depended strongly on the species and, in the case of pines, on the degree of their defoliation. We therefore hypothesize that ongoing climate-change driven succession in plant community could modify substantially ecosystem CO₂ fluxes and its environmental drivers.

S.23-03-O

Drought-induced tree die-off: Progress on mechanisms, consequences, and options from the perspective of the piñon pine *Pinus edulis* as a model species.

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Several recent studies highlight examples of widespread tree mortality in response to drought, warmer temperatures, and/or biotic agents such as bark beetles. One predominant example has been mortality of the piñon pine *Pinus edulis* across a large fraction of the southwestern USA. A diverse suite of research on this species provides an opportunity for it to serve as a model species for better understanding the mechanisms, consequences and management options of drought-induced tree die-off. These include soil and plant water status measurements in the field through mortality, experimental glasshouse and field manipulations, ongoing development of models of mortality, assessments of impacts on ecosystem goods and services, and suggestions for adapting to changes in the supply of services. Comparing and contrasting this suite of research with other globally related research may aid in improving understanding, prediction, and adaptation options associated with drought-induced tree die-off.

S.23-04-P

Spatio-temporal differentiation of decline and mortality processes: a case study on silver fir in south-east France.

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Tree decline and mortality are main processes in forest functioning and dynamics. As it impacts forest regeneration, timber production, carbon sequestration and biodiversity, an increasing number of studies were reached on this topic, but our knowledge on the determinant of the process are still limited. Decline in tree vitality was reversible. In the worst cases, when the stress is too long, intense, occurs too frequently, the process is irreversible leading in tree death. With the increase in summer drought intensity and frequency, numerous tree decline and mortality events were reported during last decades especially in water-limited areas such as Mediterranean area. As this climatic trend is predicted to persist in the future, more experimental research is needed to better understand which factors predispose and incite tree to decline and/or to die. We compared the decline and mortality processes of silver firs (*Abies alba* Mill.) on three Mediterranean mountains located in Provence, south-eastern France, to firstly evaluate what kind of indicator should be used to characterize tree vitality (radial growth / sapwood area / crown condition). Then the impacts of biotic, edaphic and climatic conditions on tree vulnerability to dieback were assessed using a spatial analysis which especially showed complex relationships between mortality and site dryness. Finally, as severe crown damage did not always lead to mortality, an original functional view of the decline and dieback processes was proposed.

S.23-05-O

Widespread crown condition decline, food web disruption, and amplified tree mortality with increased climate change-type drought.

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Climate change is progressively increasing severe drought events in the Northern Hemisphere, causing regional tree die-off events and contributing to the global reduction of the carbon sink efficiency of forests. There is a critical lack of integrated community-wide assessments of drought-induced responses in forests at the macroecological scale, including defoliation, mortality, and food web responses. Here we report a generalized increase in crown defoliation in southern European forests occurring during 1987- 2007. Forest tree species have consistently and significantly altered their crown leaf structures, with increased percentages of defoliation in the drier parts of their distributions in response to increased water deficit. We assessed the demographic responses of trees associated with increased defoliation in southern European forests, specifically in the Iberian Peninsula region. We found that defoliation trends are paralleled by significant increases in tree mortality rates in drier areas that are related to tree density and temperature effects. Furthermore, we show that severe drought impacts are associated with sudden changes in insect and fungal defoliation dynamics, creating long-term disruptive effects of drought on food webs. Our results reveal a complex geographical mosaic of species-specific responses to climate change-driven drought pressures on the Iberian Peninsula, with an overwhelmingly predominant trend toward increased drought damage.

S.23-06-O

Microbial community shifts following climate-change driven ecological succession of a Mediterranean forest.

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Climate change in the Mediterranean basin, with longer summer droughts and higher temperatures, is submitting organisms to an important adaptive force. At the ecosystem level, ongoing increase in the frequency, duration and severity of drought and heat stress is inducing tree mortality and forest decline, and hence, triggering ecological succession. Because relations plant/soil microbial communities are highly complex and specific to a certain extent, we expect climate-driven changes in plant distribution to also trigger ecological succession of soil microbial communities. We, therefore, investigated the effect of climate-change driven plant succession on soil organic matter (SOM) composition and microbial (bacterial and fungal) taxonomic composition and diversity in a mixed Mediterranean forest dominated by *Pinus sylvestris* and *Quercus ilex*. The Scots pine population, affected by drought-induced dieback (approximately 20% of standing mortality) presents a varying degree of defoliation in surviving trees, while the Holm-oak population, better adapted to such climatic conditions, is gradually replacing pines as the dominant tree species. We used solid-state ¹³C nuclear magnetic resonance (NMR) spectroscopy, to characterize soil organic matter (SOM) composition and pyrosequencing (Genome Sequencer Titanium FLX system (454| Life Sciences) to determine taxonomic diversity of soil bacteria and fungi at soils from the rhizosphere of pines at different degree of defoliation (from healthy to dead) and from the rhizosphere of Holm-oaks. Preliminary results indicate that die-back of Scots pines and subsequent dominance of Holm-oak was followed by substantial changes in SOM composition and by a shift towards a microbial community dominated by Holm-oak associated microorganisms. Because at least half of the CO₂ emitted by terrestrial ecosystems is produced by microbial-mediated decomposition of soil organic matter (SOM), observed shifts in composition and diversity of microbes might be crucial to understand future CO₂ emissions from the Mediterranean basin.

S.23-07-O

How to predict tree decline and mortality from process based models?

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Climatic change will induce strong modifications in forest community functioning. The observed and expected increases of heat wave and summer drought phenomena will raise probably forest decline and mortality. Many studies have already reported a decrease of wood growth in southern Europe caused by successive intensive droughts and an increase of mortality rates measured from forest inventory. There is a huge necessity to better understand the overall processes which can lead to decline on the one hand and to mortality on the other hand. Tree mortality can be due to carbon starvation or xylem embolism. But this view is in reality oversimplified since (i) decline and leaf fall led not automatically to death, (ii) fall of water conductivity also contribute to carbon starvation by stomata closure and decrease of phloem flow, (iii) from decline to death, bark beetles can play a major role. We first summarize main results concerning the observed links between silver fir decline, tree ring records, soils properties and pathogen dynamics in a study case of decline in Mont Ventoux. Then we used a process based model (CASTANEA) to predict from 1960 to 2100, the evolution of mortality probability along an altitudinal gradient. Two versions of the model are compared: an initial version where mortality is related to carbohydrate reserves (simple hypothesis of carbon starvation) and an improved version of the model including roots plasticity in function of soil heterogeneity in depth and a link between hydraulic vulnerability and stomata conductance. Impact of pathogens is finally discussed.

S.23-08-P

New insights into the mechanism of water-stress induced cavitation in conifers.

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Motivated by the urgent need to understand how water stress-induced embolism limits the survival and recovery of plants during drought, the linkage between water-stress tolerance and xylem cavitation resistance was examined in tree species. Moreover, cavitation resistance is known to be intimately linked to the anatomy of the xylem but the actual mechanical properties of the pit membrane are not well known and the exact mode of air-seeding by which cavitation occurs is still uncertain. We examined the relationship between cavitation resistance and bordered pit structure and function in 40 coniferous species. Xylem pressure inducing 50% loss of hydraulic conductance (P50, a proxy for cavitation resistance) varied widely among species, from -2 to -16 MPa. First our results showed that lethal water potential was correlated with the tension producing a 50% loss of stem hydraulic conductivity. Second, highly cavitation resistant species exhibited both a high flexibility of the margo and a large overlap between the torus and the pit aperture, allowing the torus to tightly seal the pit aperture. Our results support the hypothesis of seal capillary-seeding as the most likely mode of air-seeding, and suggest that the adhesion of the torus to the pit border may be the main determinant of cavitation resistance in conifers.

S.23-09-O

Retrospective approach to dieback in *Pinus sylvestris* through the analysis of carbon and oxygen stable isotope composition in tree ring cellulose.

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The aim of this study was to compare the historical record of healthy and declined trees in a *Pinus sylvestris* L. stand, before and after a dieback episode occurring just after a strong thermal contrast in autumn 2001. The stand is located in the Gúdar Range (Iberian System, Spain), at 1690 m.a.s.l, with average temperature of 8.6°C and annual precipitation of 546 mm. In this area, a progressive increase in annual temperature has been recorded during the last decades. We hypothesised that the adjustment to these new conditions should be detected in tree-ring archives (radial growth, carbon -d13C- and oxygen -d18O- isotopes), and that this adjustment would differ in healthy and declined trees. Following a multi-scale approach, we determined d13C and d18O in wood cellulose with annual resolution (1975-2004), separating early and late wood (1990-2004) and dividing each year into four sections (2000-2006). In addition, as an indicator of the storage pool, starch content in the trunk was determined. We observed a decline in radial growth and an increase in water-use-efficiency from 1975 to 2004, being faster in declined trees. d13C and d18O were negatively correlated in declined trees but not in healthy ones, further supporting a stronger stomatal limitation of the former. Overall, our results indicate that a differential history in terms of water-use determined the fate of individuals during the dieback event. The extremely low starch content in wood for both declined and healthy trees points to carbon starvation as the ultimate cause for tree decline.

S.23-10-P

Determinants of crown condition and carbon reserves recovery of holm oak (*Quercus ilex* L.) seven years after a drought episode.

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Episodes of drought-induced forest dieback have already been reported worldwide. Severe drought may increase physiological stress on long-lived woody vegetation, occasionally leading to mortality of overstorey trees. Little is known about the factors determining tree survival and subsequent recovery after drought. We have studied the long-term effects of a single drought episode, occurred in summer 2000, on a holm-oak (*Quercus ilex* L.) forest located in NE Spain (42°8'43" N, 2°27'41" E). Generalized linear models were used to study the environmental correlates of forest crown condition seven years after the drought event, and its relationship with the amount of nutrients and carbon reserves stored in lignotubers. Our results showed that stand structure and topographic attributes were associated to the observed long-term effects of drought on crown condition. Seven years after the drought event, stored carbon reserves were still depleted by 60% in highly drought-damaged trees. Additionally, successive surveys in 2007 and 2011 showed a direct association between reduced carbon reserves and further deterioration of crown condition. Severe drought events may produce loss of resilience by depletion of reserves (mostly carbohydrates) in Mediterranean forests, leading to prolonged recovery of surviving individuals and, occasionally, to delayed tree death.

S.23-11-P

The effect of ENSO-associated drought and fire on tree mortality in a fragmented Mesoamerican lowland wet forest.

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Occurrence of fires is an unusual event in many tropical rain forests, in particular those in Mesoamerica. As a result of the unusually intense ENSO event of 1998, these forests were subjected to a prolonged drought that favored the propagation of extensive fires. In the lowland rain forests of the Atlantic Coast of Nicaragua these were mostly low-intensity leaf litter fires, but produced high mortality among trees. Data from 5–17 years of study of permanent plots/transects from four sites were used to investigate whether survival following the ENSO drought episode and subsequent fires may be affected by factors such as taxonomic identity, successional status, tree size, or growth rate. The study included two sites that burned in their entirety, one that only had part of its area burned and a fourth site that was not affected by fire. Species were grouped in five guilds corresponding to their ecological successional status, namely: (1) pioneers; (2) subcanopy/understory heliophiles; (3) canopy heliophiles; (4) subcanopy primary forests species; (5) canopy primary forest species. Following fire, there were significant differences in survival among the 15 most abundant species. Using a larger pool of the 38 most abundant species, it was observed that after fire: (i) guild had a strong relationship with post-fire survival, being significantly lower for the pioneer guild (66%) but non-significant among the other four guilds; (ii) tree size had a significant effect on survival after fires, where trees of smaller basal area in all guilds were more likely to die; and (iii) relative growth rate had significant negative effect on survival in plots that burned. The effect of drought associated with the 1998 ENSO event resulted in (iv) a significantly reduced overall survival when compared with years without ENSO, particularly in the pioneer guild, but was non-significant for the remaining guilds; (v) individual tree basal area -only for pioneers- had a significant negative effect on survival as a result of drought. Differently to hurricanes, this study highlights that survival after fire varies greatly among taxa, so there is no neutral effect at the species level. Traits associated with tree size may positively determine the likelihood of survival at the individual tree level.

S.23-12-P

Modeling drought-dependent changes in forest productivity and tree mortality.

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Climate scenarios predict an increase in frequency, severity, and duration of drought events towards the end of this century in many regions worldwide. As water shortage limits vegetation growth and can lead to higher tree mortality, we expect that forest ecosystems will be influenced by the future anticipated changes in precipitation. Water shortage for plants due to drought has two different dimensions, the duration of the drought and the frequency of drought occurrences. In this study we investigate the influence of different drought patterns, e.g. the frequency and duration of drought periods on tree carbon uptake, tree growth and the resulting impacts on forest structure and dynamics. We use the ecosystem model LPJ-GUESS and apply historic climate data, but also synthetic precipitation patterns to represent different durations and frequencies of drought conditions. We study forest ecosystems in Switzerland and estimate the impact of droughts on productivity, forest structure and tree mortality. Interestingly if growing season precipitation is low, intermediate droughts, interrupted by days of more heavy rainfall showed a higher productivity than years with a rather equal distribution of a low amount of rainfall. We show how these differences in productivity result in changes in tree growth and tree mortality. We further discuss the influence of drought induced mortality on forest structure and composition.

Defining past and future bioclimatic limits on tree survival: a case study from southern Australia.

Mitchell, Patrick. Pinkard, Libby. O'Grady, Tony.

CSIRO. CSIRO.

Drought-induced tree mortality in natural ecosystems is thought to be increasing worldwide. Many species show a large degree of plasticity in their ability to cope with changes in water availability allowing them to survive in highly variable climates. Southern Australia exhibits inter-decadal shifts in rainfall and future climate scenarios in this region show significant increases in the frequency and areal extent of exceptionally hot and dry periods. Few studies to date have related such predictions to the observed bioclimatic limits that determine tree survival. This study reviews the history of drought-induced mortality events in this region with the objective of defining the climatic drivers of mortality within the context of the underlying physiological mechanisms involved in tree death. The observed climate patterns were assessed using standardised precipitation and evapotranspiration indices (SPEI) and heat stress values for several mortality sites across the region. The majority of mortality events represented periods when both SPEI and heat stress were above their 95th percentile and were exceptional events in terms of either their intensity or duration. The observed and predicted datasets show shifts towards events of greater intensity and/or longer duration between 1960 and into the future. The conditions needed to produce the observed mortality events fell well outside the normal operating ranges of these species and were exacerbated by acute heat stress in most cases. The physiological pathway of water stress and mortality in eucalypt species in response to different droughts is discussed in relation to the future vulnerability of these forest types to climate change.

Induced drought stress in burned *Pinus halepensis* Mill. stands: morphological and ecophysiological status of dominant species one year after the fire.

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According to IPCC projections, significant climatic changes will be strengthened in the Mediterranean Basin. Temperature increase and changes in precipitation regimes (increasing aridity) have been predicted which will promote an increase of wildfire frequency and intensity. The plant communities of the Mediterranean area have developed adaptive traits to both disturbances, wildfires and drought periods, but the changes may have large impacts on vegetation productivity, density and distribution. The regional models for south-eastern Spain are predicting rainfall decrease of 20% and temperature increase of 4.5°C. To check how rainfall decrease in summer could affect species adapted to both disturbances, we designed an experiment to induce drought in natural regenerated post-fire communities. In summer 2009, a mid-high severity fire burned over 1000 ha of Aleppo pine (*Pinus halepensis* Mill.) forest in south-eastern Spain. Six months later, a salvage logging was carried out. The Aleppo pine recruitment was negligible. During summer 2010, twenty square plots (2m x 2m) were set in the study area in pairs. Ten were randomly disposed as control plots and ten as drought treatment by reducing precipitation using metallic structures to fix elevated plastic half-pipes and digging trenches on the sides of the plots to exclude lateral water flow. The structures were made with transparent PVC covering 20% of the surface area of the plots. We recorded the total height and surface cover of three dominant understory species: a resprouter, the esparto grass (*Stipa tenacissima* L.) and two bush seeders, rosemary (*Rosmarinus officinalis* L.) and rockrose (*Cistus clusii* Dunal.). To estimate the soil water availability and the water stress in the plants, we used a Compact Plant Water Status Console (pressure chamber method) recording the predawn leaf water potential which is related to the overall water status of the individuals. We also recorded and calculated the net photosynthetic rate, PAR, transpiration and the water use efficiency (WUE) for four individuals from each species in the studied plots. The measurements were carried out at ambient conditions (800 to 1100 h, solar time) using a portable gas exchange system (LI-6400XT and 6400-07 Needle Chamber). In late summer 2010, the seedling growth in control plots was significantly higher for the three species than that found in the induced drought plots. In the same way, the increase of covered surface by species was significantly higher for both seeder species. Regarding to the status of the plants, the esparto grass showed the lowest mean leaf water potential value in both treatments and times. After the drought period, the leaf water potential values were higher in the control area although not significantly. The morphological and ecophysiological variables were checked to not differ significantly before the drought period. The comparison of linear regressions relating PAR and net photosynthesis revealed significant differences depending on the species and the treatment, showing higher ratios for both seeder species not affected by drought. Esparto grass showed lower ratios than seeder species and a decrease in the induced drought area after the summer. We found no significant differences for WUE but esparto grass showed a decrease after the drought period. Transpiration was significantly higher for Rosemary in both treatments. We found that all individuals under drought survived the summer 2010 which was characterized as being very hot although not extremely dry. The water status of the studied species varied with the interception of 20% of precipitation although was significant just for esparto grass. However, lower transpiration and water use efficiency were found in the control area which induced the stimulation of the total height and cover, especially for seeders, rosemary and rockrose individuals. It was confirmed that climate change in the Mediterranean area influences productivity and development of adapted communities in the short term. Such a record could imply a failure on the survival or regeneration in the medium and long-term, mainly after disturbances such as severe droughts or wildfires.

S.23-15-P

Seed mass, germination and seedling growth under variable water cycles.

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Climax forests in Borneo have evolved with episodic El Niño Southern Oscillation (ENSO) events. ENSO events are simultaneously associated with drought, high rainfall variability and mast seed production. Regeneration dynamics under these ENSO events may be dependent on specific traits such as seed mass. In Bornean forests, seed mass among tree species varies as much as two orders of magnitude, and large seeded species likely have an advantage under drought and variable rainfall conditions. We tested the role of seed mass on germination and early seedling growth under a range of watering patterns from daily to six day cycles. Cumulative germination declined with seed mass (-2.86 seeds per log mg; $F_{1,7} = 5.4$, $p = 0.053$) and decreasing water frequency (-7.4 germinating seeds from daily to six day cycles; $F_{3,24} = 10.57$, $p < 0.0001$). Days to germination increased with infrequent watering cycles ($F_{3,21} = 22.85$, $p < 0.0001$) and small seeds germinated faster under daily watering but slower under the six day cycle (slope of 0.92 and -1.25, respectively; Interaction: $F_{3,21} = 7.93$, $p = 0.001$). Small seeded species had higher size standardized relative height growth rates (SGR) than large seeded species in daily watering but reduced SGR in six day watering cycles. Cumulative germination, days to germination and SGR of small seeded species was inhibited by infrequent watering. Small seeds will likely establish faster under regular rainfall, but this temporal advantage is lost with infrequent rainfall. Large seeded species establishment may be favored under Bornean climate change projections.

S.23-16-P

Seasonal patterns of water use and extraction in drought-exposed Scots pines and competing Holm oaks.

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Centre for Ecological Research and Forestry Applications. Centre for Ecological Research and Forestry Applications. Centre for Ecological Research and Forestry Applications. Centre for Ecological Research and Forestry Applications/Global Ecology Unit CREAF-CEAB-CSIC. University of Edinburgh. Institute of Environmental Assessment and Water Research, IDAEA-CSIC. Institute of Environmental Assessment and Water Research, IDAEA-CSIC. Centre for Ecological Research and Forestry Applications/Global Ecology Unit CREAF-CEAB-CSIC.

Scots pine is a widely distributed tree throughout boreal regions, but it also occupies more southerly locations thanks to its highly plastic hydraulic architecture. However, chronic water stress and recurrent drought spells are leading to reduced growth, crown defoliation and increased mortality rates of Scots pine in some populations throughout the Mediterranean basin. In the Prades Mountains (NE Spain), the more drought-tolerant Holm oak has benefited from this decline, expanding its canopy and competing with Scots pine for below-ground resources. We studied three areas within the same valley, covering a gradient from dry to comparatively moist conditions: a pure Holm oak coppice, a mixed Scots pine-Holm oak stand, affected by drought-induced decline, and a pure Scots pine stand. In each plot, we measured sap flow (Granier method) and water potentials during the year 2010. In the mixed plot we also compared the oxygen isotope composition of water in the xylem, soil (4 depths) and groundwater. Defoliated Scots pines were more sensitive to summer drought than healthy pines, with some trees virtually reducing sap flow to zero during the months of July and August. Comparatively, co-occurring Holm oak trees decreased sap flow only slightly. Scots pine regulated midday water potential at similar values across sites and crown conditions, but defoliated pines showed lower predawn water potentials than healthy pines. The isotopic analyses will confirm whether defoliated pines, non-defoliated pines and Holm oak trees in the mixed stand also differ in the patterns of water extraction.

S.23-17-O

Drought effects on Scots pine dieback in the European Alps - an integrative ecosystem analysis across multiple disciplines and scales.

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In the European Alps extensive forests are formed by the subboreal *Pinus sylvestris* L. growing here on dry sites close to its southern range of distribution. In the past decades, mortality processes in pine forests have been reported for many of the dry inner-Alpine valleys. In an integrative ecosystem analysis multiple research approaches were applied on various temporal and spatial scales to study pine decline and to disentangle the various driving factors. Special emphasis was put on the role of drought, which was studied using inventory data, long-term monitoring plots, physiological experimental plots, rain-out shelter experiments and an irrigation experiment. The main studies were conducted in the Swiss Rhone valley, with contributing studies from other inner-Alpine regions. The results presented are a synthesis of 15 years of research on this topic. The findings show that predisposing stress factors such as stand competition, mistletoe infestation, shoot-feeding by insects and pathogenic blue stain fungi impacted the pines during decades and increased their susceptibility to short-term, inciting stresses such as drought or insect breeding. These inciting factors affected the physiological functioning of the pines, and reduced their potential for pathogen defense. Single and particularly multiple drought years were shown to be both, the main driver of the pine mortality and the main limiting factor for pine regeneration. But our experiments also showed, that multiple moist years allow the pine forests to recover from drought stress. Hence the future performance of *Pinus sylvestris* forests will depend not only on the frequency of dry but also of moist years.

S.23-18-P

Selective drought-induced decline of pine species in southeastern Spain.

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The negative impacts of severe water deficit on the growth and vigour of tree species in drought-prone areas and their relationship with forest decline have not been properly evaluated taking into account the differential responses to drought stress of trees, sites and species. We evaluated these responses assessing the changes in radial growth of plantations of four pine species (*Pinus sylvestris*, *Pinus nigra*, *Pinus pinaster*, *Pinus halepensis*) which showed distinct decline and defoliation levels after severe droughts in two contrasting sites in southeastern Spain. We used dendrochronological methods and mixed models of basal area increment to quantify the responses of trees and pine species to site conditions and drought stress. In the study area a temperature rise and a decrease in spring precipitation have led to drier conditions during the late twentieth century which culminated with a sequence of severe droughts (1994, 1995, 1999 and 2005). The defoliation level and the reduction in basal area increment were higher in those species more vulnerable to drought-induced xylem embolism (*P. sylvestris*) than in those more resistant (*P. halepensis*), and these differences were more notable in the most xeric site (Filabres) than in the less one (Baza). The greatest reduction in basal area increment was observed after two consecutive severe droughts (1994, 1995). A decrease in soil water availability in spring, when most radial growth occurs, is the major causing factor of recent decline. The sharp growth reduction and widespread defoliation and decline of Scots pine plantations make their future persistence in xeric sites subjected to frequent and severe droughts unlikely under the forecasted warmer and drier conditions.

S.23-19-P

Factors influencing crown condition and tree growth in decaying pine plantations in the species rear edge: is drought the main decline factor?

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Drought is considered a key trigger for forest decline. Currently, widespread forest decline is observed at the southern edge of Mediterranean forest distribution, with drought being considered as a key driver. Yet, the mechanisms underpinning vulnerability to climate change of Mediterranean mountain pine plantations at the species rear edge are not well understood. We analyze the impact of biotic and abiotic factors on tree growth and vigour and, we develop a predictive model of forest decline risk for pine plantation. Dendrochronological data were collected on 40 plots for *Pinus nigra* subsp. *salzmannii* and 30 plots for *P. sylvestris*. Tree size, competition, site characteristics and climatic variables related to pine plantations decline were examined. We used correlation and Principal Component Analysis to identify correlates of crown condition and tree growth. We used logistic regression and generalized linear models to examine the relationship between canopy defoliation and growth respectively for *P. nigra* and *P. sylvestris*. The PCA analysis showed three main components (climate, competition and physiography) related with crown damage and growth, respectively. Probability of crown damage was associated with tree size, competition and climatic conditions. *P. sylvestris* was more sensitive than *P. nigra* to high summer potential evapotranspiration. Climate and competition were the two main drivers influencing tree growth. Unlike crown defoliation, physiography had an important effect. Within each species, there was a divergence in competition factors among healthy and damaged trees. *P. sylvestris* growth was more sensitive to summer temperature and precipitation, than *P. nigra*. Declining growth was found in trees with higher crown defoliation in drier sites. This increases their vulnerability to extreme conditions, suggesting that low growth is able to increase die-off risk. The main factors influencing crown condition and tree growth in decaying pine plantations in the species rear edge were drought, competition, respectively and physiography only in growth. The sharp growth reduction and widespread defoliation in decline pine plantations in the rear edge make their future persistence unlikely under the forecasted warmer and drier conditions.

S.23-20-O

Did wood traits and radial growth good indices of Douglas-fir vulnerability to mortality following severe droughts?

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Douglas-fir is the first exotic tree species planted in France. Some of the most important productive regions in France have suffered an important decline and dieback induced by a series of droughts which begin with the 2003 extreme drought and heat wave. This decline caused early mortality and loss of productivity. We have recently shown a strong relationship between radial growth variation and the intensity of soil water deficit. This previous result was based on water balance calculation and tree-ring analysis on 60 sites in two French regions severely impacted in 2003. Dead trees neighboring healthy trees were observed on 37 of the 60 plots. This amount of dead trees induced by drought was an opportunity to test if wood traits could be used as vulnerability indices to mortality. As a relationship between wood hydraulic properties and wood density was recently observed in Douglas-fir, we compare dead and surviving trees for wood density and radial growth variables. We cored to pith 85 dead trees and 375 healthy neighboring trees. We found significant differences for several basic wood properties between both groups of trees. Dead trees were found to be significantly denser and faster growing than healthy trees during several years before the 2003 drought. The adaptive consequence of such differences will be discussed in term of possible physiological mechanisms involved in mortality, as carbon allocation or hydraulic failure.

S.23-21-P

Modeling the delayed impact of drought on tree architecture as a contribution to forest dieback.

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Cemagref. Canadian forest service. Université du Québec en Abitibi-Témiscamingue. Cemagref. CIRAD - AMAP.

The impact of drought on tree architectural development was studied in France from 1995 to 2010 on 6 conifers. During and after bad years, a fall occurred in branching rate, polycyclism frequency, size and number of leaves. The resulting simplified architecture limits for several years the capacity of trees to explore available space and contributes to a low LAI and to crown transparency. Small leaves also limit the potential maximum LAI for 3 to 8 years according to their life span. We designed and calibrated a model of branch architectural development with observed data. We also integrated the observed parameters in whole-tree development models. These models were used to simulate the direct and delayed consequences of climate accidents of various intensity and duration (1 to 5 year) on tree potential LAI and photosynthesis. Together, light architecture and smaller needles may cut by up to 75% the potential LAI at the end of a multi-year accident. The full recovery of crown density with a normal climate is delayed from 2 to 8 years according to the severity and duration of the accident. This long lasting deficit contributes to carbon shortage. It helps explaining why forest-die-back, partly driven by carbon starvation, may occur many years after climatic accidents.

S.23-22-P

Hydraulic failure or carbon starvation in *Eucalyptus sideroxylon*.

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Background/Question/Methods The role of carbon starvation and hydraulic failure as the cause of mortality is currently under significant debate, and mechanisms causing drought mortality are currently unresolved. We tested whether hydraulic failure and/or carbon starvation were causes of mortality in *Eucalyptus sideroxylon* plants subject to well watered conditions and extreme drought for 60 days. Theory suggests that reduced stomatal conductance and increased water use efficiency under elevated CO₂ will lead to higher soil water availability and 'water savings'. We tested whether elevated CO₂ led to water savings, mitigated drought stress and delayed mortality due to drought, and, conversely, whether elevated temperatures increased drought stress and reduced time to mortality. Water relations were measured on Eucalypt seedlings grown across a CO₂ gradient of 280, 400 and 640 ppm CO₂ concentrations, and ambient and elevated (ambient +4 degrees C) temperatures. Stomatal conductance, transpiration, leaf and soil water potential, leaf area and xylem vulnerability curves for each treatment were compared to determine the effects of CO₂ and temperature on hydraulic architecture. **Results/Conclusions** Carbohydrate, leaf and soil water potential data and xylem vulnerability curves suggest that mortality in the Eucalypt saplings was caused by hydraulic failure rather than carbon starvation. Interestingly, elevated CO₂ did not lead to increased water availability, rather, it caused trees to grow larger, and use more water, which led to faster mortality from drought. As expected, high temperatures increased water stress and reduced time to mortality. Results from this experiment suggest that Eucalypt saplings may increase their growth rates rather than experience water savings under elevated CO₂. These increased growth rates, combined with higher temperatures, suggest that under future climates, these Eucalypts may be at higher risk of drought mortality. Furthermore, we describe the evidence that hydraulic failure, played a stronger role than carbon starvation, causing mortality in a Eucalypt subject to an extreme 60 day drought.

S.24- Concepts in the center of ecological knowledge? Probing a reflexive tool in biological conservation, ecological model building and data collection

S.24-01-0

Reflections on the Conceptual Framework of Ecology - Focusing on the Ecosystem.

Haber, Wolfgang.

Ecology links non-living and living nature, land and water, from global to local scales, and within life's sphere microbes, plants and animals both as individuals and communities, regarding evolutionary aspects - and also links the transformations of all this caused by all kinds of human impacts, extending ecology into economics, technology and socio-cultural sciences. The resulting huge complexity restricts experimental approaches, measurements and quantifications, and requires additionally observational, descriptive and heuristic ways of cognition. As a rather young science, ecology is still at pains to develop and assess strong vital concepts for ensuring its scientific standing as well as matching the high societal demands and expectations of the era of sustainable development. The systems' concept, in the guise of the eco-system, is recognized as the basic and most promising concept capable to link and to integrate, as far as possible, the many various and variable features of the planet's nature which determine all aspects of life as mentioned above. The ecosystem concept can be adapted to the diversity of these aspects by choosing suitable approaches, considered as sub-concepts, focusing e.g. on composition and organization, structure and function (for the ecosystem itself and for systems depending on it), inputs and outputs, energy and matter, information and response, usability and change - even environment and landscape. Examples will be presented and discussed. Of course, the ecosystem is a mental construct, derived from reality and re-projected on it, and cognitively hampered by its abstractness translated into models on the cutting edge between constructivism and positivism. A living organism, even a living cell, is a system, too, but distinct from the ecosystem by their components' non-individuality, and by their 'tangibility'. For many reasons, the discussion about the ecosystem's 'nature' will continue, the more so as humans, having invented its idea, are struggling about its semantics and epistemology - and about whether they are its components or its external users being served by them.

S.24-02-0

Concepts used in conservation biology are ambiguous but don't worry: ambiguities are fruitful!

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Ecologists have been searching for a solid theoretical framework for political advice in nature conservation. Key concepts in this endeavour are 'biodiversity' and 'ecosystem services'. The concepts capture critical ecological aspects on which human sustenance is based. They build upon strong normative undertones by pointing toward human duties to protect the life-support systems of the Earth. Perhaps inevitably, the normative pathos of the concepts flows over to empirical research, bringing along reasonable but not necessarily well-grounded background assumptions. As concepts, both 'biodiversity' and 'ecosystem services' refer to synthetic aspects of ecological systems. Hence, there is more contextual variation and internal heterogeneity in the phenomena covered by the concepts than is often acknowledged. Furthermore, the role of humans as ecological agents is often neglected. My aim is to explore the variability and heterogeneity of the concepts, drawing upon empirical work on urban diversities in southern Finland. As a heuristic perspective, I adopt the notion of 'post-normal science' of Silvio Funtowicz and Jerry Ravetz. Their scheme allows systematic assessment of qualitative uncertainties in scientific policy advice. I consider ambiguities at the conceptual-empirical border-line a strength to be explored and utilized rather than a weakness. Ambiguities imply that there are choices to be made. Specifying the choices offers sites for social learning. Clarification of ambiguities through social deliberation and citizen involvement builds up shared collective understanding of key questions.

S.24-03-O

Should I stay and should I go: correlated plant extinctions over 70 years.

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Loss of connectivity through land conversion increases the sensitivity of plant populations to demographic and environmental stochasticity, potentially causing local disappearances many years after the initial habitat loss. This potential for delayed extinction is referred to as “extinction debt”. Here, we present a unique study in which we consider extinction patterns among populations of 75 declining species. Over a 2500 km² area in South-Western England we use species presence data from 7575 vegetation surveys made in the 1930s - a period before large-scale agricultural intensification. Using GIS and niche modelling we estimate presence likelihoods in 1930s and compare these with the locations of all current populations. Subsequently, via Monte Carlo assignment procedures, we determine the connectivity of both extinct and extant populations in 1930s and 2000. A meta-analysis is employed grouping the results in terms of species traits. In general, the overall extinction debt is relatively low. The current distribution of populations reflects the current connectivity better than that in the 1930s, which suggest that the loss of connectivity has already led to spatially correlated extinctions. However, not for all species: species with lower dispersal capacities but good survival capacities, such as high clonality and long term seed banks, still harbour an extinction debt. An analytical framework as depicted here has clear applied uses. Avoiding unexpected population extinctions is vital in restoration and conservation planning. Using such framework could not only warn of extinction risks but also indicate those species for which restoring the dispersal infrastructure is highly important.

S.24-04-O

Improving ecosystem assessments through conceptual analysis: reflections on the concept “ecosystem functioning”.

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There is high desire for measures that provide information about the overall performance of ecosystems, commonly labeled as “ecosystem functioning”. In spite of the intuitively plausible idea that ecosystem should be preserved in a (properly) functioning state, assessing functioning is far from simple. The reason for this difficulty is not just a lack of empirical data but is to a considerable degree also due to a lack of conceptual clarity. Many different approaches to describe ecosystem functioning exist under different names, such as ecosystem integrity, ecosystem resilience, or the maintenance of ecosystem services. “Ecosystem functioning” is in fact not a clear-cut operationisable concept but describes a cluster of similar concepts pertaining to the idea of the (proper) performance of ecosystems. Operationalising the concept requires analysis both from a perspective of the epistemology (conditions for clearly delimiting the specific meaning), but also from the social sciences, because assessing “ecosystem functioning” implies normative choices on various levels. As such, “ecosystem functioning” is not unique among current concepts of ecology and even more conservation biology, but is only one among an increasing number of important concepts with both descriptive and normative dimensions. The presentation will describe these multiple dimensions of “ecosystem functioning” and provide some guidelines for how conceptual reflections can make it more workable in a systematic manner in practice.

S.24-05-O

Landscapes in fragments, vegetations in fragments: ambiguous interactions between schools in geography and ecology.

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Between 1923 and 1939, a number of geographers and ecologists made the multiple discovery of the “smallest unit of landscape”. The discovery was made from the air, from aerial photographs, depicting the landscape at scales between 1:10.000 and 1:25.000. A fragmented landscape appeared on the photographs, and more clearly on map-like diagrams made on their basis. Soon called ‘ecotopes’, these units of the natural landscape were similar in size to acres and hedgerows in cultured landscapes. Pictures, diagrams and maps established a new heterogeneous vision of the landscape, remarkably different from the holistic ecosystem view of the landscape as prevalent in the Humboldtian traditions in both geography and ecology (and which continued to be dominant through the seventies). The German geographer Carl Troll became the champion of the fragmented vision of the landscape. It was he who coined the word ‘ecotope’ and who, in the 1950s, established a field around him called ‘landscape ecology’. Ies Zonneveld, a Dutch geographer/ ecologist, aligned himself with Troll from early on. Zonneveld tried to forge a link with the so-called phytosociological school in ecology. This school had established a system of smallest units of vegetation: associations (communities) of plants. The associations were to be identified not by visual technologies but by computational means: the counting of all individual plants in a given area and discerning patterns in their spatial distribution. Ultimately, the marriage of these schools was not successful. By comparing them, we aim to explore several dimensions of the baroque heterogeneity of the landscape.

S.24-06-O

Dynamics in the formation of ecological knowledge.

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The starting point for these considerations was the finding that one and the same ecological research object is “seen” in very different ways and that it may be described simultaneously in different theories and conceptions: Organisms in a lake, for example, can be communities, societies or merely assemblages, depending on how strongly their mutual interconnection is seen to be and how necessary their incorporation into their environment. These organisms may have predominantly friendly or indifferent “neighbourly” relations, or they are hostile towards one another; the resources available to the organisms exist in unlimited quantity, or they are described as being permanently scarce; and, finally, organisms themselves can be conceived of principally as a unit of production, as a storage container or as a unit of selection. It has become almost a commonplace observation that ecology is a science being characterized by plurality. It is built of multiple research programmes that are not necessarily related to each other; concepts and theories used in the field might be incommensurable. The study of the semantic, pragmatic and cognitive evolution of concepts contributes to unravel this inevitably entangled setting. In this paper is argued that ecological plurality is shaped in a distinct way and can be conceptualized as a structure consisting of three so-called basic conceptions. The idea of the basic conceptions is to capture different orientations by describing a connection between the philosophy of nature involved in a basic conception and the formation of scientific concepts. The three basic conceptions might be defined as follows: Each of the three characterizes a particular historical field of knowledge that embraces practices and theories about living beings in their environments. Over time, basic conceptions are flexible, they show a dynamic behaviour that is described as an oscillation. This triadic conceptual system suggests a dynamic conceptualization of ecological knowledge and thus to bring forward a likewise historical and epistemic perspective in the building of ecological concepts and models.

S.24-07-O

Review on Point Pattern Analysis (1990-2009): findings and preliminary conclusions.

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Point Pattern Analyses (PPA) are increasingly used in Ecology and have a large variety of applications concerning the dynamics of plant and animal communities, and the occurrence of spatially-explicit events such as tree-fall gaps, fires and bycatch captures. In this study, we have reviewed up to 259 articles regarding Point Pattern Analysis in Biology, Ecology and Forestry during the period 1990-2010, in order to summarize and evaluate all the work done until now with this type of statistical techniques. We have found that most of the articles concern unmarked points-patterns of trees in temperate and wet tropical forest communities. Pattern homogeneity has been generally assumed and problems of “virtual aggregation” (i.e. clumping at all scales) are widespread. Ripley’s $K(t)$ and $L(t)$ raised as the most used functions, and non-accumulative functions have been started to be considered just recently. The difference between the ecological hypotheses (processes) assessed and the statistical analyses (patterns) performed is not always made, and marked-point patterns are usually considered together with independence instead of random-labelling null models. Some analyses are poorly justified and described, and complex ecological questions are broached with relatively simplistic summary statistics and null models. In spite of these pitfalls, our revision strongly shows that PPA are nowadays relatively mature and reliable, and that there is now a wide array of available techniques which could be used to broach a large number of ecological questions. Our study also offers a set of basic guidelines in order to improve future applications.

S.25- Applied Ecology

S.25-01-P

Highways as corridors for plant dispersal in Madrid (central Spain): An aerial survey.

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Complutense University of Madrid. Rey Juan Carlos University. Complutense University of Madrid.

Highways are corridors for passengers and freights, but roadsides (roadcuts and embankments) also provide paths for animal and plant dispersal. In order to act as biological corridors, road verges necessarily have to interact with the surrounding vegetation. This study was conducted to assess the quality of the ecological frontiers crossed by highways in a given area and to explore the potential role of roadsides to convey plant migration from the surrounding vegetation. In this study, we surveyed, on aerial photographs, the roadslopes of the motorway network in the Comunidad de Madrid (Spain). On each roadslope, we evaluated abiotic variables (type, size, aspect, and lithology, among others) as well as the woody vegetation presence. We also assessed surrounding vegetation variables, including plant coverage of different vegetation types and land uses at different distances from the roadslope. Our results reflect the effect of environmental filters on roadside colonization and the determinant role of the surrounding flora on vegetation development at the roadside.

S.25-02-P

Estimating avian predation intensity on caterpillars using artificial prey in temperate oak forests.

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Controlling herbivore insects by insectivorous birds is a major ecosystem service in forest. Nevertheless, most studies on the interaction between birds and herbivore insects have been concentrated on the breeding biology and feeding of nestlings rather than on the way how do birds regulate populations of herbivore insects. Hence, very little is known about the level and mechanism of this natural control. Thus, our main aim was to study bird predation intensity on caterpillars, and to examine the relationship between bird abundance and predation rate, and to investigate the effects of habitat structure variables on predation level. The study was carried out in temperate oak forest (*Quercetum petraeae-cerris*) in the Mátra Mountain in North Hungary. We selected areas with different vegetation structure - half of them were structurally heterogeneous, the others were homogenous. We quantified predation using artificial caterpillars made of green plasticine resembling real caterpillars of geometrid moth, and investigated the abundance of insectivorous birds by point counts at each area. The structural variables examined were tree species richness, size distribution of trees, dead wood and cavity availability, canopy closure and density of shrub and understorey layers. Our preliminary results indicate that the use of artificial caterpillars is an efficient method to estimate predation level, and we expect to find that forest heterogeneity promotes diversity and density of birds and these assemblages are more effective in controlling caterpillars.

S.25-03-P

Wadden Sea Habitats in the German Wadden Sea.

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Habitats, as part of ecosystem are in a continuous shift and permanent change. Relations of inhabiting species and biospheres are not in a balanced equilibrium but rather alternating. Natural or anthropogenic disturbances and interventions cause different reactions. Existent data provide a solid base of knowledge about various areas, which is intensified with every implemented study. The carried out work focuses on the Jade Bay area in the German Wadden Sea. Using the example of the EUNIS classification (European Nature Information System, European Nature Agency) and the MESH project (Mapping European Seabed Habitats, JNCC 2004) a habitat classification for the Jade Bay was implemented. Data on the abiotic parameters bathymetry, median grain size and bed shear stress from different research projects was therefore processed in different ways. After several steps of pre-processing the data were interpolated, ran through a co-kriging or kriging. The outcome grids were reclassified to fit their range to the conditions given in the study area. By performing these steps, the resulting maps are as significant as possible. These three grids were combined afterwards, a marine landscape for the study area was thus developed. The final map shows a total of 194 areas. The units possess the same values for the three variables, which means it identifies areas with more or less the same abiotic conditions. Further work includes macrobenthos communities like Seaweed, *Mytilus edulis*-beds and different macrozoobenthos-communities to verify the results, as well as the validation of the map with aerial photographs.

S.25-04-O

Is control burning an effective management tool to maintain the biodiversity of southern heathlands under the actual scenario of increased nitrogen deposition?

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Heathlands were recognized as important ecosystems with outstanding biodiversity by the European Union Habitats Directive (1992). This has prompted numerous research studies aimed at heathland conservation. Similarly, many heathlands have recently become nature reserves, as for *Calluna vulgaris*-dominated heathlands of the Cantabrian mountain range (NW Spain), which represent its southern-most distribution in western Europe. Traditionally, these heathlands were used for grazing livestock in transhumance pastoral systems. Also burning and cutting were regularly used to maintain pastures. However, these practices have nearly disappeared due to changes in agricultural policies and for socio-economic reasons, making these heathlands scarce. Besides, there has been an increase in the atmospheric deposition of nitrogen in these heathlands. Nitrogen deposition produces a range of effects, including the accumulation of nutrients in the soil and an increase in heath aerial/subterranean ratio. In addition, high N content in heath tissues increases its sensitivity to frost and phytophage attacks. Consequently, the ability of heaths to compete with herbs decreases, favouring plant community substitution and the disappearance of these heathlands. The Heathlands Research Team from the University of León has investigated the effects of global change and common perturbations on the biodiversity, dynamics and functioning of southern *Calluna*-heathlands located in areas of high conservation interest. Results from a five-year manipulative experiment simulating prescribed burning and nitrogen deposition by fertilization with ammonium nitrate will be presented. We will attempt to determine if burning is an adequate management strategy for maintaining high diversity in these heathlands, regarding the vegetation and edaphic arthropod fauna

S.25-05-P

Predicting movement pathways with a-priori least cost models: The reintroduced Asiatic wild ass in Israel.

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Understanding mechanisms affecting animal movement patterns is essential for predicting and conserving movement corridors between population core areas. Successfully reintroduced species offer a unique opportunity to study the effect of different landscape features on population range expansion. Our research goal was to predict the movement pathways of the reintroduced Asiatic wild ass (*Equus hemionus*) between population core areas in the Negev desert by understanding the effect of landscape factors on their movement patterns. We constructed six a-priori least-cost models using GIS techniques. The model outputs were least-cost pathways that took into account different landscape factors (e.g. topography, water sources, vegetation and human made routes). We surveyed dung density using transects along each least-cost pathway, as an index of pathway use. The best least-cost model that predicted the movement pathways was the vegetation coverage model (Kruskal-Wallis, $p=0.013$). However, in order to study long distance movement pathways, we analyzed the least-cost models only with transects in mountain ridges (landscape barriers). The analysis showed that topography was a key factor within landscape barriers. Using all transects of six a-priori models, we fitted the data to GLM models, and selected the best models (AICc). The GLM of vegetation coverage and distance from water sources gave the best fit. We conclude that least-cost models that consider vegetation, water sources and topography could be used to predict long distance movement pathways of wild asses. This information could be integrated into landscape planning strategies that take into account the protection of important habitats for the wild ass.

S.25-06-P

Plant cover effects on microclimate: a feedback loop between roadslope habitability and plant recruitment.

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Microclimate has significant influence on ecological processes such as soil respiration, growth, nutrient cycling, wildlife habitat selection, photosynthesis and plant regeneration. Thus, a detailed description of microclimatic conditions can be decisive in restoration ecology of degraded scenarios by human activities. However, microclimate is, in turn, ruled by plant development through its effects on the albedo, evapotranspiration, and water infiltration, among others. The main goal of the present study was to elucidate whether variations in microclimatic conditions can be explained by changes in vegetation and/or litter cover on roadslope surface. A complementary goal was to develop an objective method using digital photograph for ground cover estimation (vegetation, litter and bare soil). The study area was located in central Spain, Madrid on the M-12 highway in two south-oriented roadcuts. The experimental design incorporated 10 plots (50 x 50 cm) with different ground cover degree, 5 in each roadcut. Several sensors were installed in soil surface to measure: photosynthetically active radiation (PAR), soil temperature, soil moisture, air temperature and relative humidity. Measurements of these parameters were taken every 30 minute for 2 years. Plots were photographed every month for a year. Finally, we chose eCognition Developer (object-based image analysis software) to estimate ground cover due to its reliability and fast processing. In addition, unlike other programs, eCognition Developer calculates vegetation, litter and bare soil cover separately. The results show covariation between vegetation cover, litter and bare soil, and microclimatic parameters, which may influence colonization process by creating new conditions to other individual or species recruitment on roadslopes.

S.25-07-P

Effect of irrigation on height growth of Paulownia tomentosa seedlings.

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Paulownia species, are endemic in China and Japan, which are very fast growing species, have been used for establishing green space and park and inter-cropping with many kinds of crops in many countries. The aim of this study was to investigate on adaptability of Paulownia tomentosa to climatic and edaphic condition of West Azarbayjan. Random experimental design was applied with 3 irrigation level (5, 10 and 15 liter) and 2 irrigation period treatment (3 and 6 days) with 10 replicant. Seedling's height increment was measured at the end of each month during the growth season. The seed germination percentage of Paulownia tomentosa was 10% after 20 days. The height mean of Paulownia tomentosa in different treatment (except for treatment B in which the seedling had been dried) was 25/4 centimeter. The maximum height growth of Paulownia tomentosa in different treatments was occurred in the first month and the seedling height was not considerably raised during the upcoming months. Even though with increasing the irrigation amount, the seedling's height growth was not altered significantly. Keywords: Paulownia tomentosa, plantation, Irrigation, Period, Iran.

S.25-08-O

Acorn predation in fragmented oak forests: Does fragmentation reinforce antagonistic plant-animal interactions?

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Habitat fragmentation is one of the major drivers of global change and a worldwide challenge for biodiversity conservation. In addition to other effects, the reduction of habitat size and isolation may alter mutualistic or antagonistic plant-animal interactions, both relevant for the maintenance of biodiversity and ecosystem services. We used seed predation by the highly specific acorn weevil (*Curculio* sp.) as a study model to investigate whether forest fragmentation may reinforce antagonistic plant-animal interactions. In fragmented oak forests in California and Central Spain, we recorded acorn predation by weevils in all forest patches whatever the abundance of oaks and their degree of isolation. This suggests that fragmentation does not have a negative impact in this highly specialized insect, either because higher dispersal ability than often suggested or a high local resilience to the well-known temporal changes in acorn availability (masting), even in small forest patches. Conversely, from the oak side, the proportion of acorns predated and the number of multi-infested acorns increased with fragmentation: i.e. it was higher in small forest remnants in urban and agricultural areas than in larger forest patches. All these things considered, our results suggest that forest fragmentation may increase the negative outcome for plants of an antagonistic plant-animal interaction such as seed predation. Even though oaks are long lived organisms that may persist as isolated trees or in small forest patches for centuries, acorn predation by weevils may severely constrain their reproductive output and potential expansion to surrounding areas.

S.25-09-P

Herbarium records as a tool for exploring native and alien plant distributions in developing countries.

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In developing countries, herbarium records are at present time the main and most reliable source of information available for plants species distributions. They provide a source of data, which can contribute to a wide range of studies, reducing the cost of collection such information in complementary ways. We assess the current state of alien and native plants distributions in Chile, and discuss the advantages of using herbarium records in developing countries. We calculated number and density of alien and native species recorded at grid cell (10x10km), and testing for spatial autocorrelation of both groups. We assessed sampling effort using numbers of species divided by number of specimens in each cell. Latitude, longitude, altitude, road density and distance to the nearest city, were used to explore the main drivers of species diversity. Finally, latitudinal patterns were evaluated for both groups of species, using number of species divided by the logarithm of the area of each band. From the total grid (7423), more than a fifty percent of the primary cells lacked data (native species 2548; alien species 1203). Alien and native species were positively correlated. Both groups follow the same pattern of accumulation along the latitudinal gradient, demonstrating that follows the same pattern of accumulation. Sampling effort showed native species more collected than alien one. Spatial autocorrelation was low between both groups indicating low levels of aggregation on the data. Alien species showed strong association to urban areas and roadsides, while native species showed a contrasting pattern, correlated with longitude and altitude. Herbarium records have been useful to evaluate alien and native species distribution, as well as the detection of the main driver its distributions. However, lack of a systematic collection effort is clear, and systematic survey is necessary for specific areas of the territory. However in developing countries, lack of funding and organization, difficult the generation of a public inventory of plant species. Acknowledgments: Project ICM 05-002 and PFB-23.

S.25-10-O

Remote sensing data predict indicators of soil functioning in semi-arid steppes, central Spain.

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A substantial part of current research efforts on desertification are devoted to establish monitoring systems to evaluate the status of natural resources and the onset of desertification processes. Methodologies based on ground-collected soil and plant indicators are being increasingly used for this aim because they are affordable yet do not compromise accuracy. Despite their inherent value, these methods have limitations regarding the extent of the area that can be monitored using them. Such limitations can be overcome combining field-based approaches with remote sensing data, which allow the establishment of monitoring programs over large areas. In this article we tested the relationship between a field methodology based on indicators of ecosystem functioning, the landscape function analysis (LFA), and a vegetation index (NDVI) obtained from satellite images of the ASTER sensor using data gathered in *Stipa tenacissima* steppes from Central Spain. LFA uses soil surface indicators to assess the condition of a given ecosystem by producing three numerical indices (stability, infiltration and nutrient cycling) reflecting the status of basic soil functions. We found a significant positive linear relationship between the NDVI, the three LFA indices and some key structural attributes of vegetation related to the cover of perennial plants. Our results indicate that NDVI can be used as a surrogate of ecosystem functioning in semi-arid Mediterranean steppes, and thus can be a helpful index to monitor the functional status of large areas in these ecosystems, and the possible onset of desertification processes

S.25-11-O

The impact of roads on wildlife: understanding the underlying mechanisms.

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Road kills and barrier effects are recognized as major contributors to the global biodiversity crisis but the actual mechanisms behind them are poorly understood. We examined the individual space use responses of two common species, particularly vulnerable to road mortality (barn owls *Tyto alba* and stone martens *Martes foina*) at different scales: home range, habitat selection, individual movements and actual highway crossings. Both species show no sensitivity to highways at the broader scale, apparently being indifferent to the highway when selecting their home ranges, while habitat selection in the vicinity of the highway is explained by the presence of foraging habitat and cover. On the contrary, fine-scale movements are affected by the presence of the highway: the directionality is influenced by the distance to the highway. Indeed, both species show slightly different responses: barn owls increase the probability to move towards the highway in a higher distance than stone marten. Finally, individuals have clear preferences for especially risky locations to cross highways, thus increasing the mortality likelihood. Our findings suggest that managers must reduce sources of attraction, in particular for barn owls, reducing prey alongside the road by frequent mowing in known hotspot segments and make more attractive the existing crossing structures (natural elements inside passages) to encourage safe highway crossings by martens and other carnivores. A better understanding of the mechanisms underlying the effects of roads is critical for an appropriate management of infrastructures.

S.25-12-O

Are exotic and native plant species in diverse Mediterranean dune ecosystems distinguishable based on spectral features of leaf chemistry?

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In southwest Portugal dune ecosystems are severely affected by invasions of trees and shrubs of the genus *Acacia*. Understanding potential ecosystem changes on a landscape scale and their management requires detailed distribution data on the exotics. In order to map the spread of the exotic tree *Acacia longifolia* which acts as an "invasive engineer" in these dune ecosystems we gathered high resolution hyperspectral airborne imagery and LiDAR data. For interpreting the hyperspectral data, it is important to understand the spectral variability of the characteristic species via field spectra analysis. We used an innovative method, the ASD plant probe, which offers a great advantage over the common hand held approach as leaf spectra can be taken in the field almost under laboratory conditions. Field spectra of characteristic shrubs and trees in the stabilized dunes in southwest Portugal were sampled. With the ASD plant probe we took around 1600 measurements of in-situ leaf spectral in only 3 days under laboratory conditions. Based on these field spectra we present a spectral library of the dune vegetation of our study site. The spectral library will be screened for spectral separable groups of species (in particular invasive shrubs), higher taxonomic groups (genus, family etc.) and life forms. In particular, spectra of *A. longifolia* at different sites will be compared with other invasive and native species based on biochemical features that allow distinction of spectra. Furthermore, advantages of the plant probe for gathering clean spectra in comparison to the hand-held approach are highlighted.

S.25-13-O

Biodiversity and Ecosystem Functioning-a case study on macrozoobenthos data from the German Wadden Sea.

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The relationship between species richness and ecosystem processes has been one of the major research topics in ecology for several years now. Many experiments assessing their relationship have been conducted and although there are ample studies stating an effect of biodiversity on ecosystem processes and their rates in laboratory and enclosure experiments, it has been difficult to verify a causal relationship between the two in natural systems due to the many environmental factors that cannot be accounted for or controlled. Our aim was to validate this relationship for natural communities. Therefore, we analysed 11 years of biomass and species abundance data on marine macrozoobenthos communities. The data was collected at 8 permanent sampling stations, located along a transect in the tidal flats between the East Frisian back barrier island Norderney and the coast of Lower Saxony (Germany). Biomass (ash free dry weight) was used as a proxy for productivity and the coefficient of variance (CV) served as a measure for ecosystem stability. Despite high variability in the species abundance and biomass data we found a clear positive correlation between the mean species richness and biomass production for the 8 sampling stations. The correlation between the coefficient of variance and productivity was strongly negative indicating higher stability in the community for sampling stations with more species. These results further supports the often discussed existence of the effect of biodiversity on ecosystem functioning and stability.

S.25-14-P

The effect of nitrogen deposition and precipitation on germination, growth and biomass on *Calluna vulgaris* and *Erica tetralix*.

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Heathlands in the Cantabrian Mountains (NW Spain) are characterized by the dominance of *Calluna vulgaris* and other dwarf ericaceous species, such as *Erica tetralix*. In the Cantabrian mountain range there has been an increase in the atmospheric deposition of nitrogen. This increase is likely to lead to changes in the woody vegetation ability to regenerate after climatic variations such a decrease in the rain into the framework of the global change. The main objective is to analyse the effect of N-deposition and water stress on the germination and growth of *C. vulgaris* and *E. tetralix*. In a greenhouse experiment we test: 1) the effect of nitrogen deposition, 2) the effect water stress or dry conditions and 3) the effect of nitrogen deposition plus dry conditions on the percentage of germination and aerial/root growth and biomass of *Calluna vulgaris* and *Erica tetralix* seedling. We used 50 replicates (pots) of each treatment: *C. vulgaris* control, *C. vulgaris* N-addition, *C. vulgaris* dry conditions, *C. vulgaris* N-addition plus dry conditions; *E. tetralix* control, *E. tetralix* N-addition, *E. tetralix* water stress, *E. tetralix* N-addition plus dry conditions. *Erica tetralix* showed higher percentage of germination in dry conditions than in control. There were no effects of nitrogen addition in the percentage of germination of both species. There were significant effects of nitrogen addition on the aerial growth of *C. vulgaris*, however this differences were not significant in the aerial biomass. *C. vulgaris* root biomass and growth was significant higher after N-addition than in the control.

S.25-15-P

Responses of radial-increment dynamics of *Pinus sylvestris* and *Fagus sylvatica* to thinning and canopy type in a Pyrenean mixed forest.

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The effects of thinning and type of canopy on radial-increment dynamics of *Pinus sylvestris* and *Fagus sylvatica* are being studied in a Pyrenean mixed forest. Three thinning intensities were carried out in March 2009 (T0, T20, T40: 0, 20, 40% reduction in basal area) based on three replicates per treatment and distinguishing pure *P. sylvestris* patches and mixed *P. sylvestris*- *F. sylvatica* patches. Changes in radial increment were studied fortnightly or monthly using manual band dendrometers from April 2009 to December 2010. *P. sylvestris* showed several radial increment peaks in both years with most radial increment occurring between mid April and October (89%), while *F. sylvatica* showed a single annual peak with most radial increment (88%) occurring between mid May and August. The cumulative radial increment in Scots pine increased with thinning intensity in pure patches, particularly during the second year after thinning. However, the cumulative increment of pine and beech in T40 was lower than that of T20 in mixed patches. The cumulative radial increment of pines was reduced by 19%, 3% and 26% in mixed relative to pure patches for T0, T20 and T40, respectively. These reductions in mixed patches suggest that competition for resources with beech translates into growth reduction in Scots pine. However, only moderate thinning (T20) appears to reduce competition, but further research will involve elucidating the mechanisms behind this pattern.

S.25-16-O

Genetic structure and larval competition among the complex of Dacini (Diptera: Tephritidae) attacking cucurbits on La Réunion.

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CIRAD.

In La Réunion, cucurbit crops suffer considerable damage due to fruit fly attacks. A complex of three species (The Melon fly, *Bactrocera cucurbitae*, The Ethiopian fly, *Dacus ciliatus*, and The Indian Ocean fruit fly, *Dacus demmerezi*) coexist in the island and can infest 16 different species of Cucurbitaceae. In order to develop sound and sustainable management methods for these pests, we need to know more about their behavior and ecology. Our goal is to understand i) the pattern of genetic variability and the geographical origin of *B. cucurbitae* colonization processes, ii) the ecological repartition of these pests, iii) the intraspecific and interspecific larval interactions. To study genetic variability and ecological repartition, infested cultivated and wild cucurbits were picked up randomly according to altitude, during summer and winter 2009, and were brought to the laboratory until adult emergence. To measure the effect of larval competition on the survivorship rate of larvae and on the pupal mass, infestations of squash were carried out in the laboratory with L1 larvae according to five levels of infestation. We proved existence of a well-differentiated population of *B. cucurbitae* on La Réunion. Moreover, African continent seems to be the major entry point of invasion. We found that larvae of these species don't have the same strategy faced to an increase of intraspecific larval competition in a same fruit. Larvae of *B. cucurbitae* are able to share resources and maintain a good survivorship whereas for *D. demmerezi* it decreased but the pupal weight of survivors remains high.

S.25-17-P

Loosening environmental filters at the roadside: topsoiling and microtopography manipulations to boost vegetation development on roadcuts.

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Roadslope restoration projects are most often focused on recovering ecosystem structure by sowing and planting. However, little is known about processes underlying vegetation structure on these environments. In that sense, Community Assembly tries to explain how biotic interactions among species or environmental filters drive community development after disturbance. In roadcuts, vegetation recruitment is limited mainly by the lack of suitable abiotic conditions. The aim of the present study is to test how microtopography changes, topsoiling and the application of both treatments influence germination and establishment, and hence community reassemble in roadcuts. In a roadcut located in Torres de la Alameda, Madrid (Spain), three replicates of the different treatments were applied. In each treatment, seed bank and seed rain, seedling density, plant cover, and soil variables were measured. We hypothesize, on the one hand, that roughness achieved by changes in microtopography and topsoiling will enhance safe-site availability. This involves higher retention of seed and hence, higher germination density. On the other hand, modification of soil condition through application of both treatments will increase plant survival which contributes to increase vegetation cover. Likewise, modification of soil conditions would act as a filter to plant establishment which modifies composition of roadcut plant community. Our results showed an effect of topsoiling in establishment success. However, germination does not seem to be affected by the modifications on roadcut surface conditions but it essentially depends on a window of opportunity with favourable environmental conditions like water availability and good temperature.

S.25-18-O

Post-fire salvage logging increases water stress and reduces seedling growth and nutrient uptake of *Pinus pinaster* in the Sierra Nevada, Spain.

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The effect of three post-fire management treatments on the growth and performance of seedlings of a serotinous pine (*Pinus pinaster*) was experimentally analyzed in a Mediterranean mountain range (Sierra Nevada, Spain). Treatments differ in the degree of intervention, ranging from “no intervention” (NI, all trees left standing) to “partial cut plus lopping” (PCL, felling most of the trees, cutting the main branches, and leaving all the biomass in situ), and “salvage logging” (SL, removing the logs and masticating the woody debris). Three years after the fire, a random sample of naturally regenerating young pines was harvested (above-ground biomass) and analyzed for growth, biomass, nutrient content, and leaf $\delta^{13}C$. Total above-ground biomass was similar among treatments, although it tended to be higher in PCL. The height growth and biomass increase during the second and third growing seasons was also higher in PCL or NI treatments, and the lowest in SL. Needle macro and micronutrients concentrations were similar among treatments. Pines from SL also showed higher leaf $\delta^{13}C$ values, indicating more severe water stress in this treatment. Overall, the results support that salvage logging has a detrimental effect of pine growth and performance in relation to treatments where burnt logs and branches are left in situ. This is likely associated with the amelioration of microsite conditions by the presence of remaining wood, which increases soil moisture and nutrient availability through wood decomposition. The results suggest that less aggressive post-fire management practices should be considered for forest restoration.

S.25-19-P

Managing the landscape for passive restoration: How to increase seed dropping by animals in deforested areas.

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The recolonization of deforested lands by zoochorous trees is frequently hampered by the reluctance of animal dispersers to leave the forest and drop seeds in open habitats. Thus, ascertaining the landscape and/or habitat features that condition seed deposition out of forest has become a target to develop passive restoration tools of these deforested areas. For two years (2009-2010), we studied the arrival into pastures of tree seeds dispersed by frugivorous birds (*Turdus* spp.), in a highly-fragmented forest landscape of the Cantabrian Range (N Spain). We related the probability of seed deposition to distance to forest cover and to the spatial configuration of forest cover and fruit availability around the pasture. Distance from forest cover highly influenced the probability of seed arrival to pastures, in fact no seeds were found further than 38 m away from forest edge. The configuration of forest surrounding the pastures was also relevant: seed deposition was more frequent in pastures surrounded by numerous, even small, nearby patches than in pastures with no nearby forests, or even surrounded by big but distant forest patches. Seed arrival was better explained by the configuration of surrounding forest when incorporation the availability of fruits within forest. The effects of distance to forest and forest configuration varied between years, being weaker when the proportion of fruits produced by scattered small forest patches increased. In sum, variegated patterns of forest cover, with numerous and small nearby patches scattered through the landscape, would optimize passive reforestation plans by maximizing seeding into deforested lands.

S.25-20-P

Soil carbon stocks and climate change mitigation potential of grassland ecosystems in Spain.

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Climate change associated with greenhouse gas emissions has important effects on grassland ecosystems. This type of land-use covers approximately two-fifths of land area in Spain (Peninsula and Balearic Islands). An updated preliminary assessment of soil organic carbon (SOC) stock in grasslands showed a high total SOC stock of 0.96Pg C (approximately one quarter of total SOC in Spain) though great differences among grassland types. Mediterranean-type low land grasslands storages 66% of the total SOC stock, due to its large surface area. Perennial grassland of moist mild climate of northwest peninsular Spain contributed to a 26% of total SOC stock, despite its smaller surface area, due to its higher soil carbon content. Climate and land-use changes were potential drivers of SOC stock. Between 1989 and 2008, there was an experimental evidence of average SOC stock increase at a 2.2% annual rate in grasslands of central Spain. This rate did not significantly change after six year from abandonment. Projected scenarios of global change, that considered this SOC stock change rate and a small increase in grassland surface area, indicate that sequestration potential of grasslands would be of 0.11PgC in 2020. Grasslands must be considered as low-cost and effective option for climate change mitigation in Spain.

S.25-21-P

Current distribution of *Procambarus clarkii* in NW Portugal.

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The red swamp crayfish (*Procambarus clarkii*) is an invasive species who was first introduced in the Iberian Peninsula in 1973 in southern Spain. It was then first recorded in Portugal in 1979 and since then has expanded its distribution from south to north by both anthropogenic transport and natural expansion. The majority of this specie's distribution in the peninsula coincides with the distribution of the Mediterranean climate. In 2011, Capinha & Anastácio proposed a predictive map for the whole peninsula based on environmental variables (temperature). The northwest of Portugal is mountainous and is one of the coldest and wettest regions of the country, subject to an Atlantic climate. It also has a gradient of increasing elevation and diminishing temperature, as well as a change in soil type, from west to east. We studied the crayfish's current distribution in 5 river basins in this region and we overlapped it with the potential distribution as predicted by Capinha and Anastácio. *P. clarkii* is still absent from some apparently suitable areas, being present at lower altitudes but almost completely absent in higher altitudes. We modeled the distribution of this species in these river basins based on a set of local variables and we indicate the more vulnerable areas to natural expansion in the near future.

S.25-22-P

Effects of goat's gut passage on seed germination and survival of the native invasive *Retama monosperma* (L.) Boiss.

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Grazing by domestic livestock has historically modelled vegetation communities in coastal dunes, sometimes controlling shrub encroachment or plant invasions. Six female goats of similar size and age were fed with 900 fruits of the leguminous native-invasive shrub, *Retama monosperma*, commonly found in coastal dunes of SW Spain, where the species has displayed invasive behaviour in recent decades. Seeds were retrieved from the goat's dung along 96 hours after ingestion. Both germination and viability rates were tested along with seeds not eaten by the goats. We retrieved 31.6 % of seeds from dung and found that 7.5 % were regurgitated. The major part of seeds from dung was retrieved between 48 h and 96 h after ingestion. The passage through the goat's gut significantly increased seed germination from 5 % (not eaten seeds) to 32.5 - 78.75 %, depending on the time of permanence into the gut. Regurgitated seed showed similar increases in germination rates (36.7 %), also significantly higher than not eaten seeds. No differences on seeds viability was found among experimental cases. The obtained temporal pattern of seed defecation and germination improvement could be used as management tool to control populations of *R. monosperma* in coastal dunes, in order to prevent and control the shrub invasion in undesired areas.

S.25-23-P

The potential of European abandoned landscapes for rewilding.

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For millennia, mankind has shaped the landscapes that it occupies, particularly through agriculture. In Europe, this age-old interaction considerably marked the cultural heritage. Yet European farmland is being abandoned for the past sixty years, especially in remote areas. The loss of the bucolic European landscapes and the resulting opportunities for rewilding is generating controversy for both the scientific community and the public. As a result, rewilding, as an alternative to abandonment, is seldom considered. Here we ask to what extent farmland abandonment can be considered as an opportunity for rewilding in a European context. We first studied the perceptions of both traditional agriculture and wilderness and how they can influence land management policies. We then reviewed present and future trends of agriculture in order to understand how these impact land-uses and biodiversity. Finally, we assessed the value of rewilding for human society from both an economy and ecosystem services perspective. Our review shows the impact of European agriculture on both the landscapes and the way they are perceived. We also illustrate the extent, inexorability and projections of abandonment. Several species could benefit from land abandonment and forest regeneration, including humans through the ecosystem services provided by "wild" landscapes. Rewilding is also an interesting economic option especially in comparison to the subsidies dedicated to maintain populations in remote areas by the European Union. We thus believe that rewilding should be considered as a sustainable landscape management option.

Seedlings survival of native tree species implanted in a stretch of riparian vegetation impacted by cattle in southeastern Brazil.

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The riparian forests represent great importance for promoting benefits to the ecosystem, playing a key role in the protection of natural resources, and are considered as natural ecological corridors. Nevertheless, in Brazil, riparian forests, even protected by law, has been impacted for decades. Ecological restoration thereby become indispensable for the recovery of these environments. The aim of this work was to evaluate the success of restoration plantings of riparian vegetation in an area impacted by cattle, in the Environmental Protection Area of Pandeiros River (Januária, Minas Gerais), by monitoring the survival of seedlings in different recovery models. The monitoring was conducted from January/2010 to February/2011 after the planting of 5,003 seedlings of native species belonging to 28 species and 15 plant families, in an experiment with four plots of 1 ha (50 m x 200 m). Each plot was isolated from cattle, ploughed and added organic matter. The four implanted treatments consisted of seedlings planting in rows between two distances (2 and 4 m) and presence or absence of direct sowing (S), called T2, T2S, T4 and T4S. The percentage of individuals survival per species and between treatments were calculated. Overall survival of seedlings during the study period was high, but the treatment T2S showed higher survival percentage (78.49%), followed by T4 (72.23%), T4S (69.82%) and T2 (63.00%). In the most complex recovery model considered thereby, there was greater survival of seedlings planted, probably due to the decreased grass density. Moreover, some species such as *Anadenanthera colubrina* (Vell.) Brenan (82.67%), *Hymenea* sp. (81.78%) and *Myracrodruon urundeuva* Allemão (87.03%) showed high survival in all treatments. These species may indicate an adaptation to disturbed environments and therefor can be recommended for the recovery of riparian vegetation in the study area. Few studies of vegetation restoration report the seedlings survival, which hinders the comparison of data on the success of planting. Moreover, most projects do not evaluate different models of recovery against the cost (complexity) and benefit (seedlings survival) of the implanted experiment.

S.25-25-O

Prescribed forest burning application may promote production of carbon-based defence metabolites in *Pinus* sp under natural conditions: an indication of stress conditions.

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Prescribed burning is increasingly being used by forest management organisms in Mediterranean ecosystems to preserve forests with economical and/or cultural value. In order to evaluate whether this practice accounts for a stress factor, we studied the production of carbon-based secondary metabolites (terpene and phenolic compounds) in two Mediterranean *Pinus* species. Plants store increasing amounts of these metabolites under abiotic stress conditions as a mean to neutralize cell oxidation resulting from high temperatures. Prescribed burning was applied on *Pinus halepensis* and *P. laricio* under in situ conditions in Mediterranean regions. Three types of plots were used: unburned plots, plots that had been burned once and plots that had been burned twice. *P. halepensis* appeared to be highly sensitive to this practice since terpenes, especially sesquiterpenes, and single flavonoids were significantly promoted by prescribed burning, with the highest concentrations being found when burnings were repeatedly applied within 3 years interval. By contrast, *P. laricio* only presented sporadic increases in the flavonoids index 3 months after application of prescribed fire but these changes were not noticeable anymore either 3 or 4 years following burnings. These results suggest that although *Pinus halepensis* forests are significantly forced to produce increasing amounts of carbon-based secondary defenses in order to cope with the stress they have been submitted to, prescribed burning does not seem to affect tree growth based on preliminary growth results.

S.25-26-O

Railway edges as functional corridors.

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MNHN (Museum National d'Histoire Naturelle). MNHN. MNHN. MNHN.

Across human-made matrices, and especially in urban contexts, where linear patches of habitat are uncommon, railways likely provide connectivity for many species, thus playing an important role in maintaining biodiversity. Although this question is of great importance for landscape management, it has yet to be thoroughly examined. To address this knowledge gap, we predict that if railway edges favour functional connectivity, this phenomenon should attenuate the effect of urbanisation filters on railway plant communities compared with isolated patches. Also, spatially connected communities should be more similar than disconnected communities, and we tested this hypothesis through field sampling and a literature review on the effects of urbanisation found in isolated patches. Our results highlight the potential role of railway edges as corridors in an urban context. This role was not homogeneous across species, and was linked to species mobility. This role seemed to be ensured for highly mobile species and for moderately mobile species when edges were not disrupted by an overpass. Railway edges did not seem to provide connectivity for exotic and invasive species. Functional connectivity was maintained in railway stations, in contrast to overpasses, which interrupted it. As a result we recommend certain actions to improve connectivity and discuss the incorporation of railway edges into green network planning especially in urban landscapes.

S.25-27-P

Impact assessments on the Moor frog - a modelling approach.

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In many parts of Europe, urbanisation and intensive land use have reduced and fragmented the natural habitats of the Moor frog (*Rana arvalis*). Thus, the Moor frog is one of the many species listed in the Annex IV of the EU Habitat Directive. We are developing a computer model, to be used as a standardized and quantitative tool for assessing the possible impacts of habitat changes, such as new road constructions, on protected amphibians. The project is funded by the Danish Road Directorate. The model considers a landscape mosaic of breeding habitat, summer habitat and uninhabitable land. As input we use a GIS-map of the landscape with information on habitat type, habitat quality and altitude. In addition, data on observed frog populations in the survey area are needed. The seasonal migration of adult Moor frogs and the dispersal of juvenile froglets are simulated by means of individual-based modelling, while a population-based model is used for simulating long-term population dynamics. In combination the two types of models generate output on landscape connectivity, migration routes and population viability. Analysing maps without the planned road constructions constitutes a "null-model" against which other scenarios can be compared, making it possible to assess the effect of road projects on landscape connectivity and population dynamics. The effect of mitigation measures, such as new breeding ponds and passages, can be evaluated by incorporating them in the maps, thereby enhancing the utility of the model as a management tool in Environmental Impact Assessments.

S.25-28-P

Soil physicochemical characteristics are affected by thinning and type of canopy in a Pyrenean mixed forest.

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Long-term effects of thinning (T) and type of canopy (C) on soil physicochemical characteristics are being studied in a Pyrenean mixed forest. Three thinning intensities were carried out in 1999 (0, 20, 30% reduction in basal area) and 2009 (0, 20, 40% reduction) in 9 plots (30 x 40 m), with three replicates of each treatment. Within each plot *Pinus sylvestris* (P) patches and mixed (M) patches (*P. sylvestris* and *Fagus sylvatica*) are distinguished. Soil samples were taken from April 2009 to January 2010. Unlike in 2007, generally, the second thinning did not significantly reduce soil nutrient concentrations, probably due to the influence of decomposing branches left on the soil after thinning in March 2009. In accord with this hypothesis, mean ammonium concentration increased 16% in T20 and 21% in T40 relative to T0. However, a consistent decreasing concentration trend when increasing thinning intensity, was observed for some variables. For instance, relative to T0 organic matter, Ca, and Mg decreased in T40 by 10%, 11% and 17%, respectively. Type of canopy had significant effects on organic matter ($P > M$, $p = 0.047$), microbial N ($P > M$, $p = 0.038$) and P ($P < M$, $p = 0.01$). Alteration of nutrient stocks and organic matter in the soil appears to be a progressive process caused mainly by a reduction of litterfall, and by changes in type of canopy as beech cover increases. These changes might affect ecosystem functioning and sustainability of forest practices in the long term.

S.25-29-0

Effects of French grassland measures on farmland bird communities.

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Agri-environment schemes have been implemented to cope with loss of farmland biodiversity due to agricultural intensification during the last decades. However, the efficiency of AES to produce benefits for biodiversity was recently debated. In France, "grassland measures" are presumably the most effective AES because they are most implemented and rather in moderately or low intensive areas. In this study, we evaluated the efficiency of French grassland AES to enhance farmland bird diversity on a national scale, using local abundances of 19 farmland breeding birds (from the French breeding bird survey's data) within 713 small agricultural areas covering France during 2001-2008. We modelled responses of species abundances and species richness to five categories of grassland AES, taking into account characteristics of local production systems. We found that species responded positively to management of landscapes fixed point elements, while abundance responses to other each four categories were more mixed. Extensive grassland management had a significant positive effect on species richness. Species specialization in farmland habitat, species trophic level in community and feeding habits seem to explain abundance responses to some AES categories. Finally, we highlighted patterns of similar or opposite species responses to the different grassland measures. We concluded that diversity of species responses could be explained by differences in their ecological requirements. The same agricultural policies may be favourable for some species but detrimental to others, so they cannot be assumed to bring uniform conservation benefits. Otherwise, these results are an optimistic outcome on potential efficiency of some French AES.

S.25-30-0

The use of species-area relationship models to assess habitat value for biodiversity conservation.

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Land-use changes are currently the main driver of biodiversity change and loss in terrestrial systems. Finding straightforward methods to assess species responses to habitat modification is fundamental to respond to the threats deriving from fast environmental changes. We tested the use of species-area relationships as a tool to investigate the value of native oak forest patches for the conservation of forest plant species in two ecological contexts of habitat modification (i.e., in comparison with forest plantations, and in a countryside landscape, with fragmented oak forest, versus a continuous oak forest) and at three spatial scales (the intra-patch scale, the landscape scale and the regional scale). We used three different species-area relationship models, depending on the ecological context and on the spatial scale: the exponential model, the power model and the countryside model. Diversity patterns of forest species were compared against the patterns of non-forest species for a better assessment of species responses to habitat quality. Results, as suggested by the parameters of species-area relationships, show that forest species are more affected by the characteristics of native forest patches (size and continuity) than non-forest species, and that large patches of oak forest may be particularly important for the conservation of forest species. These findings are relevant for the conservation practice: the use of the adequate species-area relationship models may constitute a straightforward approach to assess habitat value based on the species diversity patterns conveyed by model parameters.

S.25-31-P

Early survival and growth experiments with willow seedlings and cuttings.

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The expansion of Carolina Willow (*Salix carolineana*) is changing community structure and composition in herbaceous wetlands at the Saint John River, Florida, U.S. Understanding factors affecting establishment and growth can guide management aimed to control expansion of invasive species. We assessed survival and growth of seedlings and cuttings under different soil types, nutrient levels, and moisture regimes. The experiment used a cross over design with six soil types crossed with four levels of moisture, and six nutrient levels (replicated 4-8 times). We analyzed variation in survival, change in height, crown diameter, and number of leaves. Seedling survival was lowest without nutrient addition and in sandy and low nutrient peaty soils, particularly when they were in combination. Seedling height and crown diameter growth was highest in the high nutrient peaty soil. Reduced watering and nitrogen addition treatments decreased seedling height growth compared to other watering and nutrient treatments. Nutrients and watering did not affect crown diameter growth. Number of leaves was lowest in sandy soils and reduced watering. There was no effect of any of the study variables on cutting survival. Soil was the only variable that affected cutting growth. Crown diameter growth was lowest for the low nutrient peaty soil. Stem growth and change in number of leaves were lowest for the sandy soil. Seedlings were more sensitive to soil, water and nutrient variation; cutting were more plastic. These results together with prior experiments on seed germination indicated that emphasis should concentrate on control of early stages of colonization.

S.25-32-O

Limiting pest damage to native timber trees in the tropics: the effects of planting schemes on herbivory and potential natural antagonists.

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Planting native timber trees on deforested pastures in the tropics can protect remaining forests and sustain local communities by generating income and restoring degraded land. Tree growth, however, is often impeded by insect herbivores, rendering cost-effective and environmentally friendly pest management strategies essential to assure the success of such reforestation efforts. We investigated bottom-up effects of two new experimental planting schemes, as well as top-down control of insect herbivores by ants and parasitoids. Focusing on the timber tree *Tabebuia rosea* (Bignoniaceae), we quantified herbivore leaf damage and abundance of ants (1) for trees growing in monoculture and 3-species mixture plantations, as well as (2) for trees surrounded by multipurpose companion trees or planted solitarily in silvopastoral systems. We found that the amount and composition of leaf damage differed significantly between planting schemes and between study plots. The most relevant damage was caused by pyralid caterpillars and chrysomelid beetles. Ants were generally not abundant but their activity differed significantly between planting schemes and study plots. Herbivory was not affected by ants, and parasitism was not influenced by planting schemes. Our results demonstrate how innovative planting schemes and small-scale environmental variation affect herbivores and their antagonists. Bottom-up effects appeared to be particularly influential on herbivory in reforestation systems.

S.25-33-P

Nestedness of Species and Patch-community Persistence in artificial ecosystems.

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Disentangling the processes behind ecological patterns requires dealing with complex systems that difficult the evaluation of the results. One possible approach is to use simplified versions of the reality to control for the factors that are not within the scope of the analyses. In this article we used a waterbird community in irrigation ponds as a simplified study system to test the relationship between nestedness and persistence. When a community is nested, assemblages of species-poor patches are subsets of species assemblages in richer patches. Many studies have analysed nestedness, but few have included the temporal variability in the pattern. As community fluctuates temporally, long-term studies might provide extra information about the temporal evolution of these patterns. We related the spatial component of nestedness to the persistence, which is a more integrative measure of the temporal variability. In general, the persistence data presented a nested pattern. The persistence of most of the species was low, and we related it to the characteristics of the ponds. We also studied the relation nestedness-persistence at species and patch level. We predicted that in a perfectly nested system, the species with lowest occurrence rates should be the first ones to disappear in case of disturbance of the system, and therefore should be considered as very sensitive. Our results support this prediction, since we found that species with low occurrence rates were also the less persistent. Accordingly, an important proportion of these species are considered as threatened in Spain. Similarly, waterbird communities in some patches were more sensitive to disturbance than others, showing also low persistence rates. Our results emphasize the importance of the accumulation of effects, since both nestedness and persistence seem to interact and affect the status of species and communities.

S.25-34-O

Predators consuming plant food: consequences for biocontrol.

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Many biocontrol agents consume plant food (e.g. pollen, nectar, sap) in addition to consuming detrimental herbivores. Their potential to sustain themselves on plant food during periods of prey scarcity is considered to increase cropping security, making them ideal for biocontrol. However, the importance of host-plant genotype for plant-feeding predators has not been much studied. We hypothesized that the performance of the plant-feeding predator *Anthocoris nemorum* would be affected by *Salix* genotype. We further hypothesized that the proneness of the predator to consume detrimental herbivores would be affected by host-plant quality. We present data showing that some *Salix* genotypes are sufficient as food for *Anthocoris* even in the absence of animal food. Other *Salix* genotypes were substandard, resulting in 98% predator mortality in the absence of animal food. The proneness of the predators to hunt for animal prey varied in parallel with plant-food quality. *Anthocoris* was an effective biocontrol agent, removing large proportions of the herbivores, on plants of low quality. On high-quality plants *Anthocoris* switched from consuming herbivores to consuming plant sap. The results illustrate the importance of host-plant genotype for the performance and foraging behavior of plant-feeding predators. The results imply that the potential of omnivorous predators to function as biocontrol agents depends on host-plant quality.

S.25-35-P

Responses of microbial catabolic activity and functional diversity to thinning and type of canopy in a Pyrenean mixed forest.

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Universidad Pública de Navarra - Nafarroako Unibertsitate Publikoa. Universidad Pública de Navarra - Nafarroako Unibertsitate Publikoa.

Effects of thinning intensity (T) and type of canopy (C) on microbial carbon utilization patterns are being studied in a mixed forest. Three thinning intensities were carried out in March 2009 (0, 20, 40% reduction) in 9 plots (30 x 40 m), with three replicates of each treatment. Within each plot pure *Pinus sylvestris* (P) patches and mixed (M) patches (*P. sylvestris* and *Fagus sylvatica*) were distinguished. Soil samples (n = 54) were taken in July 2010. Patterns of metabolic response of six substrate carbon guilds were analyzed using BIOLOG EcoPlates, and curves were fitted with a logistic model. Among carbon guilds, only amine-amides and carboxylic acids showed significant treatment effects. Thus, for amine-amides C affected asymptote (k) ($P > M$, $p = 0.001$), but this effect depended on thinning intensity ($T \times C$, $p = 0,0001$) as $P > M$ in T0, but $P = M$ for T20 and T40. The duration of the lag phase (λ) for carboxylic acids was higher ($p = 0.06$) under mixed canopy in T0 and T20, but the opposite pattern was observed in T40. No differences between pure and mixed patches in number of positive wells (i.e., richness) were found for T0 and T20 but they were found for T40 ($M > P$). Globally, these results suggest that thinning and type of canopy affect both microbial catabolic activity of some carbon guilds, and substrate richness.

S.25-36-O

Indices based on soil surface indicators successfully predict soil functioning in semi-arid Mediterranean shrublands and grasslands.

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Land degradation and desertification are some of the main environmental problems in countries with arid, semiarid and dry sub-humid areas. Several methodologies are being developed to assess the conditions of a given ecosystem, and to identify and monitor areas that are already degraded or can be degraded in the future. Those based on indicators occupy a prevalent place when assessing ecosystem functioning and monitoring desertification processes because they are affordable yet do not compromise accuracy. Among them, one of the most popular is the Landscape Function Analysis (LFA), developed in Australia by David Tongway and collaborators. LFA is a monitoring procedure that uses rapidly acquired field-assessed indicators to estimate the biogeochemical functioning of landscapes at the hillslope scale. This method produces three numerical indices: stability, infiltration and nutrient cycling. The aims of this study were to evaluate the relationship between LFA indices and soil variables related to nutrient cycling and soil stability in shrublands and *Stipa tenacissima* steppes from Spain, Morocco and Tunisia. The nutrient cycling index was strongly correlated with soil variables related to microbial activity and nutrient cycling, such as soil pH, soil N and phosphatase and b-glucosidase activities. Strong correlations between the infiltration index and soil compaction were found. The stability index was also significantly correlated with most of the soil variables evaluated. Our results indicate that the LFA indices may be employed as surrogates of soil variables related to nutrient cycling and water infiltration in Mediterranean semi-arid ecosystems. The LFA methodology has an enormous potential to assist land managers and policy makers in the establishment of cost-effective desertification monitoring and restoration programs in semi-arid environments.

S.26- Trophic interactions and ecosystem functioning in real-world landscapes

S.26-01-P

An unified framework for species richness gradients: the adaptive trait continuum.

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CSIC. Museu de Granollers. CREAM. CSIC. CSIC. CSIC.

A comprehensive assessment of demographic and evolutionary dynamics in species richness gradients requires the consideration of several interrelated adaptive traits. Here we examined a suite of traits (phenology, diet breadth, dispersal capacity and wing size) and species-specific habitat variables (thermal breadth tolerance) and tested if they tend to co-vary consistently and predictably, are phylogenetically conserved, and are able to explain species distributions and spatial genetic variation along an altitudinal species-richness gradient for butterflies in Catalonia, Spain. We found that traits co-varied along a main axis ranging from specialist to generalist butterflies. This specialist-generalist continuum was closely associated with the observed eco-evolutionary dynamics along the altitudinal gradient and predicted interspecific differences in patterns of spatial genetic variability (FST and genetic distances), population responses to the impacts of global change, local turnover dynamics, population abundances and distribution ranges. We conclude that the specialist-generalist adaptive trait continuum hypothesis offers an integrative and mechanistic framework for exploring geographical gradients in species richness.

S.26-02-P

Microbial resource limitation in tropical rainforest litter of variable C:N:P stoichiometry.

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In nutrient poor tropical rainforests, litter decomposition is of key importance for nutrient availability to plants and soil microorganisms. In an Amazonian rainforest we tested resource limitation and stoichiometric constraints on leaf litter decomposition and substrate induced respiration (SIR) as a proxy for microbial biomass in leaf litter from six tropical tree species displaying a wide range of C:N:P stoichiometry. With an additional external supply of mineral N and P, and organic C (in the form of cellulose), we evaluated whether non-limiting external resources can compensate for non-optimal litter elemental ratios and whether the initial litter stoichiometry would influence the magnitude of the response of microbial processes to external resource supplies. Leaf litterbags with small and coarse mesh size (to allow or not access of fauna) were placed in a fully factorial CNP fertilization experiment with 5 independent blocks in a natural tropical rainforest at Paracou, French Guiana. After 4 months, litter mass loss and SIR in remaining litter and associated underlying soil were analyzed. Our results show that (i) initial litter stoichiometry had a weak impact on the decomposition and associated microbial biomass of that litter, (ii) litter decomposition and associated microbial biomass were accelerated with combined addition of N and P: this effect was mediated by fauna and especially as initial litter stoichiometry was unfavorable. Our data suggest that litter stoichiometry is an important determinant for how decomposers respond to increased external nutrient supply and that soil microorganisms are co-limited by P and C in this Amazonian rainforest

S.26-03-O

Relative functioning of multiple ecosystem processes along the same landscape gradient.

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Habitat loss and fragmentation lead to changes in species richness and composition which may affect ecosystem functioning. Yet, few studies distinguish between the effects of habitat loss and isolation, or how multiple ecosystem processes may be affected simultaneously. We investigated the effects of variation in cover of woody and open semi-natural habitats and isolation from forest on the relative functioning of pollination, seed predation and insect scavenging in agricultural landscapes. We established 30 sites in grassland locations in the Swiss plateau around Berne. The sites varied independently in their isolation from forest edges, in the percentage of woody habitats and in the percentage of open semi-natural habitats in the surrounding landscape (500 m radius). We experimentally exposed primroses, sunflower seeds and cricket corpses during spring 2008. None of the three studied services was affected by variation in woody or open semi-natural habitat cover. However, the proportion of flowers setting seed was significantly reduced by isolation from forest. Further, seed predation and insect scavenging were significantly lower at isolated sites than at sites connected to woody habitat. This pattern was particularly pronounced for seeds and insect corpses that were enclosed by wire netting and thus inaccessible to vertebrates. Thus, all three studied processes responded quite similarly to the landscape context. The observed small-scale determination of seed set, seed predation and insect scavenging contrasts with larger-scale determination of pollination and insect pest control found in other studies.

S.26-04-P

Thieves or mutualists? pulp feeders enhance endozoochore local recruitment.

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Despite the fact that interspecific interactions are often described as either antagonistic or mutualistic, most of them correspond to a mixture of conflicting and overlapping interests, with the capacity of being positive or negative for the participants. Networks of trophic interactions do not escape to such complexity, since interacting organisms often inflict both positive and negative effects on their partners. For instances, many small-sized birds and mammals are thought to negatively affect fleshy-fruited plants because they ingest the fruit reward (i.e., the pulp) without dispersing seeds (i.e., cheating), leaving them within the risky parental environment and precluding seed ingestion and dispersal by legitimate dispersers. Nonetheless, by consuming part or most of the fruit pulp, such 'pulp thieves' could release seeds from the pericarp inhibitory effect, enhancing germination and, presumably, other plant stages such as seedling survival. We evaluated such largely neglected hypothesis by considering the interaction between *Pyrus bourgaeana* and its pulp thieves (mostly rabbits) in a Mediterranean scrubland. We found that the likelihood of removal by legitimate dispersers of fruits partially eaten by pulp thieves is between 0.5- and 0.9-fold lower than for whole ripe fruits; thus, confirming that thieves impose a significant cost to *P. bourgaeana* in terms of dispersal. Interestingly, however, we experimentally showed that pericarp removal by thieves had a consistent strong positive effect on seed performance (e.g., lower rotting and higher germination percentages) and seedling fate (greater emergence, growth, and survival). The cumulative probability of recruitment for depulped seeds was from 4 to 25 times higher than for seeds in whole ripe fruits. Moreover, contrary to what is usually assumed, the fitness benefits of depulping were not overridden by high propagule mortality beneath fruiting trees or in adverse microhabitats. Thus, pulp feeders can offer an important service to endozoochorous plants and, in many cases, should be considered mutualists rather than thieves. The long-term maintenance of this and other mutualisms despite the strong incidence of exploiters could be explained if exploiters deny one or more services (i.e., cheat) while supplying some subtler but critical services.

S.26-05-O

Functional complementarity drives the effect of bee diversity on pollination.

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It is generally assumed that biodiversity is important for ecosystem functioning, a paradigm of increasing relevance in the face of global environmental change threatening biodiversity. However, studies about diversity effects in pollination, which is an important ecosystem process, are extremely scarce. We set up an experiment with 14 different flowering plant species in 59 flight cages of eight square meters inhabited by different combinations of one to five wild bee species (and controls). Thereby, we are able to test the biodiversity-functioning relationship for pollinator diversity for the first time in a realistic scenario, controlling for abundance and environmental effects. Our study showed a general trend for a positive effect of pollinator diversity on pollination success of a plant community representing a diverse array of plant families and flower types. Focusing on the underlying mechanisms revealed that functional complementarity with respect to weather conditions and flower preferences explains the pollination effect of bee communities much better than the number of species. Plant-pollinator interaction networks were strongly influenced by interactions among bee species further accentuating the effect of realized complementarity in multispecies communities. We conclude that biodiversity-ecosystem functioning relationships are important in pollination systems, but knowledge on biological traits and mechanisms strongly improves the ability to predict pollination value of different bee communities.

S.26-06-O

Functional heterogeneity in a plant-frugivore assemblage conditions resilience of seed dispersal to habitat loss.

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Diversity within networks of trophic interaction is thought to guarantee ecosystem functions. However, little is known on how and why functional heterogeneity within networks affects response diversity, and the resilience of the derived functions, under global change. We studied the effects of functional variability within a plant-frugivore assemblage in terms of resilience of seed dispersal to habitat loss. For three years (2007-2009), we quantified the abundances of tree fleshy-fruits, frugivorous birds (*Turdus* spp.) and dispersed seeds, as well as fruit consumption, along a gradient of forest loss in the Cantabrian Range (N Spain). Both absolute and relative abundances of fruit and bird species changed between years. Total fruit abundance increased from 2007 to 2009, mirroring progressively the distribution of forest cover. All frugivore species changed their diets according to the variations in fruit availability. The spatial distribution of birds was always explained by those of forest cover and fruit abundance. However, fruit tracking by birds was stronger in 2007, when fruits were scarcer and more widespread across the whole fragmented landscape. The seed rain mirrored the distribution of forest cover, but this spatial match was weaker in 2007, mostly due to a larger proportion of seeds being dispersed to non-forest sites. Then, the process of seed dispersal overcame the constraining effects of forest loss thanks to resource tracking by frugivores. The ability of frugivores to change their diet and spatial distribution among years was a source of functional heterogeneity that conditioned the resilience of seed dispersal to habitat loss.

S.26-07-P

Spatial heterogeneity in herbivore-pollinator interactions?

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Herbivores are often the most important environmental variable affecting plant fitness. Especially in the case of a monofagous herbivore this antagonistic relationship may influence pollinator attraction and eventually reproduction of the plant species involved. Spatial heterogeneity in the effects on these life history traits is expected when herbivore occurrence differs between localities. If the plant and herbivore species co-occur the plant will benefit from having defence mechanisms. However, if the herbivore species is absent there is no need to invest in these mechanisms. The study system in which we investigate interactions between herbivory and pollination involves *Cynoglossum officinale*, its pollinators and the specialist root herbivore *Mogulones cruciger*. Earlier research by Prins et al. (1992) showed a 30% reduction in seed production when larvae of this herbivore were present in the roots. In a previous field experiment we found indications of different pollinator foraging behaviour towards plants that were infected and plants that were uninfected by this root herbivore. This year we tested the effects of *M. cruciger* herbivory on plants of different geographical origins with different histories in herbivore presence in a reciprocal genotype x environment experiment. The results of this experiment in which we tested whether pollinator attractive traits, pollinator foraging behaviour and reproductive output differed between genotypes and/or herbivore treatment will be presented.

S.26-08-P

Trophic preferences of the Canarian endemism *Acrostira bellamyi* (ORTHOPTERA: PAMPHAGIDAE).

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The Pamphagidae family (Orthoptera) is represented in the Canary Islands by five endemic species of the genera *Purpuraria* (1) and *Acrostira* (4). Most of these species are found in dry scrub-land dominated by plants of the genus *Euphorbia*, which leaves and shoots they feed on. *Acrostira bellamyi* is endemic to La Gomera and unlike to the rest of Canarian Pamphagids, it also has stable populations in the monteverde forest, a completely different habitat with extremely scarce *Euphorbia* plants and belonging to different species. After developing a study about its diet, we have discovered that *A. bellamyi* feeds on a minimum of 6 plants in the scrub-land and at least on 10 in the monteverde. The most important components of the diet of this grasshopper in the monteverde are *Erica arborea* and *Myrica faya*, and in the scrub-land are *Euphorbia* spp., *Chamaecytisus proliferus* and *Cistus monspeliensis*. We have performed conduct experiments with specimens of *Acrostira bellamyi* in captivity in order to check if its diet is influenced by the abundance of these plants in their habitat. Preliminary results show that among the different plants supplied, the individuals prefer to consume those previously found in lower proportion in their feces in the wild, which are also found at lower densities in the habitat. The low capacity of movement of *Acrostira bellamyi* could be the cause of this apparent inconsistency in their trophic selection. However, an analysis of the nutritional components of the plants used can show that such selection is due to other different reasons.

S.26-09-P

Shorter flowering season in a warmer Arctic.

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Observations of earlier flowering in response to increasing temperatures have been reported across biomes, and such shifts under climate change may potentially uncouple the phenology of plants and pollinators. Phenological responses previously recorded at Zackenberg in high-arctic Greenland have been shown to outpace estimates from lower latitudes, and this could render plant-pollinator interactions particularly vulnerable to phenological uncoupling here. We extend previous analyses by investigating how the spatial variation in flowering phenological responses may alter resource availability to flower visiting insects. Flowering phenology has mostly been studied at the local (square meters) scale even though the pollinators affected by changes to flowering phenology typically are operating at the landscape (hectares to square kilometers) scale. Here, we investigate inter-annual variation in the duration of flowering at both the local and landscape scale in six common flowering plant species using long-term (1996-2009) observational data from Zackenberg. At the local as well as the landscape scale, duration of flowering was related negatively to mean temperature during flowering. In addition, timing of snowmelt had a positive effect on the duration of flowering at the landscape scale in five of six species with an interaction-term between temperature and snowmelt in three species. An aggregation of species into a measure of community-wide duration of flowering was similarly significantly negatively related to temperature during flowering and positively related to timing of snowmelt. During the 14 seasons of observations, mean summer temperatures have increased and timing of snowmelt has advanced leading us to conclude that the current warming at Zackenberg result in shorter flowering seasons. A reduced flowering period could increase the risk that flowering is not occurring when pollinators have their peak resource demand.

S.26-10-O

Multi-specific assemblages of free-living species: the functional value of complex mutualistic networks.

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Plant-animal mutualisms take a tremendous variety of forms in nature and have pervasive consequences for the dynamics and evolution of species. Pollen and seed movement are their primary outcomes, yet we know very little of how highly diversified webs of mutualisms coevolve and what are the consequences of their diversity. Pairwise interactions build up into mega-diverse networks involving dozens and even hundreds of interacting species. These coevolutionary networks are highly heterogeneous, with a core of super-generalists, nested, asymmetric, and contain multiple modules that act as the basic blocks of the complex web. Every interaction mapped in the network has a functional value for the whole system, and the diversity of functional roles embedded generates extensive complexity in the process of plant regeneration and animal population dynamics. Because pollination and seed dispersal (and their counterpart interactions, plant food provisioning) is serviced by multiple species, studies focusing on pairwise interactions in isolation will underestimate levels of biodiversity required to maintain multifunctional networks. Loss of biodiversity in these assemblages entails losses of key functional services. Zooming in the interaction pattern itself and its natural history details, I show how sensitive is the whole network to losses of component species and interactions. The network approach has been useful to unveil patterns that pervasively influence the resilience of these assemblages to extinction of species and interactions. A much needed step is to develop early warning signals of ecosystem "health" or to identify key steps to rebuild functional ecological services.

S.26-11-O

High temporal consistency in food web structure in the face of extreme species turnover.

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How changes in species composition will affect species interactions at different trophic levels and modify food web topology over time? The extent of temporal variation in food web structure remains poorly known. In this study, we examined the structural consistency of 22 local food webs as followed over two consecutive years. The focal food webs consisted of specialist herbivore hosts and their natural enemies on individual oak trees. In the dynamics detected, we searched for effects of species-specific ecological traits (abundance, trophic rank and feeding guild) on population persistence. Local food webs showed high consistency between years in terms of species richness and quantitative structure: food web structure in one year well predicted that in the next year. Nonetheless, the species composition of local food webs changed dramatically over time. Overall, a mean 44% of all species present in a community in 2006 were no longer detected in 2007, whereas 31% of the species encountered in 2007 were new to the site. Species turnover was unevenly distributed among feeding guilds, and increased with a decreasing abundance of the species. Species turnover was reflected in metrics of quantitative food web structure. Overall, this study supports an emerging impression that the structure of natural food webs is relatively consistent over time. This consistency results from the fact that the most common species accounting for quantitatively dominant interactions are least prone to extinction.

S.26-12-P

Integrating context- and stage-dependent effects in studies of frugivorous seed dispersal: an example from south-east Kenya.

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Since a wide array of frugivores jointly shape the seed dispersal kernel of endozoochorously dispersed plants, a variety of factors related to the abiotic and biotic environment determine variation in these. Abiotic conditions are mainly related to structural components of the landscape, biotic ones to those of the dispersing community and their behaviour, and the prevalence of diseases or predators of both plants and their dispersers, all of which can be affected by the landscape context. Yet, studies of landscape effects usually refer to the direct effects of (a)biotic factors in a given location on single processes, often ignoring indirect or cascading effects. We used data from three years of field observations on the dispersal system of an avian dispersed tree in a heavily fragmented Afrotropical forest, to simulate tree recruitment in a dynamic, heterogeneous environment by means of a spatially explicit individual-based model. We show that seed dispersal by frugivorous animals is both stage- and context-dependent. More importantly, our results show that landscape effects extend beyond the effects of fragment size and matrix type per se, and that indirect effects of landscape changes via altered frugivore community as well as combined effects of these three parameters may have important consequences for seed dispersal and plant recruitment. Such a highly dynamic nature of seed dispersal effectiveness may have important implications for the balance among selective pressures driving evolution of seed dispersal features and may change our intuitive ideas on the resilience of an ecosystem.

S.26-13-P

Measuring the effect of natural enemy guild interactions on crop yield and herbivory: what importance of the landscape context?

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Interactions between natural enemies have important consequences for the efficiency of top-down control of herbivore populations. Yet, their response to landscape complexity and the consequences for crop productivity have rarely been studied, particularly in complex, real-life ecosystems involving multiple pest species and enemy guilds. In this study, we measured the effect of experimentally isolated natural enemy guilds on herbivory, arthropod abundance and yield of white cabbage plants *Brassica oleracea* var. *capitata*, in 18 fields of the Haean catchment, South Korea. Fields were managed organically and chosen to vary in landscape context. Seven enclosure treatments were applied in each plot, accounting for potential guild interactions of ground-dwellers, parasitoids, predatory wasps and syrphids, as well as birds. Guild exclusion led to significant differences within and between plots, indicating considerable and complex contribution of natural enemies to pest control and crop yield in such a real-world agroecosystem.

S.26-14-P

Assessing “the soil fertility hypothesis” for gall-inducing insects: a tri-trophic experiment.

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Fernandes and Price (1991) argued that galling insects parasitize less plants growing in nutrient-rich soils than plants in nutrient-poor soils. In poor soils plants grow slowly and concentrate defensive secondary metabolites in their tissues, including galls, enhancing greatly the protection of the galling insects against their natural enemies: galling insects survive better in such plants. I experimentally verified this hypothesis on five gall-inducing aphid species (Aphididae - Fordini) in 18 *Pistacia atlantica* trees: under six I spread each 1kg of N-P-K (20%-20%-20%) in winter 2009 and 2 kg in winter 2010; under six others, 2 kg of N-P-K in winter 2010 only, while the six remaining served as control. In summer 2010, I found that trees in fertilized soil grew more than control, but had not more leaves. The more the soil was fertilized - the less the trees were colonized by *Forda riccobonii*, *Slavum wertheimae* and *Smynthuroides betae* but not by *Geoica* sp. Dissection of galls which were not attacked by natural enemies showed that galls of *S. wertheimae* were less populated when developing on trees in fertilized soil, contrary to the three other aphid species which were not differentially occupied following treatment. Three natural enemies attacked more galls created on trees that grew in fertilized soil: *Monoctonia pistaciaecola*, *Alophia combustella* and *Palumbina guerrini*, while the predator fly *Leucopis* sp. attacked more galls on control trees. In conclusion, we cannot reject the “soil fertility hypothesis” of Fernandes and Price (1991).

S.26-15-P

Plant-animal interactions mediated by a parasitic plant may shape plant communities assemblages.

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Plant-animal interactions may shape plant community assemblages by modulating local biodiversity patterns. Mutualistic relationships between zoochorous plants and the seed-disperser community constitute a first filter strongly affecting seed rain spatial patterns. Post-dispersal processes, such as seed predation, are a second filter that contributes to shaping plant community assemblages. Mistletoe infected trees are doubly attractive for frugivorous-birds acting as a perching and feeding places. We hypothesize that parasitized trees receive more frugivorous visits promoting a disproportionate zoochorous-seed aggregation below their canopy. Such seed accumulation might increase seed-predator's activity reducing the seed abundance in the seed bank which, coupled with other factors, is finally reflected in the bank of recruits. This study was conducted in Sierra de Baza, a Mediterranean mountain range in Southeastern Spain, during 2009 and 2010. We selected 110 trees, of which 55 were parasitized and 55 non-parasitized, as control. We examined frugivorous-birds behavior, diversity and abundance of seeds dispersed into all selected trees, seed predation on the seed bank, and the abundance and diversity of zoochorous-saplings below the canopy. Our results indicate higher frugivorous-birds activity on parasitized trees thus, increasing the diversity and abundance of seeds below their canopy. Seed predation was high, but differences were not significant among parasitized and non-parasitized trees. The differential seed input under parasitized trees together with a non-selective seed predation could cause a differential recruit bank. Thus, mutualistic and antagonistic plant-animal interactions mediated by a parasitic plant may filter establishment dynamics and determine future plant community composition.

S.26-16-P

Stochastic dynamical simulation of a tropical food web.

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We assess and quantify human impact on a river ecosystem. The Kelian river (Borneo) flows through an increasing gradient of human influence. At six locations, we built a food web model and performed stochastic dynamical simulations on the system. Based on sensitivity analysis, we quantified the dynamical, simulated community effect of trophic components. We determined which one has a dominant effect on ecosystem dynamics and which one is mostly sensitive to disturbing others. We also studied the dynamical effects of human presence. Our study represents a step towards systems-based conservation.

S.26-17-O

Dung beetle community structure and ecosystem functioning in fragmented landscapes.

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Dung beetles account for a major ecosystem function: the decomposition of cattle droppings. Working on both regional and national scales, we have previously shown how landscape context affects the structure of dung beetle communities. We have also demonstrated that ecosystem functioning is disproportionately affected by the presence of particular species. To extend these findings and to relate large-scale variation in insect community composition to realized variation in functional rates, we conduct a unique experiment in the summer of 2011. Building on the principle of "citizen science" (i.e. volunteer involvement in the generation of scientific data sets), we involve one hundred youngsters around the Finnish country side in a joint ecological experiment conducted at a nation-wide scale. Targeting cattle farms in their vicinity, participating volunteers manipulate access to replicate dung pats by selected insect taxa, and monitor the resulting effects on dung decomposition. In this talk, I will offer a first glimpse of the outcome of the experiment.

S.26-18-P

Reduced plant species richness decreases network complexity of multitrophic functional group interaction webs.

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Friedrich Schiller Univeristät Jena. Friedrich Schiller Univeristät Jena.

Background/Motivation /Methods unpre In the face of the currently observed rates of species loss it is of great importance to understand the consequences of this loss for the structure and functioning of ecological communities. Plants are at the base of terrestrial food webs and trophic bottom up effects are considered to be very strong. We tested the theoretical prediction that reduced diversity of plant species results in a less complex network structure and reduced interaction diversity of the multitrophic ecological networks basing on them. We used plant biomass and arthropod abundance data from the Jena Experiment and classified the 427 insect and spider species to 13 functional groups using cluster analysis. Using these functional groups we calculated multitrophic functional group interaction webs and compared communities based on differing plant species richness. Results/Conclusion Interaction webs basing on less diverse plant communities showed reduced complexity in terms of connectance as well as diversity and strength of interactions among functional groups. The strongest effects were found for interactions between adjacent trophic levels indicating that these were mainly trophic interactions, while significant interactions among plant and carnivore functional groups were generally rarely present. Reduced interaction diversity has the potential to decrease and therefore destabilize ecosystem processes. We conclude that the loss of basal producer species leads to more simple structured and less linked species assemblages which may have crucial implications for the stability of the whole community.

S.26-19-O

The functional role of animal body mass for structuring seed-dispersal relationships in tropical and temperate ecosystems.

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Mutualistic relationships between plants and their animal seed dispersers are functionally important in many terrestrial ecosystems. In the presented study, we aimed at identifying traits of frugivorous animals that structure seed-dispersal relationships in tropical and temperate ecosystems and tested in particular whether animal body mass is a crucial predictor for the role of frugivore species in seed-dispersal systems. We conducted an in-depth literature survey and extracted 35 quantitative plant-frugivore interaction networks from temperate and tropical systems, in total comprising more than 500 frugivore and 800 plant species. We compiled a trait database for all frugivore species, including species abundance, habitat niche, degree of frugivory, sociality, mobility, and body mass. Animal body mass is a crucial trait in seed-dispersal systems because large-bodied species can disperse seeds over longer distances than small-bodied species, but are usually the first to disappear in disturbed ecosystems. For every single network, we determined the relationship between animal body mass and both complementary specialization (d') and interaction strength, and used a meta-analysis to generalize the findings from single to multiple networks. We hypothesized that large-bodied animals were less specialized on particular fruit species and were functionally more important than small-bodied frugivores. We also tested whether the proposed relationship between the body mass and the functional role of a frugivore species differed between temperate and tropical systems. This study advances our understanding of the factors that structure plant-frugivore networks and that shape seed-dispersal processes in real-world ecosystems.

S.26-20-O

Understanding species' roles and dynamic importance in empirical food webs.

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It is well-known that individual species are not interchangeable within a community. Indeed, the removal of some "keystone" species leads to an atypically large disturbance. Similarly, the web of predator-prey interactions mediates a community's ability to respond to threats such as extinctions or invasive species. It remains unclear, however, how we might link the organization of a single species' interactions to its dynamic importance within its community. In this presentation, we will introduce a novel means to quantify species' roles within their community based on how they and their interactions "fit into" their food web. This structural feature has a clear dynamic analog with which we quantify the importance of species to their community based on how they contribute to food-web robustness. Instead of focusing on keystone species, we can characterize the importance of all species in a community---from the smallest insect to the largest predator. We then analyze the roles of species found in a diverse set of empirical food webs. As expected, some species are keystone species of critical importance to their community while others appear to contribute rather little. We find further that phylogenetically-related species tend to be of similar importance. Intriguingly, this pattern transcends the specifics of the individual food webs: related species from different communities are of similar relative importance to their local communities. Our study provides a framework with which to quantify the importance of species across the tree of life and to assess the community-wide consequences of their extinction.

S.26-21-P

Junipers and mammals traveling together along dirt roads.

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Human linear developments (e.g. roads, firewalls) are usually known by their negative ecological impacts (e.g. habitat fragmentation, road kills), though they could have also other overlooked effects. For example, many frugivorous mammals often move along them delivering seeds in their verges, which could assist in the spread of plant populations. In Doñana National Park (SW Spain), we evaluated whether dirt roads affect the mammal-generated seed rains of two emblematic fleshy-fruited shrubs: the Phoenician juniper (*Juniperus phoenicea*) and the endangered maritime juniper (*Juniperus oxycedrus macrocarpa*). During two falls, we collected mammal feces within two transects (500 m each) along roadsides and other two parallel transects in the scrubland, 60 m away from them. Moreover, we sampled 15 plots (12 m² ea) within each transect counting seedlings, saplings and adults of both junipers. As suspected, the amount of seeds within mammal feces found on the roadsides was much greater than in the scrubland, since 100% of Phoenician juniper seeds (n = 2532) and maritime juniper seeds (n = 96) were on the roadsides. In concordance with the mammal-generated seed rain, adults, saplings and seedlings of Phoenician juniper were 11.0, 3.3 and 3.0 times more abundant on roadsides than in the scrubland, respectively. Although the maritime juniper occurs almost exclusively in the coast line, we found six individuals, all of them associated to roadsides (2 Km away from the coast). Human corridors can thus modify the dispersal service provided by mammals, which has important management and conservation consequences, especially for endangered species.

S.26-22-O

Effects of atmospheric nitrogen deposition on trophic interactions and ecosystem functioning in rear-edge *Calluna vulgaris* heathlands.

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Evidence suggests that, in nutrient-poor *Calluna vulgaris* heathlands, nitrogen (N) deposition due to atmospheric pollution greatly affects heather chemistry, productivity, growth rates and phenology. Also, findings of previous surveys indicate that deposition-induced improvements in host plant quality and availability lead to population increases and altered outbreak dynamics of the monophagous heather beetle (Coleoptera: Chrysomelidae: *Lochmaea suturalis*). Yet, the possible mechanisms by which N inputs may disrupt the plant-herbivore relationship and the implications for the ecosystem processes are not well understood. In a 5-year manipulative experiment, we analysed how N addition (simulated by fertilisation with ammonium nitrate) influenced the performance of heather plants, the dynamics of larval populations of the heather beetle and the activity-density of predatory ground beetles (Coleoptera: Carabidae). We intended to assess the impact of N on the relative strength of bottom-up (host plant quality and quantity) and top-down (predator) forces in regulating the larval populations, at the rear edge (i.e., low-latitude margin) of heathland distribution. Based on prior results, we hypothesised that plants may have primacy over predators influencing the herbivore larval populations. As expected, we recorded positive bottom-up effects on larval abundance, developmental speed and body size, especially in the third year of N addition. However, our results were also compatible with the idea of induced plant resistance: observed changes in plant chemistry and growth during the fourth year of N addition may constitute a delayed response to the increased grazing damage of the previous year, resulting in detrimental effects to the next larval generation.

S.26-23-O

The structure and stability of mutualistic and antagonistic networks.

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Understanding which structures and processes contribute to biodiversity persistence and ecosystem functioning is a major issue for both ecological theory and ecosystem conservation. In natural communities, the organization of interactions between species often presents non-random patterns at the origin of complex network architectures. There is growing evidence that these particular structures can enhance the long-term species coexistence and stability. Moreover, few recent studies have highlighted structural differences between networks depending on the type of ecological interaction involved, i.e. mutualistic or antagonistic. These findings raise the following questions: (i) To what extent does the structure of ecological networks differ depending on the type of interaction considered? (ii) How do these different structures affect ecosystem persistence and stability? (iii) Does the type of ecological interaction involved affect the relationship between network structure and its persistence and stability? We address these questions by using both theoretical approaches with dynamical models of interaction networks, and comparative approaches on empirical datasets describing mutualistic and antagonistic networks

S.26-24-P

Landscape moderation of biodiversity patterns and processes.

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Understanding how landscape characteristics affect local biodiversity patterns and ecological processes is critical for mitigating effects of global environmental change. In this review, we use knowledge gained from human-modified landscapes to suggest the following hypotheses, which we hope will encourage a systematic research approach on the role of landscape composition and configuration in determining the structure of ecological communities, ecosystem functioning and services. (1) The dominance of beta diversity hypothesis: dissimilarity of local communities across the landscape determines the landscape-wide biodiversity and can override negative local effects of habitat fragmentation on biodiversity. (2) The landscape species pool hypothesis: local biodiversity is influenced predominantly by the size of the landscape-wide species pool. (3) The intermediate landscape-complexity hypothesis: effectiveness of local conservation management is highest in structurally simple, rather than in cleared (i.e. extremely simplified) or in complex landscapes. (4) The landscape-moderated insurance hypothesis: landscape complexity provides spatial and temporal insurance, i.e. high resilience and stability of patterns and processes in changing environments. (5) The cross-habitat spillover hypothesis: spillover of energy, resources and organisms across habitats, including between managed and natural ecosystems, influences landscape-wide community structure and associated processes. (6) The landscape-moderated concentration and dilution hypothesis: spatial and temporal changes in landscape composition can cause transient concentration or dilution of populations and functional effects. Shifting our research focus from local to landscape-moderated effects on biodiversity will be critical to developing solutions for future biodiversity and ecosystem service management.

S.26-25-O

Global change and ecosystem functioning: traits, resources, and networks of interactions.

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Global environmental changes affect ecosystem functioning directly, and also indirectly through changes to the diversity and composition of species and functional traits. Changes to the physical environment or the availability of resources may also alter the importance of diversity for ecosystem functioning, or the ability of species to interact with one another in a network context. Various studies demonstrate that the importance of diversity for various ecosystem functions can depend on the amount and distribution of resources. Meanwhile, there is growing evidence that the structure of interaction networks can be altered by environmental changes, with the traits of species potentially determining their ability to interact in altered habitats. A major challenge in understanding the effects of global change on the functioning of ecosystems is the incorporation of species traits and environmental context into network analyses.

S.26-26-P

Can we restore ecosystem functions in a fragmented landscape?

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Due to abandonment and conversion into arable land and forest, only about 10% of the historically managed grasslands in Sweden remain. Much research has focused on the negative effects of habitat fragmentation and loss. Studies have shown that fragmentation of the landscape and simplification of ecosystems can have severe impact on species diversity, abundance and species interactions. Less is known about the consequence for important ecosystem functioning. Despite large investments to restore semi-natural grasslands very few studies have addressed how efficient restoration efforts are, and the recovery of species interactions and ecosystem function following restoration. Especially the effect of landscape context on the efficiency of restoration programs is poorly studied. The overall project aim is to investigate how the geographical isolation of restored grasslands and time since restoration affects the re-colonization of plant and insect populations, and the recovery of plant and insect community composition and plant-pollinator interactions. Species response to restoration measures and the prospect of species recovery following habitat restoration is likely to be dependent on their life-history traits. We will assess if species' probability of re-colonization after habitat restoration can be predicted from their life history traits, and if these traits are different from the traits that predict extinction risk.

S.26-27-P

Seed post-dispersal processes can explain clumped spatial distribution of European mistletoe (*Viscum album* ssp. *austriacum*).

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Mistletoes are parasitic plants that commonly exhibit a clumped spatial distribution pattern that can be explained by seed pre-dispersal and post-dispersal processes. We focus on post-dispersal processes influencing the recruitment success of the European mistletoe (*Viscum album* spp. *austriacum*); a specialized parasite that commonly infects *Pinus* species. The study was conducted in Sierra de Baza, Southeastern Spain, during 2010 and 2011. We evaluated mistletoe-host specificity and the influence of abiotic variables on seed germination and seedling establishment. We executed a first experiment to determine parasite-host specificity, for this, mistletoe seeds were planted on 4 pine species (*Pinus nigra*, *P. sylvestris*, *P. pinaster* and *P. halepensis*) and 3 non-pine species as a control (*Crataegus monogyna*, *Sorbus aria* and *Quercus ilex*). A second experiment was performed to assess the influence of the microhabitat conditions on seed germination and establishment. We sowed mistletoe seeds in different branch positions of the 4 *Pinus* species aforementioned. We measured twig diameter, needle coverage, light availability (hemispheric photography) and temperature (HOBO data loggers) in all sowed positions. Seed predation, germination and establishment was recorded every 40 days up to one year after planting. *Pinus nigra* and *P. sylvestris* were the most frequently parasitized species. However, some *Viscum* seedlings were able to establish on *Quercus ilex*. We also found a differential recruitment success depending on microhabitat conditions. Therefore, species-specific host selection and microhabitat-specific establishment, coupled with non-random pre-dispersal processes, could explain the highly clumped distribution of *V. album* at various spatial scales.

S.27- Conservation Ecology

S.27-01-P

Identifying critical mammals areas for strengthening conservation in the Brazilian Atlantic Forest Biosphere Reserve.

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Herein we identified the geographical location of protected areas critical for strengthening conservation for mammal species in the Brazilian Atlantic Forest Biosphere Reserve by assessing sites of particular importance for mammal diversity using different biodiversity criteria (richness, rarity, vulnerability) and connectivity index. We used the mammal range maps to check whether all mammal species occurring in this reserve were well represented by protected areas of the RBMA. We also used the conservation importance index (CII) to identify the critical areas for mammal conservation across RBMA. Although 95% of mammal species were represented by PAs, most of them had less than 10% of their distribution range protected by PAs. A total of 94 critical areas for mammal conservation -representing 49.60% of the total protected areas were identified. Most of these areas were localized at endangers ecoregions. The connectivity index plays an important role in selecting these areas. We recommend that conservationist and policy makers should identify critical areas to maintaining biodiversity flux among landscapes, enhance the connectivity among PAs to increase biodiversity protection and conservation and use a legal figure protection to regularize the human actions in these areas and then halt mammal loss. The knowledge about the location of critical areas may guide managers and policy makers to develop specific programmes to strengthen mammal biodiversity protection, especially for threatened species.

S.27-02-P

Two strategies but the same result; effects of livestock exclusion on *Lippia graveolens* and *Aeschynomene compacta*.

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In many areas of Central and South America, domestic livestock has been considered to cause degradation of the vegetation, because prior to its introduction, is believed that there was a much lower density of herbivores. However, the examples of plant species with different adaptations to herbivory are manifold. In the semiarid zone of the Biosphere Reserve of Tehuacán-Cuicatlán, in Mexico, the goat grazing is considered as a major threat to vegetation. Nevertheless, many of its vegetation components presents defenses (both chemical and physical) or shows a high capacity for regrowth. In this area, were placed four fences to exclude livestock in order to analyze its effect on two plant species: one abundant and low palatable due to its content of terpenes (*Lippia graveolens* H.B.K.) and other very palatable, equally abundant but smaller in size (*Aeschynomene compacta* Rose). After 2 years of exclusion, we sampled plants of both species inside and outside the exclusions. All plants located in ten 25x2 m transects per each enclosure (5 inside and 5 outside) were measured and counted the number of flowers and fruits. For each plant, the height, the major distance between branches and the distance perpendicular to it were measured, in order to calculated their cover and total surface. Statistical analysis of data shows that in both species of plants within the enclosures has neither a greater size nor greater production of reproductive organs than plants outside. Therefore, we consider that both species are adapted to the presence of herbivores such as goats or cows that usually visit the area not excluded. This data confirm that the presence of domestic herbivores is not necessary harmful for all the plant species in areas with low density of natural herbivores.

S.27-03-O

Massive biodiversity change between the pre- and post-industrial landscapes: a new direct measure using the archaeobotanical record.

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Biodiversity loss in the world's first developed (industrialised) nations is often hidden from objective scrutiny, as the process of species loss outpaced the accumulation of species distributional data. As a new source of historic distributional information, we report exceptional levels of preservation for lichen and bryophyte epiphytes on pre-industrial building materials. These materials, timber and small wood, were locally-sourced into traditional low-status homes in the pre-industrial landscape (prior to 1750) in Southern England. Epiphytes are sensitive to a range of environmental controls (pollution, forest management) and are therefore extremely informative with respect to the known drivers of biodiversity change. Using presence-absence data (timbers), we were able to demonstrate massive biodiversity loss (c. 80% of species) between the pre- and post-industrial periods. Using high resolution community data (small wood) we made a comparison with analogue samples from the present-day landscape to infer in greater detail the pattern and process of species extirpation. Our results highlight a gross disparity in conservation for base-lines, and targets, developed with an exclusive focus on the post-industrial period. By discounting historic biodiversity loss, the regional targets for developed (industrialised) nations may be easy to achieve, and we show that these are concerned with a recalcitrant subset of what was relatively recently (1400-1750 AD) a more rich species assemblage. Thus, while encouraging developing nations to conserve biodiversity, for parity, developed nations might restore extirpated species and remedy environmental degradation which is often hidden from objective scrutiny by history, but which can be resolved by archaeobotany and palaeoecology.

S.27-04-O

The wilder the better in biodiversity conservation? Comparing two prioritization approaches in Peneda-Gerês National Park, Portugal.

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Considering all the political and social resistance that many biodiversity conservation projects encounter, as well as the trade-offs that often need to be made, prioritization of the areas for conservation should be an important item on the scientists' and policy-makers' agenda. We assessed the performance of two methods of prioritizing areas for conservation in the Peneda-Gerês National Park in Northern Portugal. One approach is based on species distribution data and aims at the maximization of the number of rare or vulnerable species. The other approach maps wilderness areas using the presence of human infrastructures as a proxy for the anthropic impact on the landscape, and is based on the idea that less impacted areas are more valuable for conservation. The results of the two approaches are assessed based on the number of species and the percentage of the high-value natural habitats that would be protected under each of the two approaches. We also assess the level of aggregation of the selected areas as higher aggregation makes it easier for the area to be protected. The analysis shows comparable performances between the species-based approach and the wilderness-based approach in terms of the number of species and the high-value habitat cover, although the former gives slightly better results. Among the species indicator, the best results are given by rarity. The level of aggregation is higher for the wilderness approach as the results show a continuum of values for the territory of the park. We conclude that for situations where a particular species or habitat are targeted for conservation, species based approaches make a lot of sense. But considering the limited number of species for which species distribution data exists and the uncertainty related to the minimum area to ensure the conservation of a species, the wilderness approach might offer a simple and effective alternative methodology. The wilderness approach makes use of readily available data and involves a shorter amount of effort. Finally it selects aggregated priority areas and tends to select areas with fewer conflicts with local populations as it prioritizes areas with low human population.

S.27-05-P

Genetic rescue vs. outbreeding depression in *Biscutella neustriaca*.

courquin, Betty. Piquot, Yves. hautekeete, Nina. Vekemans, Xavier. Collin, Carine.

laboratoire Gepv, Lille1. laboratoire Gepv, Lille1. laboratoire Gepv, Lille1. laboratoire Gepv, Lille1.

The maintenance and the increase of genetic diversity of threatened populations are described as a priority in conservation programs. Intentional hybridization may be a successful means of limiting genetic erosion, preserving evolutionary potential and curing inbreeding depression, but some questions also arise about the success of introduced genotypes in their new environment and how the existing populations will be affected by the introduction of these new genes into the local pool. Particularly, intentional hybridization might make the situation worse by inducing outbreeding depression. There appear to be two main causes for outbreeding depression, namely (i) the loss of local adaptation and (ii) the loss of intrinsic co-adaptation. The first effect, the environmental component, is likely to increase with increasing environmental differences between the parental origins whereas the second one, the physiological component (also referred to as epistasis) is more likely to increase with genetic distances. An optimal crossing distance is supposed to exist between plant populations if inbreeding and outbreeding depression operate simultaneously. One of the simplest potential indicators of the success or failure of hybridization may be the geographical distance between parental populations. In sessile organisms, genetic distance may be expected to correlate with geographical distance because of both neutral processes and natural selection, resulting in an optimal crossing distance. But local habitat heterogeneity may lead to variable selective pressures (abiotic and biotic) across space, making geographical distance an equivocal indicator, at least for the environmental component of outbreeding depression. So which kind of distances should we use in that case: genetic distances computed from quantitative characters, or ecological distances? Ultimately, the scale and the nature of an “optimal crossing distance” remain largely unknown and consequences of mixing populations of endangered or threatened species have not been adequately documented. Here, we address the consequences of intentional hybridization on progeny fitness in 5 populations of the threatened *Biscutella neustriaca* (Brassicaceae). Through experimental pollinations and growth of progeny in controlled environment and common garden experiments, we investigate the consequences of increased distances on progeny fitness. We aim to answer the following main questions: Is there an optimal crossing distance between the populations? Which kind of distances better predicts the success or the failure of intentional hybridization: i.e. neutral genetic distance between crossed populations, genetic distance estimated by quantitative characters, ecological distances or geographical distances?

S.27-06-P

Grazing sheep negatively affect the breeding success of a ground-breeding passerine of conservation concern.

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Sheep grazing is an important management tool in heathland conservation and restoration. Recent findings showed that low-density grazing is generally beneficial for breeding birds. Here however, we report for the first time that the presence of grazing sheep negatively affects the breeding success of a multi-brooded ground-breeding passerine of international conservation concern, the Woodlark *Lullula arborea*. We searched for Woodlark nests in a 4500 ha cross-border heathland in northern Belgium and the Netherlands during the breeding season of 2010. We selected six 250 ha fenced plots, three of which were stocked with equal numbers of sheep in early May, thus covering the second brood period. The other three plots remained ungrazed during the entire breeding season. We found that both nesting success and the proportion of survived offspring was lower in the plots where gazers were present. Nesting success was lower for the second brood while the proportion of fledged offspring did not differ between first and second brood in the ungrazed plots but was clearly lower for the second brood in the plots with grazers. Our study has important implications for conservation management planning. It shows that (low-density) grazing management might hamper viable population development of ground-breeding heathland birds, of which several are listed on the Annex I of the European Birds Directive. Possible solutions might be to postpone the introduction of grazers until the breeding season has finished or to work with a tended herd and avoid the known nest localities during the breeding period.

S.27-07-P

Conservation of an endemic mammal, *Lepus corsicanus*, in mediterranean man made habitat.

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Italian hare, *Lepus corsicanus*, is an endemic mammal species of southern Italy, who lived in a mediterranea landscape, characterized by a patchiness of natural and man-made habitats. The landscape is related to the grazing of sheep, cows and goats, and to mountain cultivations of wheat, legumes and fodders; these activities produced secondary grasslands. During the last 50 years, the abandon of these activities, due to the lack of competitiveness in a global market and the modification of style of life, has determined the recolonization of natural vegetation; so secondary grasslands become threatened and Italian hare too. In the National Park of Cilento and Vallo di Diano a conservation plan is started allowing the protection of Italic hare considering the management of its man made habitat and related economies. Action plan deals with: 1. Maintenance of scrubs and woods patches in the landscape; 2. Direct protection of man made habitats by modifications; 3. Increasing the competitiveness of economy based to traditional activities, in order to maintain cows on the secondary grasslands; 4. Allowing participation of farmers and shepherds in monitoring and conservation programs; 5. Involving students in conservation activities.

S.27-08-O

Integrating ecological research to conservation policy and practice: wild bees and farmland wildlife.

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We have developed a process of compiling ecological research results in a way that is accessible and relevant to conservation policy and practice. The process provides a framework for two-way communication between researchers and end-users of research. It should ultimately enable conservation to become consistently evidence-based. Here, we demonstrate the approach in two areas of strong interest for European policymakers: wild bee conservation and biodiversity conservation on farmland. First we compile a list of possible interventions to benefit a habitat or species group (farmland or wild bees, for example). The list is built collaboratively, with involvement from experts and practising conservationists. Then we review the scientific evidence for each intervention and summarise the information. For wild bees in the UK there were 54 interventions. For European farmland there were 119. We ask conservation policymakers and practitioners to score the interventions according to importance. We have consulted representatives of wildlife campaign groups, national and regional Government officials, farmers with an interest in wildlife conservation, farm advisers, ecological consultants and academics. Relating their scores to a quantitative measure of the state of scientific knowledge allows us to set research priorities in areas of high importance to end users where there is little current knowledge. We can also assess how knowledge relevant to conservation policy and practice accumulates with increasing research effort. In the case of wild bee conservation, the results reveal a bias towards landscape-scale conservation in policy and practice, and a mismatch between research and questions of importance to research users.

S.27-09-P

Impact of recreational activities on species diversity in the forest parks.

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In this study the impact of land use change of forest areas to forest parks on vegetation and soil of Parisan's park where is covered by Persian Oak (*Quercus persica*) (Ilam Province, Iran) was evaluated. For this regard, three zones included without recreation, average recreation and intensive recreation were chosen. To data collection, in each zone 20 sample plots in a systematic random design (100 m * 150 m) were established. Herbaceous species type and the percentage of their coverage by using of 4 micro-plots (1.5 m²) for each sample plot were recorded. At each sample, three soil samples were taken of 0-30 cm depth level and a compound sample was transferred to soil laboratory. Cluster analysis and Detrended Correspondence analysis were used to better understanding of the vegetation structure and to avoid subjective classification and to indicate the major gradient of variation within the vegetation structure of 3 areas. Canonical Correspondence analysis was applied to determine important soil variables of 3 areas. Results showed that the vegetation of the area with intensive recreation was perfectly different from that of the area with no recreation and average recreation and was classified in the distinctive group. 42, 20, 18 plant species were recorded in without recreation zone, average recreation zone and intensive recreation zone respectively. Total nitrogen, organic carbon, phosphorus and exchangeable potassium and litter depth were decreased in the intensive recreation area but pH and bulk density were increased in this area. Key Words: Recreation, Species Diversity, Forest park, Iran.

S.27-10-P

Water use in a coastal dune system: effect of a native-invasive species over a threatened endemism.

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Retama monosperma (L.) Boiss. is a native species that has displayed invasive behaviour by undergoing rapid recent expansion in some regions within its natural area of distribution (Muñoz Vallés et al., 2005; Valdés et al., 2007). In El Rompido Spit sandy dunes (Huelva, SW Spain), where the study was conducted, this species has colonized the inland dunes throughout the last eight decades to currently occupy almost the entire study area. *Thymus carnosus* Boiss. is an endemic shrub growing in sand dune coastal systems of SW Iberian Peninsula, in danger of extinction (CR, IUCN) since 2005. The aim of the study was to analyse the seasonal water use dynamic among *R. monosperma* and *T. carnosus*. Ten isolated and ten beneath *Retama* *Thymus* plants were marked, and the following variables were seasonally measured: xylem water isotopic composition to determine water sources ($\delta^{18}O$), predawn and midday stem water potential (ψ) in order to know plant water status, and free leaf proline content as stress indicator. Results showed a marked seasonality, mainly in water potential and proline. In late summer and spring, *Thymus* under *Retama* displayed significantly lower water potential and higher leaf proline content than isolated *Thymus*. Seasonal water sources showed different patterns depending on the *Thymus* situation: isolated ones as well as *Retama* plants always matched groundwater, whereas *Thymus* under *Retama* changed among rainfall, ground and soil water, showing a season-dependent pattern.

S.27-11-P

Long-term vegetation responses to different goat grazing intensities: a case study from Tenerife (Canary Islands).

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In an attempt to determine if current goat grazing is an activity compatible with the conservation of traditionally managed landscapes, we evaluated the species composition, diversity and structure across a grazing gradient (heavy grazing, light grazing and long-term abandonment) for plants in a Canarian Rural Park. Our objective was to determine if these characteristics were being negatively affected by grazing pressure or if virtually no differences exist between managed and abandoned ecosystems. Management regimes were found to overlap considerably in ordination space; however changes in the plant species composition gradient were significantly related with stocking rate. The largest difference between regimes was caused by a higher abundance of advanced-stage representative vegetation growing in abandoned areas. The frequency of shrubs, perennial forbs, annual grasses, annual legumes and endemic species were significantly affected by the grazing regime, but no differences were detected between abandoned and lightly grazed areas. Grazing management did not affect species richness, diversity or frequency of bare soil. We conclude that traditional light grazing management appears to be sustainable for traditionally managed ecosystems. However, controlling grazing intensity could be necessary to avoid negative effects on the vegetation, such as a decrease in shrub species and, in particular, a decline in the frequency of endemic species (e.g., *Aeonium ciliatum*, *A. urbicum*, *Sonchus acaulis*, *Teline canariensis*) detected under high stocking rates.

S.27-12-P

Population trend and demographic modelling of a relict capercaillie population using long-term monitoring data.

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ETIS Montes. UPM. IMEDEA-CSIC. Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Ambient. Generalitat de Catalunya. Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Ambient. Generalitat de Catalunya. Subdirección General de Biodiversidad. Ministerio de Medio Ambiente y Medio Rural y Marino. ETIS Montes. UPM.

Capercaillie (*Tetrao urogallus*) populations are declining in most of its distribution area but their regressive trends are difficult to quantify. In addition, the decline is often caused by several interacting causes, whose effects are not easy to disentangle. Therefore, wildlife authorities are forced to make conservation decisions based on poor evidence. Iberian capercaillie populations have been traditionally estimated on the basis of the number of males counted in leks. The actual number of females cannot be estimated using that method. Summer censuses have been carried out in the Catalanian Pyrenees to estimate breeding parameters, since the late 1980s. Importantly, these censuses let also to derive the density of adult birds, but this issue has not been addressed so far. We have compiled, filtered and standardized data coming from capercaillie summer censuses, and calculated bird densities throughout the period 1989-2010. For the first time, we analyze the trend of the population in the Spanish Pyrenees on the basis of those densities. We also show the first modeling exercise of the dynamics of a capercaillie population in southern Europe. Our modelling approach used a stage-structured matrix population model, with our own productivity estimates and survival rates from the literature, accounting for environmental stochasticity. The population was found to be declining at an annual rate of 4% for the last 20 years (deterministic $\lambda=0.96$; stochastic $\lambda=0.96\pm 0.06$). Sensitivity analysis showed that recruitment (i.e. productivity+fledgling survival), rather than adult survival, was the demographic parameter which should be increased by management, because our values of adult survival were already in the upper limits provided by the literature. Our results show that the species needs to be effectively managed to reverse this declining trend, and to ensure long-term the persistence of this relict population.

S.27-13-P

Habitat management as a generalized tool to boost wild rabbit populations in the Iberian peninsula: a cost-effectiveness analysis.

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The wild rabbit is a protected species under IUCN criteria in Spain and Portugal. Many of its populations are still declining, highlighting the need to implement management strategies to prevent further reduction. Habitat management is one of such strategies with generalized use. Notwithstanding, there is little knowledge about its true influence on rabbit populations. The main goal of this study was to assess the frequency of use and cost-effectiveness of habitat management for wild rabbit populations in Iberia, to discuss its actual effectiveness and to what scale should it be implemented. For that, we conducted a thorough literature review and used this information to: 1) estimate frequency of use of habitat management techniques; 2) evaluate the relative and absolute effectiveness of habitat management; 3) assess the economical implications of its application. Our results suggest that over 60% of hunting estates used at least one habitat management technique, being the most common the creation of pastures and/or crop plantation. Relative effectiveness of these measures is high, although our results fail to find any correlation between this parameter and biologically and/or economically meaningful rabbit densities (e.g. to support a breeding population of endangered predators and/or medium-high rabbit hunting yields). We did not find any clear relationship between the cost and effectiveness of the measures applied, suggesting that other factors are crucial for habitat management success. We conclude that rabbit management strategies in the Iberian Peninsula have to consider improved and up-scaled protocols of habitat management to mitigate threats and promote its recuperation.

S.27-14-P

Fouling of a crustacean invader (*Procambarus clarkii*) by a molluscan invader (*Dreissena polymorpha*).

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Dispersal and colonization of the invasive zebra mussel *Dreissena polymorpha* are facilitated by its life cycle, characterized by both the existence of planktonic stages and the ability to abandon byssum at any time and crawl over the substratum to find new sites. The colonization of crayfish bodies by *D. polymorpha* has been only occasionally recorded. Unionid mussels are other invertebrates that have been subject to a similar colonization: impaired movement and decreased energy reserves have been implicated as probable causes of their mortality after colonization by *D. polymorpha*, along with food competition with this species. The consequences of a similar impact on crayfish remain still speculative. In this work, we test the ability of adult *D. polymorpha* and veliger larvae to colonize the red swamp crayfish *Procambarus clarkii*, in the presence of other substrates and with a strong limitation of preferred substrates.

S.27-15-O

Occurrence patterns of epiphytic lichens are explained by the historical landscape at a small spatial and a large temporal scale.

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Habitat loss is a major cause of species decline and extinction. After habitat loss there will usually be a delayed response in species occurrence. Occurrences of species that are not in equilibrium with the current landscape will be better explained by the historical landscape configuration. We investigate the importance of connectivity to present and past dispersal sources in explaining the occurrence of five epiphytic lichens associated with old oaks, while controlling for tree and environmental characteristics. We use oak surveys from 1830 and 2009 in a Swedish landscape where the number of oaks has declined drastically during the last two centuries. We also compare species frequencies in our study area with the frequencies in an area with a higher current oak density. Our results showed that most species' occurrence patterns were best explained by the historical oak densities on a rather small spatial scale. Species frequencies were higher in the area with a high oak density. This study shows that epiphytic lichens are not in equilibrium with the landscape 180 years after the most drastic habitat decline, due to their slow colonisation-extinction dynamics. Continuity of high old oak densities seems to be important for lichen persistence and their presence may therefore indicate stands of high conservation value. For long-term persistence of epiphytes associated with old trees, conservation efforts should focus on protecting and restoring stands with a rich epiphyte flora and promote tree regeneration in these stands and in their closest vicinity.

S.27-16-P

Extremely low genetic diversity and high genetic differentiation in an endangered endemic plant (*Omphalodes littoralis* Lehm. spp *gallaecica* Lainz).

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Habitat fragmentation and inbreeding can lower genetic diversity and, as a consequence, have an impact on the ability of species to cope with environmental stochasticity. In NorthWest Spain, coastal sand dunes are organized into isolated enclaves scattered along the shoreline, an arrangement that may favor the fragmentation and isolation of their endemic organisms. The ephemeral, autogamic plant *Omphalodes littoralis* spp *gallaecica* provides a good example of the latter. With a very narrow distribution range (it is known to occur only along

S.27-17-0

Assessing the dynamics of geographic range contraction.

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Doñana Biological Station CSIC. Doñana Biological Station CSIC. Doñana Biological Station CSIC.

Extinction is the final step in a species decline process which starts with range contraction due to population extirpation. Therefore, understanding the dynamics of the range contraction process is an important issue in conservation biology. Up to date two different hypotheses have been proposed to explain the dynamics of contraction: the demographic hypothesis and the contagion hypothesis. The former is derived from an assumption of greater population abundance in the center of the distribution leading to a prediction that extirpation will occur from the outside of the range inwards with the last populations located in the core of the historical range. The contagion hypothesis, assumes that the factors affecting species extinction follow a directional cline starting on the border of the range and extending like a contagion. As a result this hypothesis predicts that the last population will be located in the farthest point of where extirpation began, and thus in a border of the historical range. We conducted a literature review which suggests neither of these two hypotheses can accurately describe the dynamics of range contraction. We propose an alternative, the resistance-area hypothesis. This hypothesis assumes that extirpation is less probable in areas of difficult access to humans, so it predicts that the last remaining population will be in isolated or remote areas of the historical range. We evaluated the three different hypotheses using historical and present range data for more than 400 species of mammals, birds, amphibians and reptiles, distributed across four continents.

S.27-18-0

Does soil seed bank diversity limit post-fire regeneration in small remnants of long-unburnt mallee vegetation?

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Flinders University. Flinders University. Flinders University.

The Kangaroo Island Eastern Plains Fire Trial is a project run by the Department of Environment & Natural Resources which is investigating regeneration by burning of *Eucalyptus cneorifolia* dominated mallee on Kangaroo Island in South Australia. Thirty-eight small .

S.27-19-P

Floristic and structural variations of the tree community in relation to soil properties in the riparian vegetation of the Pandeiros River in the Brazilian semi-arid were studied.

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This study aimed to describe the structure of the tree component of an area of riparian vegetation of the Pandeiros River (Januária, MG) and to evaluate the influence of soil on the distribution of species. The survey was conducted in 70 plots of 100 m² parallel to the riverbank, distributed into four sectors. Five classes of soil were found in the four sectors and 759 individuals belonging to 31 families and 107 species sampled. The families of greatest wealth of species are Fabaceae, Malvaceae, Myrtaceae, Apocynaceae, Bignoniaceae and Combretaceae. *Hirtella gracilipes*, *Xylopia aromatica*, *Averrhoidium gardnerianum*, *Tapirira guianensis*, *Hymenaea eryogyne* and *Byrsonima pachyphylla* were the most abundant species, and *H. eryogyne*, *T. guianensis*, and *Copaifera langsdorffii* presented the greatest values of importance. The obtained results suggest that in addition to variables: CA, K, MO, and RI, which showed strong correlations with some species, the organization of the plots in three groups is also related to the soil types found in the sectors. So, the heterogeneity of the plant formations nearby and the wide variety of soils in the study area determine the formation of a quite unique riparian forest with the occurrence of interactions among species unique to riparian forests, dry forests and savannah. Keywords: Riparian vegetation. Caatinga. Cerrado. Floristic composition. Phytosociology, Environmental heterogeneity.

S.27-20-P

Is the "Plant Micro Reserve" an adequate form of protection to conserve tree species? *Betula pendula* subsp. *fontqueri* in "La Garganta de los Caballeros" (Ávila).

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In 1994 the Plant Micro-Reserves Programme was created in the Region of Valencia (Anonymous, 1994) with the aim of protecting threatened vegetation. Its originality lies in adapting the size of "Natural Protected Area" to the size of the protected species. First experiences focused in small populations of herbaceous taxa. Recently, the Castilla y Leon region has adopted this form of protection; they set the maximum extension of the Plant Micro-Reserves to 200 hectares (Anonymous, 2007). With these conditions, we consider the implementation of this management tool to protect a population of a tree species: *Betula pendula* subsp. *fontqueri*. This birch is an endemic Iberian-North African with fragmented and scattered distribution area and limited number of individuals. In "La Garganta de los Caballeros" (Ávila), this tree population lives on a north-facing slope on rock outcrops and scree. Accompanying the birch are other interesting species, many of them are rare and remnant species of the Spanish Central System: *Populus tremula*, *Streptopus amplexifolius*, *Adenostyles alliariae*, *Veratrum album*, *Phyteuma pyrenaicum*. (Sardinero, 2004, Sánchez del Alamo, 2010) This proposal of the Plant Micro-Reserve (Martínez et al. 2010 inéd.) was carried out with the extension and has some advantages in the field of conservation. Firstly, it applies a protective management tool on the target species. Secondly, this species could act as a protective umbrella for other equally interesting relict and possibly threatened populations. Protecting a tree species like this, give managers a tool that protects an ecosystem and the ultimate objective should have a conservation policy.

S.27-21-P

Not always as good as it seems: Forecasting the future impact of extensive livestock farming on habitat suitability for an endangered vulture.

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Despite livestock production being a major driver of global environmental change, some extensive livestock practises have proved to be compatible with biodiversity conservation. These sustainable systems are currently pressed by land-use change, either by abandonment or intensification. The way in which extensive farming will change in response to future socioeconomic and political scenarios and thus affect biodiversity conservation is uncertain. The Egyptian vulture *Neophron percnopterus* is a globally endangered vulture that, in most of its range, is heavily linked to food resources provided by livestock, especially extensive sheep and goat farming. We analyse the role of extensive livestock in shaping habitat suitability for the Egyptian vulture in northwestern Spain, and how changes in livestock abundance, integrated into different socioeconomic scenarios, would modify species' habitat by 2020 and 2050. The most important environmental variables in shaping habitat suitability for the Egyptian vulture were those related with cliff availability and extensive sheep and goat farming at low relative densities. The surface of suitable habitat for the species could decrease up to 49% by 2020 and 74% by 2050 under both global and local economic scenarios and also under an environmental future globally oriented. In contrast, a regional, environmentally oriented scenario could increase habitat suitability (i.e. 9% by 2020 and 47% by 2050). Our results show that extensive rearing of sheep and goat markedly determines the habitat suitability for a globally endangered scavenger. Future scenarios of changes in extensive livestock numbers, under different socioeconomic contexts, would cause profound and contrasting modifications in the species' habitat. Wildlife managers should carefully define the type and stocking rate of extensive livestock to improve both management and conservation of the livestock-dependent biodiversity. Our approach can help to better design these management strategies for conservation and sustainability targets.

S.27-22-P

Ecological zoning based on a hierarchical analysis of landscape variation tendencies: integrating ecological and cultural inheritance.

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The concept of ecological landscape should be considered from a holistic perspective based on consideration of the hierarchical structure of the landscape levels. Many methods of landscape classification and evaluation are based on this reference system, which enables landscape units to be differentiated, these being structured in a hierarchical and spatial manner. Thus, the use of these methods allows detection of landscape variation trends and spatially related groups of variables, as well as identification of spatial sectors, which present homogeneous biophysical and cultural characteristics at different scales. These units are used as a reference for land planning and management. This approach, based on the ecological concept of hierarchical organization of natural systems, was applied in the ecological zoning of Fuerteventura (Canary Islands, Spain) as part of a series of basic studies for the establishment of a National Park on the island. The procedure was based upon sequential multivariate analyses and the variation trends obtained were used as synthetic descriptors of the landscape at different integrated spatial scales (climatic, geomorphological, hydrological, biological and cultural). Spatial representation of the hierarchical analyses provides us with integrated maps which represent the main variation tendencies in the landscape. The procedure developed helps managers and decision-makers to understand the interaction between ecological characteristics and human activities reflected in the traditional landscape and therefore constitutes a useful tool for landscape conservation, planning and management.

S.27-23-P

Can we establish how endangered is *Lobaria scrobiculata* in Spain? - the need to know its population dynamic.

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In order to get a real idea about the conservation status of *Lobaria scrobiculata* in Spain, we started a study to find out which variables are affecting the population dynamics of this species. Since genetic diversity is a fundamental parameter to diagnose the state of conservation of this species, we aim to develop *L. scrobiculata*-specific microsatellites. Furthermore, as the species can grow on rocks and trees, our hypothesis is that individuals growing on mossy rocks perform better than those growing on oak bark and, that saxicolous individuals would serve as propagule sources. As the isolated partner of the symbiosis is needed to get the complete genetic sequence, we have currently set fungi cultures to get enough DNA. To obtain population dynamics data, we set two 50x50 m monitoring plots in oak forests (*Quercus pyrenaica*) in Central Spain. The plots were characterized by several macro-environmental and forest structure variables. To describe these populations, all *L. scrobiculata* individuals were measured, considering variables related to individuals size, reproductive capacity, health and niche characteristics. Besides, 400 individuals (200 on rocks, 200 on trees) were randomly selected to be monitored. Pictures of every marked individual will be taken every 4 months, to be able to detect any kind of change during the whole monitoring period. Moreover, physiological variables are being recorded monthly, as stress indicators. Environmental factors determining presence, abundance, size and reproductive capability will be analyzed using generalized lineal models. This study is supported by a project from the Spanish Ministries of Education and, Science and Innovation (ref. CGL2010-22049 and CGL2007-66066-C04-04), and a FPU predoctoral fellowship to S.Merinero.

S.27-24-P

Foraging strategies within a guild of native and exotic ungulates in a Mediterranean ecosystem.

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Ungulates have been widely introduced in multiple ecosystems all over the world due to their social and economic value as food resources and for sport hunting. The identification of foraging preferences of both exotic and native ungulates in sympatry is, therefore, becoming increasingly important in order to assess potential impacts of exotics on the host ecosystem. In this study we compare the trophic ecology of three sympatric ungulate species living in a Mediterranean pasture-scrubland landscape: the native Iberian red deer *Cervus elaphus hispanicus*, and two exotic bovids, the European mouflon *Ovis orientalis musimon* and the aoudad *Ammotragus lervia*. We simultaneously determined herbivore diet through analyses of faecal content and assessed the nutritional content of these diets. Deer selection for scrub layer was sustained throughout the year, while mouflon and aoudad went through various seasonal shifts in forage selection. The two bovid species displayed a dietary selective strategy that related to an overall higher nutritional quality than that of deer. These divergent exploitation patterns between the study cervid and bovids seem to have been related to body mass, taxonomic affiliation and feeding type, and they are largely affected by seasonal nutritional changes in vegetation. We suggest that specific trophic strategies within ungulate guilds must be considered when assessing the importance of herbivory for the ecosystem conservation and management.

S.27-25-O

Habitat properties of golden eagle (*Aquila chrysaetos*) territories relative to random sites - a multi scale approach.

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Landscape properties were drawn from a randomly selected subsample (N=30) of active golden eagle territories in 2005 throughout Västerbotten and Västernorrland counties (N=86), northern Sweden, and compared to landscape properties of similar sized randomly selected sites (N=30) sampled from a larger randomly generated population (N=86). Multiple spatial scales were used to analyse territories in a geographical information system (GIS) with fixed radius at a nest site scale (1km) and at successively larger landscape scales of 3km, 5km, 8km and 10km. The linear distance of roads, power lines and railways were summed within territories since they likely generate both positive and negative affects for golden eagles. These same active golden eagle territories were then compared to kNN-data from 2005 at the different spatial scales using stand volume to classify open (30m³ha) forest habitats. Forest habitats were also classified from a previously derived segmentation method enabling a mean stand volume to be assigned to individual polygons. The above landscape properties were also mapped alongside a terrain ruggedness index calculated from a triangulated irregular network (TIN) in a GIS. Fragstats 3.3 was used to retrieve landscape based statistics to compare golden eagle territories at different spatial scales with similar sized randomly selected sites.

S.27-26-P

Developing a high resolution spatial distribution model from indirect observations: the case of the Asiatic wild ass (*Equus hemionus*) in Israel.

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Habitat distribution models are basic tools for identifying essential habitats for species' conservation. They can be applied to predict potential range expansion of species, as in the case of reintroduced animals following release to the wild. Once widely distributed in west Asia and the Middle East, the Asiatic wild ass (*Equus hemionus*) has become extinct from these regions due to over-hunting and habitat destruction. Between 1982-1993, *E. hemionus* was reintroduced in Israel. Today the species is distributed throughout the Negev desert. However, little is known about its habitat preferences. We aimed to construct a spatial probability distribution model for *E. hemionus*, based on indirect observations of species presence. We conducted a feces survey in 122 sites in the Negev. In each site we sampled three 500 m transects and recorded the locations of feces mounds as an indication of species presence. Explanatory variables for feces distribution, including climatic and topographic factors, woody vegetation distribution and anthropogenic factors, were mapped using GIS and used to construct a MAXENT-type spatial probability model. The resulting high-resolution (10 m) map, describing the species' probability of occurrence over the entire landscape, enabled us to deduce *E. hemionus* habitat preferences in the region. The most important factors affecting the species distribution were: percentage of woody vegetation (47.5%); slope inclination gradient (29.1%); relative humidity in August (9.1%); and distance from permanent water sources (3.9%). These findings may be used for identifying and protecting habitats important for *E. hemionus* persistence and for assessing its future range of distribution.

S.27-27-O

Promoting resilient populations in a changing climate.

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In theory, site and landscapes attributes might be manipulated to create populations more resilient to environmental change. Landscapes can be characterised in terms of the heterogeneity, configuration (i.e. connectivity) and the area of different biotope types, and also at a wide range of different spatial scales. In order to determine the most salient landscape characteristics and most appropriate spatial scale we used an evidence-based approach whereby data on bird and butterfly density and stability were related to a range of different landscape metrics. We discuss which landscape metrics and spatial scales best predicted population density and stability and the implications of these results for climate change adaptation. We discuss how well these results, and others, provide supporting evidence for published climate change adaptation principles.

S.27-28-P

The effect of pastoral abandonment on dung beetle diversity in the Alps.

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Pastoral abandonment is one of the major land use changes affecting the landscape and, ultimately, the biodiversity of the Alps. This research was carried out in the Sessera valley (Piedmont, north-western Italy) to assess the effect of pastoral abandonment on dung beetle (Coleoptera, Scarabaeoidea) assemblages. The study area is covered by beech *Fagus sylvatica* climax forests intermingled with pastures and patches of shrubs and pioneer forests representing seral stages of ecological succession following the disuse of pastures. Dung beetles were sampled across 16 sampling sites set in the four habitat types quoted above at two different altitudes (two replicates per habitat per altitude). A total of 6947 individuals of 27 species were caught from June to September 2010. Generalized linear models showed that both total abundance and species richness were significantly higher in pastures and beech forests than in shrubs and pioneer forests. Analogously, Indicator species analyses (IndVal) revealed that species positively selected pastures or forests, but not shrubs or pioneer forests. The analysis of additive gamma diversity showed that β differences among habitat types were always greater than those among altitudinal levels and replicates, and that the contribution of β diversities to γ -diversity was higher than expected by chance. Temperate Palearctic assemblages of dung beetles are usually considered to be dependent on pastures. Our preliminary results confirm pastures are important, but they also suggest that climax beech forests may effectively contribute to preserving dung beetle biodiversity in circumstances of pastoral abandonment.

S.27-29-0

Temperature driven niche expansion in a rapidly expanding butterfly species.

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Many species are shifting their ranges polewards in response to climate change, but rates of expansion at the leading edge depend on habitat availability. However, species habitat associations are also expected to change at range boundaries in response to climate change. Many species have a narrower niche breadth at their range edge compared with their range core. For example at their cool range boundary species become restricted to habitats with the warmest microclimates, or herbivores become restricted to host plant species on which development is most rapid. As the climate warms such constraints are expected to relax and realised niche breadth widen. We have documented an increase in host plant species used by the butterfly *Aricia agestis* at its northern range boundary in the UK in response to climate change. By comparing the population dynamics of this butterfly feeding on old and new host species we show how an increase in the frequency of warm summers has facilitated population persistence on host plants where positive population growth was not possible under cooler climatic conditions of the past. We show that this is due to differences in the microclimatic conditions provided by the alternative host plants. Use of additional host plant species has vastly increased the area and connectivity of habitat available to this butterfly and led to unexpectedly rapid rates of range expansion. Shifts in habitat and host plant associations need to be considered when predicting species future ranges and to inform appropriate conservation management as the climate warms.

S.27-30-0

The effect of cushion-forming prostrate shrubs on biodiversity in the Sierra Nevada Mountains, SE-Spain.

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Species interactions influence overall species distribution and are an important topic in biodiversity research. In stressful habitats such as alpine areas positive interactions among plants are able to increase biodiversity to a considerable extent. Alpine vegetation in the Sierra Nevada Mountains in South Eastern Spain is to a good part characterised by a variety of woody shrub species with prostrate habit. Studies in other alpine areas could show that these cushion-forming species can act as nurse plants inhabiting several beneficiary species, since they are able to mitigate abiotic conditions such as soil moisture and temperature. To study the role of the cushion-forming shrubs on local species richness in the Sierra Nevada we investigated different cushion plant species and recorded their species composition and the nearby surrounding areas along an altitudinal gradient between 2300 and 3000 m a.s.l. in the north and south aspect in the Sierra Nevada National Park. We hypothesised that cushions will positively affect species richness in the alpine belt of the Sierra Nevada, that these effects will be species specific, and that there are beneficiary species constrained to microhabitats formed by the cushion plants. First results indicate that the effects of the cushions on their co-occurring species are highly species specific and vary from facilitation to competition. In addition, the net effect of cushions is dependent on the abiotic conditions of the habitat, where positive interactions are more frequent in sites where the respective cushion is able to alter a limiting factor for plant growth. The results further show that several species significantly prefer growth conditions provided by cushions, to the extent that some endemic species only survive under their canopy. These results let us conclude that the woody prostrate shrubs play an important role for biodiversity of the Sierra Nevada. They provide small scale habitat conditions able to inhabit a variety of species including specialised species almost exclusively occurring under the effect of the nurse plant. Therefore, these cushion plants may play a critical role for biodiversity conservation of the unique flora of the Sierra Nevada which may suffer from ongoing climate change.

S.27-31-O

Over-run while scavenging? Spatial patterns of vertebrate roadkills in three Spanish motorways.

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Wherever there is available food, one might expect that some species will take advantage from it. Vertebrate roadkills are an issue of major concern by themselves, but they also provide carrion. This could attract carnivores, increasing their own possibility of being hit by a vehicle, and therefore affecting their populations. We analyzed data from three motorways (80 km), surveyed monthly during a year (December 2009-November 2010) from vehicle for small and medium vertebrate carcasses, and from a database of carnivore roadkills from 2007 to 2010. During the survey, we found 459 carcasses (43% lagomorphs, 22% birds, 20% reptiles, 15% others), of which more than 70% were on AP-6 motorway, and they concentrated in summer and early autumn. About carnivores, there were 214 casualties (54% foxes, 24% dogs, 12% mustelids, 8% cats and 2% genets), of which 60% were on AP-6, and showed no clear seasonal pattern. The analyzed taxa showed spatially aggregated patterns, allowing the detection of "black-spots" in each motorway. However, carnivore and carcasses black-spots only coincided partially. Correlations between carnivore roadkills and carcasses (mainly lagomorphs) corrected by spatial aggregation were significant for feral cats (p

S.27-32-P

Seasonal changes in habitat use and diet selection by European mouflon (*Ovis orientalis musimon*).

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In order to understand how exotic species affect native ecosystems we have to first understand how these species behave. The European mouflon (*Ovis orientalis musimon*) is native to Corsica and Sardinia and has been repeatedly introduced in most of Europe since the second half of the nineteenth century. It was introduced in Spain in 1953. Mouflon, which is an alien species in Spain, are adapted to different habitats, mainly in private game areas, and might (or not) negatively affect ecosystems (local flora and fauna). The objective of this project was to study the seasonal changes in habitat use and diet selection of a mouflon population in a private game area in Ciudad Real. For habitat use we divided the study area into three habitat types: open, scrub and edge. We estimated relative abundance by counting pellet groups in each habitat type. We found strong differences in open habitat use between seasons. We determined the botanic content of the diet using microhistological analysis of plant remains in faecal samples. The presence of different plants in animal diets are constrained by plant availability in the field, so that Savage Selectivity Index was used to normalize the seasonal use of each resource by its availability. Mouflon winter and autumn diets were associated with herbaceous Leguminosae. Also, shrubs such as *Asparagus* and *Cytisus* spp correlate with spring diet in mouflon. These are preliminary results of an on-going project. Results of this project will reinforce and complement existing knowledge and management strategies.

S.27-33-P

Retarded effects of fire on growth and survival rates.

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Fires are frequent in the Mediterranean basin and their impacts affect the structure of the whole ecological community yielding both direct and indirect effects on the population dynamics of the species. It is expected that some traits like individual growth or size at maturity result affected, influencing local survival rates after the fire. In this work we examine the effects of a fire in the individual growth patterns of a population of the spur-thighed tortoise (*Testudo graeca*) in south-eastern Spain and we relate these effects with the species' population dynamics. A recapture protocol and biometric measurements allowed us to compare the growth of 168 tortoises before and after the fire. After we tested several models, the von Bertalanffy growth model resulted the most appropriate to describe the growth pattern both for males and females. Population survival analyses using this growth model reported a significant decrease of the local survival rates for adults of both sexes (from 86.4% to 82.6% for males and from 96.4% to 90.7% for females). These results are further discussed in relation to the conservation of the species.

S.27-34-P

The impact of forest ski-runs on small mammals in the Alps.

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Since the beginning of the 20th century, development of ski areas has severely disturbed the environment in the Alps. The aim of this research was to study the impacts of forest ski-runs on small mammals by assessing (i) whether ski-runs were used or avoided (thus providing evidence of habitat loss) and (ii) whether they acted as ecological barriers to local movements. Fieldwork was carried out in two ski-districts of the north-western Italian Alps. Three capture-mark-recapture experiments on core species were carried out to assess habitat use (one experiment) and the capability of crossing ski-runs (two experiments: spontaneous crossing and individual translocation). Radio-tracking surveys of the fat dormouse *Glis glis* were carried out to locate home ranges and resting sites in relation to ski-runs. In the habitat use experiment, virtually all individuals were captured outside ski-runs, suggesting that they are selectively avoided. In the spontaneous crossing test, recaptures of marked individuals showed they moved on one side of the ski-run only, and never crossed it; however, in the translocation experiment (that simulated situations in which individuals were highly motivated to cross a barrier), 18.6% of trans-located individuals were able to cross the ski-run and come back to the original forest patch. Fat dormice maintained home ranges on one side of the ski run and they never crossed it. Our study clearly suggests that ski-runs represent a habitat loss to small forest mammals and are ecological, semi-permeable barriers that partially or totally prevent individuals from moving between adjacent forest patches.

S.27-35-P

Determination of core zone in biosphere reserve area planning of karaburun peninsula.

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Biosphere reserves which have international significance are the regions that protect biological diversity while provide the continuity of economic development and cultural values. In order to reach this agreement, biosphere reserve region is divided into three zones: core zone, buffer zone and development zone. In biosphere reserves, core zone is the area in which the strict protection policies are applied. This zone, in which there is no human activity except scientific observation and research, has vital importance in the protection of significant species and habitats. Karaburun Peninsula which is selected as working area is the area of living and breeding of Mediterranean monk seal (*Monachus monachus*) and Audouin's gull (*Larus audouinii*) which are in red list of IUCN. These areas are under danger because of several human activities. Other bird kinds and ecosystems which are important in European scale and local scale in the area also need to be protected. Despite all these, the area still has protected its natural and cultural properties relatively and is open to the sustainable land use. Therefore, it has been come up as potential biosphere reserve region. The aim of this study is to establish core zone which include species, habitats and ecosystems need to be protected in the area within the scope of biosphere reserve region. In this direction, significant resource values of the area and the threats towards these have been determined. Observational records about wildlife, data about living and breeding areas, data of satellite images, map and area observations have been transformed into thematic maps by remote sensing and GIS techniques. Core regions have been determined on the basis of wildlife (Mediterranean monk seals and birds), vegetation, land use and protected areas. Keywords: biosphere reserve, core zone, Karaburun

S.27-36-P

Researchs on evaluation of ida mountains as a world heritage.

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Natural resources are values of humanity and also they are indispensable for human life as well as being most important value and wealth for a country or a region. Today, most natural resources are under threat both our country and around the world. This situation shows itself as a global environmental problems and their results effect mostly communities in Developing and Undeveloped Country. Interaction between human - environment and lack of use - protection balance are located on the basis of all of them. At this point, Ecosystem based conservation approach is gaining importance. The main objective of this approach is protect ecosystems as a whole and to ensure sustainable biodiversity. Ida Mountains Region which is spread over an area of approximately 258,000 ha in the South of Çanakkale - Biga Peninsula, has a significant potential in terms of natural resources and it is considered as an area rich in biological diversity which is the most important indicator for natural resource. In this context, Ida Mountains Region is pilot area for 'In-Situ Conservation of Genetic Diversity Project' which was supported by World Bank - Global Environment Facility (GEF). But, today, Ida Mountains Region is faced environmental pressures which are occurred as a result of incorrect human usage. This type of sensitive and ecologically valuable areas are indispensable for our world future and so conservation status of these areas must be on a world scale. In this respect, UNESCO World Heritage protected status may be an appropriate nature protection status for moving Ida Mountains to the future. The natural and cultural resource values have been determined by using observation, investigation, analysis and evaluation method and in this process Vegetation density which is clue about biodiversity in the region was calculated from 1985 to present by using Geographic Information Systems (GIS) and Remote Sensing Techniques. Within the framework of results, Opinions and suggestions are made about the status of conservation and management of the area and UNESCO World Heritage potential of Ida Mountains has evaluated.

S.27-37-O

Motivations for conserving urban biodiversity: facts versus statements.

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Urban ecology is gradually developing as an interdisciplinary science, aiming to research both ecological processes occurring in the urban environment and their influence on city dwellers. However, a synthesis assessing research priorities in this developing field is still lacking. Here we performed a multidisciplinary literature review (515 papers) to assess what motivated scientists in studying different aspects of urban nature conservation. We later explored how scientific results provide evidence to support these motivations in order to identified gaps in urban ecology research. Our results revealed gaps in knowledge regarding both ecological-oriented and people-oriented motivations for studying urban nature. Although global biodiversity conservation was the most frequently cited motivation, the value of urban biodiversity for this purpose remains unknown. This is because while rare and endangered species can be found in cities, it is seldom shown whether populations of these species are viable, and whether cities are needed to protect them compared to greener surrounding environments. Moreover, urban ecology studies are focused on a few taxonomic groups and a single urban location, i.e. open green spaces. Concerning people-oriented motivations, the provision of ecosystem services or support for conservation education towards city dwellers were mentioned in 43% of the reviewed papers. Yet, in all these studies, the value of species diversity per se, rather than that of nature or urban green, remained remarkably poorly explored. Thus understanding people's perception towards species diversity and exploring how these perceptions influence nature awareness is still a challenge in urban ecology.

S.27-38-O

Microclimates and their significance for Lepidoptera.

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'Microclimates' are variations in climatic conditions across anything from a few millimetres to several kilometres, caused by fine-scale differences in vegetation or topography. Climatic conditions at this scale are highly relevant to the survival, reproduction and behaviour of many plants and animals. Here, using a global meta-analysis, I show that microclimatic differences in maximum temperature across a few metres can be larger than IPCC future climate change projections for 2100, hence outlining their importance for determining species' response to such warming. These temperature differences arise from changes in vegetation structure (e.g. between open or closed areas) and aspect (e.g. between north or south facing slopes) at sites, and provide opportunities for conservation management to help species adapt to climate warming. I also provide some of the first evidence for cross-taxon use of vegetation microclimates at a continental scale, in this case with butterflies. The extent to which species are flexible in their use of vegetation will likely define their ability to take advantage of microclimates as a means of adapting to climate warming.

S.27-39-P

Evaluating impacts of ex-urban sprawl on the local population of *Testudo graeca graeca* in southeastern Spain with dynamic simulation models.

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The spur-thighed tortoise (*Testudo graeca graeca*) is one of the most emblematic species of semiarid systems in the western Mediterranean. This study focuses on the population in the southeastern Spain between the provinces of Murcia and Almería. In addition to the loss of habitat due to urbanization, the urban sprawl increases the collection of individuals. It has been suggested that the harvesting of wild individuals for their tenure in captivity can lead to local extinction in populated areas or where the movement of people is high. In this communication we analyse this threat by means of a dynamic simulation model. The data required for the model development are taken from previous studies on the distribution and abundance of species and on the non-commercial collection of spur-thighed tortoises in this area. The simulation results show the negative effect of the harvesting of tortoises in the wild population. Using parameter values taken from field studies on the encounter likelihood, the time spent by new residents to walk in the countryside and their predilection for having a tortoise as pet, in a conservative scenario with no excessive number of houses in the residential development, the local population of tortoises in the influence area of such residential development is extinguished in less than 50 years. This indicates that the non-commercial collection of spur-thighed tortoises linked to the ex-urban sprawl is a threat that should not be obviated.

S.27-40-P

Differential responses of lichens, bryophytes and vascular plants to disturbance in eurosiberian and mediterranean coastal sand dunes.

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Understanding the responses of different taxonomic groups to multi-scale environmental gradients is an important issue for conservation and management, particularly in the case of dynamic systems such as coastal sand dunes. In this study the following questions were addressed: (1) Are lichen, bryophyte and vascular plant diversity patterns, in coastal secondary dunes, significantly correlated? (2) Is there a significant role of local disturbance, associated with prevailing coastal dynamics, in these communities? (3) Does this disturbance gradient affect equally lichens, bryophytes and vascular plants, and is this effect influenced by biogeographic context? Ten sample sites were selected according to biogeographic location and prevailing coastal dynamics. The relative abundance of lichen, bryophyte and vascular plant species was recorded in three 25x25m plots, located in secondary dunes and arranged perpendicularly to the shoreline. Spearman's correlations were significant between lichen and bryophyte richness, whereas no significant correlation was found between vascular plants and any of the cryptogam groups. These relationships did not change with biogeographic context. However, different compositional patterns were observed from DCA ordinations. In the Eurosiberian region, disturbance was found as a main gradient only for bryophytes, while in the Mediterranean region it was the primary gradient for both lichens and vascular plants, but not for bryophytes. This study suggests that (1) lichens, bryophytes and vascular plants respond differently to the analysed gradients; (2) the responses of each group to disturbance are influenced by biogeographic context; and therefore (3) these groups cannot be considered mutual surrogates concerning the effects of disturbance.

S.27-41-P

Conservation of a unique bullhead population in Flanders, Belgium.

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Bullhead is a small, bottom-dwelling freshwater cottid. Formerly it was common in Flanders, nowadays only very few, isolated populations remain. Consequently bullhead is listed as IUCN susceptible in the national Red List and fully protected. It is also listed in the EC Habitats Directive (92/43/EEC). Management should aim to conserve as many populations as possible to prevent further genetic loss. Until 2003, bullhead was thought to be extinct from the entire Demer River basin in Flanders. That year a unique relict population, containing no less than 5 private alleles, was found in the Dorpbronbeek, a small tributary in this basin. Because this population is seriously endangered due to its small living area, population size and recent habitat deterioration, the Research Institute for Nature and Forest (INBO) and the Agency for Nature and Forest (ANB) initiated a conservation project to preserve it by re-introducing its cultured progeny to another tributary, the Zevenbronnenbeek. This headwater stream was carefully selected from seven evaluated potential re-introduction locations within the Demer River basin based on water and habitat quality and food availability. In 2004 brood fish were collected in the Dorpbronbeek and transferred to the fish culture centre of INBO where a captive breeding program was developed. In October 2008 and 2009, cultured age 0+ bullhead were released. From 2009 on, the success of this re-introduction was assessed. The first results on the survival, growth and natural recruitment of the released animals, offer positive perspectives for a healthy self-sustaining population to establish in the Zevenbronnenbeek.

S.27-42-O

The tropical fire ant *Solenopsis geminata*: a threat to the Galápagos arthropodian fauna.

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Introduction of exotic species in a new environment has been identified as a major threat for ecosystems. Galápagos islands (Ecuador) are highly endemic, and therefore constitute a fragile and sensitive biota to biological invasions. We studied the distribution and the impact of one of the most destructive invasive species on earth, the tropical fire ant *Solenopsis geminata*. Our results first show that *Solenopsis geminata* is widely distributed in all the human disturbed areas on the main island of Santa Cruz, but not in the pristine vegetation zones. Our data suggest that the presence of the tropical fire ant goes along with a strong decrease of abundance and diversity of native and introduced arthropods. We investigated the competition of *Solenopsis.geminata* with other introduced ant species, among them the little fire ant *Wasmannia auropunctata*. We will also demonstrate that workers lost all intraspecific aggressiveness within populations, and that nests are organized in networks to form large colonies. Our genetical and behavioral analyses show a low genetic diversity, but also show a differentiation between geographically distant populations, suggesting that several sources of *S. geminata* were introduced in the Galápagos islands. Finally, we will discuss the genetical and ecological factors underlying the successful invasion of the tropical fire ant in the Galápagos.

S.27-43-P

Research on ecosystem degradation and land use classification, using with corine standarts by remote sensing: a case study on gediz delta.

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Canakkale Onsekiz Mart University. Board Member of Eef and Ege University.

Gediz Delta being the point where Gediz River flows into the Aegean Sea is one of the most important wetlands ecosystem of Turkey being under guard within the scope of Ramsar Convention. Bird paradise being very important for ornitotourims is situated within the delta where many lagoons, salty water and fresh water marshes and a big saline are present. Delta having rich variety of flora and fauna is very important ecosystem for sustaining natural life. The delta of Gediz is an important wetland of a category found in Turkey. 211 bird species of the total number of 426 species have been observed in Gediz Delta. Since Gediz River flowing into sea by passing four cities and is at 44 km distance to Izmir city center, determination of land use decisions of delta under the pressure of urbanization. In this research, land use decisions of Gediz Delta is evoluated by remote sensing techniques. During research process, for the purpose of obtaining data about natural, cultural and agriculture structure, research site and settlements around it were examined. Moreover, Landsat 7 ETM satellite images analysis techniques and geographical information system programs were used to obtain data about natural structure. CORINE (Coordination of information on environment) determined by European Environment Agency standards were utilized to determine land use decisions on site. as a result of this study, 10 class land use have been determined by using CORINE standards. Some of these land uses have been evaluated by ecosystem degradation.

S.28- Population Ecological Genetics and Genomics

S.28-01-P

Genetic differentiation and biological traits in eight Mediterranean Erodium species.

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Our aim is to assess the influence of biological characters including lifespan, reproductive system, geographical range size, and pollinator guild, on patterns of genetic variation and structure among 8 related species of *Erodium*. In this study, we use AFLP fingerprinting to compare observed patterns of genetic differentiation among species with contrasting life history and demographic characteristics. *Erodium* appear to have high colonization capacities (Fiz-Palacios et al., 2010), thus, geographical limitation might be due to habitat specificity rather than restricted seed dispersal per se. Irrespective of their ecological specialization, three most widely distributed species of *Erodium* (e.g. *E. maritimum*, *E. glandulosum* and *E. foetidum*) presented higher polymorphism and weak genetic structure. In contrast, two species presenting a small distribution area (e.g. *E. recoderi*, *E. lucidum*) showed low polymorphism and high genetic structure, *E. manescavi* presented high polymorphism and weak genetic structure and finally *E. paularense* presented low polymorphism and no genetic structure. Differences in levels of outcrossing and seed production alone are not sufficient to explain all these differences, which may be understood as an effect of drift in isolated populations. These results are also congruent with a complex scenario where several traits (i.e. sex investment, breeding type, life-history, and fruit dispersability) may have been crucial for the survival and/or recolonization of habitats during the Pleistocene climatic oscillations, leading to different evolutionary histories that have shaped their present genetic structure.

S.28-02-O

Extensive pollen flow but few pollen donors in an extremely fragmented landscape.

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Analysing pollen broadcast is key to understand the mating system of plant species and the shifts imposed by the availability and the spatial distribution of potential mating partners, particularly when populations are fragmented. Recent empirical studies emphasize that the ecological and genetic consequences of fragmentation usually do not run in parallel since patches do not delineate breeding populations. Here we gauge pollination connectivity (in both quantity and quality) across a fragmented landscape for the wind-pollinated shrub *Pistacia lentiscus*. To that aim we genotype adult plants and offsprings with seven microsatellite loci and assess patterns of pollen dispersal and relative male fecundity with a combination of method, including direct paternity analysis, the maximum likelihood-based approach of KinDist, and the bayesian mixed effect mating model. Our results showed extremely high levels of pollen flow from outside the study plot (>80%). Further, pollen dispersal was better fitted to a power-exponential distribution function which accounts for the occurrence of relatively frequent events of long-distance pollen dispersal (up to 900 m). However, despite extensive levels of pollen flow, we also found a strong variance in male relative fecundity in the study plot with just a few males coping most mating events. The fact that these dominant males were located in areas of low vegetation density stress the importance that landscape architecture bears in shaping the genetic composition of future generations.

S.28-03-P

Genetic characterization and structure of a high-density eagle owl population in South-eastern Spain.

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Genetic information about the populations has become an important tool in the understanding of population ecology and conservation of the biodiversity. The knowledge of how genetic variation is distributed within and between populations allows us to better understand the ecological underlying processes in the population's dynamic. In this work we present the genetic characterization (using microsatellite markers described by Issakson and Tegelström in 2002) in a high-density Eagle owl population from the south of the Alicante province (southeastern Spain). This population reach densities as high as 46 territories per 100 km² (n=48) inside the boundaries of the Special Protected Area of Sierra Escalona and a mean density of 22 territories per 100 km² (n=99) in the whole study area. Our preliminary result shows low levels of genetic diversity and heterozygosity and reveals some degree of genetic structure among individuals occupying the central area of the population and those in the surrounding areas. This pattern probably means a differential process in the territories occupancy between the core and the peripheral area.

S.28-04-P

Heritability of vegetative traits in Iberian *Aquilegia*. Implications for taxa divergence.

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The more important example of adaptive radiation in plants is the case of *Aquilegia* genus (Columbines). Columbines are distributed along North hemisphere temperate regions (North America and Eurasia). Apparently, the processes that have led to radiation in both continents are different. In North America, radiation seems to be related to pollinator-mediated divergent selection, being species differentiation based on floral traits while in Eurasia, radiation is based on habitat specialization (Bastida, 2010). However, the evolvability of floral or vegetative characters of columbines, which is crucial to understand taxa differentiation processes through divergent selection, remains to large extent unmeasured. In this study we examine one of the components of this evolvability, the heritability, for vegetative characters. To do it we use quantitative genetics through “nested full-sib/half sib” crosses in which a single male (father) is reproduced with several females (mothers), achieving full sibs (father and mother’s sib) and half sibs (only father’s sib). Our aim is to assess additive genetic variance and heritability in several vegetative traits in five Iberian columbines. Exploratory results show additive genetic variance in many vegetative traits and a comparable heritability to that of floral traits. Lately it has been shown a differential evolvability and adaptive response of these two kinds of characters in Iberian columbines. Our results suggest that these differences in evolvability are much probably based on differences in the strength of selection imposed by the biotic and abiotic environment than by differences in heritability of floral and vegetative traits.

S.28-05-O

Trophic specificity and biodiversity of acorn feeding beetles in neotropical and temperate oak forests: application of molecular taxonomy.

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The amazing biodiversity of the tropics has intrigued ecologists for decades. It has been argued that high trophic specificity promotes species richness. Moreover, the long term environmental stability in tropical areas may have reduced extinction rates. Beetles (Coleoptera) are a paradigmatic example of high diversity in the tropics, however, we still have a limited knowledge of their taxonomy and ecology. In this sense, molecular biology (DNA-taxonomy) is facilitating species delimitation, thus allowing quick biodiversity assessments. It also permits identification at all stages of the life cycle, shedding light on insect diets and detecting hidden patterns of ecological segregation at the intraspecific level eventually leading to genetic differentiation. We used DNA-taxonomy to compare the biodiversity patterns of acorn feeding *Curculio* beetles between neotropical and temperate oak forests. Our results show that *Curculio* species richness is much higher in the tropics, but not due to trophic specialization, in fact, host specificity was low and did not differ with respect to temperate forests. However, species turnover (beta-diversity) was higher in the tropics, even between nearby localities. At the intra-specific level, there was a limited inter-population gene-flow and a higher local genetic diversity compared to temperate areas. These results suggest the existence of multiple refuges in tropical areas during past unfavourable periods in which oak forests distribution was very restricted. That context could have favoured intra-specific genetic divergence and further speciation, and the current patchy distribution of neotropical oak forests may have contributed to maintain such diversity.

S.28-06-O

Genetic consequences of plant facilitation.

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Facilitation, the positive interaction where a nurse plant provides regeneration niches for other plants (beneficiary), can increase both the species diversity and the phylogenetic diversity of the communities where it is prevalent. The underlying causes are mostly related to improved environmental conditions for regeneration. Because these improved conditions can affect plant populations at the same temporal scales, facilitation could also have potential genetic effects at the intra-population level of beneficiary species. These within-species genetic consequences of facilitation have not yet been explored. We tested whether facilitation can lead to increased genetic diversity and structuring of a beneficiary species, *Euphorbia nicaeensis*. This species is abundant at a high-altitude community where it is benefitted from *Juniperus sabina* cushions, which also act as nurses for many other species. As in other communities, phylogenetic diversity of the community is higher under *J. sabina* cushions. We found that a parallel situation of increased intra-population genetic diversity under nurse trees is not present for *Euphorbia nicaeensis*, as measured with AFLP markers. However, facilitation does lead to genetic structuring of kinship relationships among individuals: a spatially controlled analysis showed that individuals growing under nurse trees have higher kinship coefficients among them than with individuals growing in open areas, and vice versa. For this species, facilitation seems to promote a mating separation of facilitated individuals from non-facilitated congeners even at small spatial scales. We explore the possible ecological mechanisms behind this genetic pattern.

S.28-07-O

Using genome scans and landscape genetics on regional and continental scales to detect temperature-related natural selection in a wind-pollinated tree.

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Adaptive genetic variation is a key factor in evolutionary biology, but the detection of signatures of natural selection remains challenging in non-model organisms. We used a genome scan approach to detect signals of climate-mediated natural selection in the Black alder, a widespread wind-pollinated tree. Gene flow through pollen dispersal is expected to be high in this species, and we therefore expected to find a clear response to natural selection. We combined this with two different landscape genetics approaches to determine which environmental variables were most associated with the inferred selection. This analysis was performed on a regional scale (northern Belgium) and on a continental scale (Europe). Because climate-related differences are much more pronounced at the continental scale, we expected to find more selection-sensitive genetic markers across Europe than across northern Belgium. At both spatial scales a considerable number of genetic loci were considered outliers, with respect to neutral expectations, and were therefore identified as selective. Based on results from our combined approach, four putative selective loci (or 2.5 %) were recovered with high statistical support. Although these loci seemed to be associated with different environmental variables, they were mainly temperature related. Our study demonstrates that using diverse methods in landscape genetics can help uncover selective loci that otherwise might stay hidden. In combination with a genome scan, the selective loci can be verified and the nature of the selection pressure can be identified.

S.28-08-O

Dissection of the adaptive response to drought in pinus pinaster ait.: functional and genetic approaches.

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Resistance to drought is one of the main characteristics in Mediterranean species. Knowing more about the genetic control of this complex trait and its functional expression may help to understand how plants develop resistance to drought. This is very relevant for an ecologically and economically important forest tree species such as *Pinus pinaster*. We generated a full-sib family from a controlled cross between parents with opposite performance in their response to drought. Phenotypic characterization in response to drought was conducted for several functional and morphological traits. We detected some degree of genetic control in gas exchange variables, WUEi and SLA. Individuals with extreme behavior in their response to drought showed significant differences in δC_{13} and osmotic potential. We genotyped SSRs, SAMPLs, ESTPs (using tilling) and SNPs (using Illumina Bead Arrays) to construct a high density genetic linkage map. In addition, we constructed eight cDNAs libraries in diverse stress conditions. Transcriptomes were sequenced resulting in more than 9000 genes represented that will be employed in the detection of SNPs to construct a 1536 Golden Gate array designed to analyze segregation of SNP for mapping purposes. The use of this tool will allow us to drastically increase markers saturation in the genetic linkage map. We will carry out comparative mapping with other genetic linkage maps for the same species and for other conifers species. Genetic linkage maps together with phenotypic characterization will be employed in the detection of QTLs in traits of interest with regard to drought response. This multidisciplinary approach will help to develop tools and strategies to improve resistance to drought in breeding, reforestation or conservation programs.

S.28-09-O

The relative influence of ecological, historical and stochastic processes on genetic diversity distribution of African tropical species: the case of *Erythrophleum* (Leguminosae-Caesalpinioideae).

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The respective role of ecological, historical and stochastic processes on African tropical plant diversity is largely unknown. Yet, African tropical ecosystems constitute a major terrestrial hotspot of biodiversity that might be strongly impacted by human-induced ecosystem changes. The understanding of the relative impact of these different processes on the differentiation and speciation of the African tropical vegetation represents a preliminary step for conservation strategies. In this context, we studied the spatial distribution of the genetic diversity of two widespread tropical sister-tree species in Africa, using chloroplast and nuclear DNA (microsatellites and DNA sequences). Firstly we characterised patterns of intra- and inter-specific genetic differentiation of *Erythrophleum* spp. over their Lower and Upper Guinea distribution. Species were shown to be geographically distributed in allopatry and to present clear patterns of intra-species differentiation. We hypothesised that the speciation between the two species was driven by environmental heterogeneity and that intra-species differentiation was driven by quaternary climatic changes. In order to test these hypotheses we conducted an integrated approach that includes molecular dating, environmental niche modelling and population model-based inference under an approximate bayesian computation framework. Different evolutionary scenario will be tested enabling to differentiate the relative influence of environmental (ecological gradients) and historical (climate changes) factors on the diversification of *Erythrophleum* spp. in tropical Africa.

S.28-10-O

Islands in the sky: a genome scan over the whole range of a mountain endemic plant.

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Genetic approaches allow the evaluation of the structure of isolated populations and how habitat fragments are connected. Stochastic processes and/or selection forces can act over the genome of these populations, modulating their genetic structure and diversity. As the combination and intensity of these processes may vary across the distribution range of a species, genetic studies should ideally encompass all the distribution range. In this context, we approached the study of *Armeria caespitosa*, an endemic mountain plant with scattered populations across Sierra de Guadarrama, central Spain. Genetic structure, diversity and possible loci under selection were analyzed from 17 populations located across his whole distribution range with a genomic survey based on AFLP markers. Altitude and geographic distances were considered in the analyses because they may be relevant in postglacial recolonization scenarios. Results showed similar values of genetic diversity in all populations. AMOVA indicate considerable level of interpopulation gene flow, consistent with *Armeria caespitosa* reproductive self-incompatibility system. Bayesian clustering identified nine genetic groups that conform to some apparent geographic structuring. However, spatially explicit analyses surveyed with all loci only revealed weak relationships. In contrast, when outlier loci lying above the 99% confidence interval for distribution of F_{st} values as a function of heterozygosity were separately analyzed, a relationship with altitude and climatic conditions was found. This suggests that selection pressures may be operating on loci that are associated with changes in altitude. These effects together with neutral patterns related to expansion across similar altitudes may help to explain the current genetic structure.

S.28-11-P

Genetic diversity in addition to ecological aspects to define Favourable Conservations Status, a case study on bullhead (*Cottus gobio*).

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The EC Habitats Directive (92/43/EEC) requires measures to be taken to maintain or restore certain habitats and species that ensure their favourable conservation status (FCS) across the European Community. Each member state is obliged to set up monitoring programmes to estimate the conservation status of each species. Currently, the criteria for the FCS are defined by each member state independently, and are based on ecological or demographic traits only, with arguable threshold values. In contrast, genetic diversity, important for both the short- and long-term viability and future evolution of populations, is generally overlooked in the FCS (Laikre et al., 2010). We present a framework for comparing FCS using ecological criteria and genetic criteria in bullhead (*Cottus gobio*), applied on 25 wild populations in Belgium, and provide tentative results.

S.28-12-O

First study of variable number of tandem repeats (vntr) system for moroccan erwinia amylovora strains.

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Erwinia amylovora, a plant-associated member of the Enterobacteriaceae, causes fire blight, a devastating disease of rosaceous plants, especially pear and apple (1). To determine the genetic relationships among the strains within lineages. Forty strains of *Erwinia amylovora* recovered from several host plants of different Moroccan foci of fire blight from 2009 to 2010 and previously identified by single PCR amplification of a specific region of plasmid pEA29 and genome ams-region (2) were characterised and compared to reference strains from different sources and origins by Variable Number of Tandem Repeats primers (VNTR). Several genomic markers with VNTRs were identified throughout the genome of *Erwinia amylovora* and evaluated for potential application in strain genotyping. VNTRs were determined to have the highest potential for application in pathogen source tracking. Here, we report the first study of PCR VNTRs primers for discrimination of strains at the international and national levels using genotypically-representative collections of *Erwinia amylovora* strains and development of novel genomics-based methods; VNTR system. (1) van der Zwet, T., and H. L. Keil. 1979. Fire blight. A bacterial disease of rosaceous plants, vol. 510. Science and Education Administration, USDA, Washington, DC. (2) V. Donat, E. Biosca, A. Rico, J. Peñalver, M. Borruel, D. Berra, T. Basterretxea, J. Murriilo and M. M. López. 2005. *Erwinia amylovora* strains from outbreaks of fire blight in Spain: phenotypic Characteristics, *Annals of Applied Biology*, 146:105-114,

S.28-13-P

Heritability of floral traits in Iberian Aquilegia. Implications for taxa divergence.

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Columbines (*Aquilegia*) are a book example of adaptive radiation in plants. In North America, radiation seems to be related to pollinator-mediated divergent selection which causes species differentiation on floral traits. In contrast, in Eurasia columbines are similarly diversified but have lower pollinator diversity and floral differentiation, suggesting that radiation is not based on pollinator but on habitat specialization (Bastida et al., 2010). However, the evolvability of floral or vegetative characters of columbines, which is crucial to understand taxa differentiation processes through divergent selection, remains to large extent unmeasured. Here we examine one of the components of this evolvability, the heritability, for floral characters. To do it we use quantitative genetics through “nested full-sib/half sib” crosses, in which a single male (father) is reproduced with several females (mothers), achieving full sibs (father and mother’s sib) and half sibs (only father’s sib). Our aim is to assess additive genetic variance and heritability in several floral traits in five Iberian taxa of *Aquilegia* genus (20 families per taxa). Preliminary results indicate the existence of additive genetic variance in many floral traits and a comparable heritability to that of vegetative traits. Recently it has been shown a differential evolutionary potential and adaptive response of these two types of characters in Iberian *Aquilegias*. Our results are congruent with the idea stating that these differences in evolvability are much probably based on differences in the strength of selection imposed by the biotic and abiotic environment than by differences in heritability of floral and vegetative traits.

Patterns of population structure and climate adaptation at candidate gene SNPs in a Mediterranean conifer distributed in contrasting environments.

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Detection of adaptive signals at the molecular level is one of main challenges in ecological and evolutionary surveys, especially when dealing with long-lived organisms such as trees. In this study, we searched for molecular footprints of adaptation related to contrasting conditions in natural populations of the Mediterranean conifer *Pinus pinaster*. A total of 12 nuclear microsatellites (SSRs) and 384 single nucleotide polymorphisms (SNPs) distributed in 221 genes were genotyped in populations covering the species' range. These genes included a number of amplicons potentially targeted by selective forces, as reported in previous functional, association and population genetic studies in conifers. Overall patterns of neutral population structure revealed at least six clear genetic clusters, identified through principal component and Bayesian clustering analyses on the SSR data. These groups mostly coincided with those previously reported with cytoplasmic DNA markers and were distributed in Atlantic France, Corsica, northern Africa and the Atlantic, Central and Mediterranean regions of the Iberian Peninsula, respectively. After removing the confounding effects of shared ancestry in populations derived from the same gene pool, significant genotype-environment associations were identified in about 3% of the surveyed gene SNPs. A more in-depth scan of the Spanish populations located in the Atlantic and Mediterranean regions revealed a few more polymorphisms putatively responding to contrasting selective pressures. Remarkably, most associations involved temperature indices during both the winter and the summer. Altogether, these results illustrate the advantage of combining various complementary methods when searching for genes involved in ecological responses in non-model species such as conifers.

S.28-15-P

Global Invasion History and Population Genetics of *Rosa rugosa*.

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In the modern era of globalization, introduced invasive species are of an increasing concern because of their negative impact on the abundance, diversity and composition of resident species. Although populations of invasive species are expected to be genetically depauperate relative to the source region this is often not the case. Genetic enrichment by multiple introductions is among the proposed causal explanation. The shrub *Rosa rugosa* (Japanese Rose) native to East Asia was introduced in the mid to late 19th century to several European countries and USA and has since the 1950's been vigorously planted at coastal habitats near settlements due to its hardiness and ornamental characteristics. Today *R. rugosa* is considered invasive in most northern European countries as well as north-eastern North America. This study aims at reconstructing the invasion history of *Rosa rugosa* in Europe, inferred by seven microsatellite markers. We detected similar overall genetic diversity for introduced and native populations with the majority of the variation found within populations. A significant population structure in both geographical regions was revealed, albeit the introduced populations were less differentiated than the natives. Most introduced populations were found to be significantly different from native populations, as revealed by a Principal Component Analysis. Bayesian clustering analysis identified three genetic clusters in the introduced range indicating that at least three independent colonisations have given rise to the invasion in Europe. A large group of European populations distributed primarily in Scandinavia and the Baltic Sea constituted a single distinct genetic cluster that did not appear related to any native population. Three populations from the introduced range clustered among a set of Japanese populations, indicating a tight relationship. Using a Bayesian assignment method we found that two Japanese populations from the Japanese Sea side of Honshu and Hokkaido respectively, were the most likely candidate source populations for four of the sixteen introduced populations. The potential for widespread dispersal and the outcrossing breeding system in *Rosa rugosa* supplemented by the connectivity of habitats in Europe is expected to continuously enable populations to avoid detrimental effects of bottlenecks and potentially increase its range and abundance in Europe.

S.28-16-P

Maintaining connectivity in fragmented Iberian pines populations.Kovacic, Iva. González-Martínez², Santiago. Robledo-Arnuncio, Juan José. García del Barrio, Manuel. Alía, Ricardo.

INIA. INIA. INIA. INIA. INIA.

One of the problems in contemporary ecology and conservation biology is the change of landscapes, resulting in habitat loss and fragmentation. Understanding how changes in connectivity impact populations in heterogeneous landscapes has led to increasing interest in connectivity measures. Maintaining and restoring connectivity among habitat patches is recognized as an important goal for the conservation of populations. In this study, we examined the influence of connectivity and fragmentation in pine trees by looking at the correlation with the genetic structure of the populations. Native populations of six species (*Pinus halepensis*, *P. nigra*, *P. pinaster*, *P. pinea*, *P. sylvestris* and *P. uncinata*) were sampled over their distribution range in Spain and characterised for four common chloroplast microsatellite loci. Genetic diversity within populations (N_a , N_e , N_h , N_{he}) and genetic differentiation between populations (F_{st} , R_{st} , D) was calculated. We wrote a program in R in order to examine which environmental factors determine genetic connectivity and isolation. The input variables can be assigned different resistances values, and each group of variables (environmental, anthropogenic and historical) additional weights. Least-cost paths between populations are calculated by cost surface analysis and correlated to the genetic parameters to find the best-fit model. We then analyse the connectivity between populations in order to determine populations of highest importance in maintaining the gene flow, and marginal and poorly connected populations. The results facilitate targeting conservation efforts on specific populations, and the program developed in R can also be used as tools in conservation of other species.

S.28-17-O

Nucleotide diversity patterns of drought and cold tolerance candidate genes along a *Fagus sylvatica* altitudinal gradient.

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INRA. INRA. CIFOR-INIA. CNR. INRA.

Natural forest tree populations exhibit both remarkable local adaptation and plasticity across their geographical range. Local adaptation arises through spatially varying selection, and can lead to genetic and phenotypic differentiation among populations, depending on the balance among selection, gene flow and population demographic history. We applied a population genomics approach to multiple candidate genes for response to abiotic stress in *Fagus sylvatica*, with the objective of identifying selection signatures linked to divergence between natural populations' adaptive traits along altitudinal gradients. Sampling was conducted in south-eastern France, a region known to have been recently colonised by *F.sylvatica*. Four naturally-originated populations were sampled at both high and low elevations along two altitudinal gradients. Populations along the altitudinal gradients are expected to be subjected to contrasting climatic conditions. Thirty-five candidate genes were chosen from a databank of 35,000 ESTs according to their putative functional roles in response to drought, cold stress or both and sequenced for 96 individuals from four populations. Classical tests of departure of site frequency spectra from expectation and outlier detection tests that accounted for the complex demographic history of the populations were used. Mean genetic diversity of $\theta\pi=0.0028$ was found for potentially adaptive candidate gene loci, and overall low genetic differentiation was detected along the altitudinal gradients. Nevertheless, polymorphism patterns at candidate genes within and among populations provided insights about the potential of this major European forest tree to adapt from standing genetic variation to drought and cold and on altitudinal migration potential in response to climate change.

S.28-18-P

Genetic differentiation and Phenotypic plasticity of Maritime pine under water-stress conditions.

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Phenotypic plasticity and standing genetic variation is of fundamental importance in evolutionary, population, conservation, and global-change biology. Maritime pine is a conifer species with high differences in plasticity and genetic variation at different levels (populations, families and individuals) and among traits. However, still it is still necessary to understand the adaptive significance or the plasticity, and also the tradeoffs among plasticity and other traits. We therefore, checked the extent of standing variation and phenotypic plasticity at three different levels (population, families and individuals) in $\delta^{13}C$ (a WUE related trait), growth, and reproductive output (estimated through the number of female cones). We sampled ca. 200 trees in two contrasting experimental sites, and for two consecutive years. The sampling scheme included 12 populations covering the distribution range of the species, 119 families and 8 trees/family. The results showed a large genetic variation in the isotopic composition ($\delta^{13}C$) of the material assayed (h^2 : 0.31-0.67 depending of the site and year), with an important GE interaction, and phenotypic plasticity (1 order of magnitude among families for max-min value of the different environments). We explored the adaptive significance of such differences by using reproductive output and growth as proxy proxies to fitness, and by regressing the values with environmental variables of the sites of origin (R^2 : 0.13-0.40 ,with Mean Annual Temperature and Rainfall).

S.28-19-P

Karyological approach to the taxonomy of *Cerastium* (Caryophyllaceae) from the South-Eastern Europe.

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Mitotic chromosome analysis and nuclear DNA contents estimation were performed for 38 populations of 17 *Cerastium* taxa from the South-Eastern Europe which is considered as a center of diversity of the genus. Number of chromosomes was determined for the first time for seven taxa and new chromosome counts were recorded in five taxa, including species *C. dinaricum* ($2n = 36 + 1B$, $2C = 2.43$) and *C. neocardicum* ($2n = 144$, $2C = 7.07$). In majority of species of the genus *Cerastium* the first polyploidization event was happened a long time ago and their lowest ploidy level actually corresponds to tetraploids ($2n = 36$). A greater range of polyploid levels (up to $2n = 144$) was observed within high-polyploid cytotypes mostly occurred in the central part of the Balkan peninsula. The monoploid genome sizes ($1Cx$) varied from 0.32 pg in *C. arvense* to 0.90 pg in *C. candidissimum*. The intraspecific quotient of variation in C-values varied from 1.003 in *C. malyi* to 1.208 in *C. decalvans* subsp. *leontopodium* which is quite high value overall. Most significant downsizing during polyploidization was observed in investigated taxa - on average the monoploid genomes in octoploids reach only 0.78 of size of tetraploid ones. Karyological, morphological, molecular and ecological data suggest that *C. latifolium* group would be the ancestral group for the type subsection of the genus, *C. subsect. Cerastium*. Differences in ploidy levels and monoploid genome values confirm taxonomic status and ranks of somewhat neglected taxa such as *C. banaticum* subsp. *kosaninii*, *C. decalvans* subsp. *glutinosum* and *C. d.* subsp. *leontopodium*. The obtained results indicate a possible close relationship between *C. banaticum* and *C. grandiflorum* (but not with morphologically similar *C. arvense*).

S.28-20-P

Key species spatial genetic pattern in Mediterranean rivers from north-central Chile.

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Patterns of genetic variation are the result of both historical and contemporary interaction among populations. During the last years, the graph theory allows to describe this variation across the heterogeneity of the landscape and offers information about ecology, evolution and conservation at a multispecific level. In the present study, two fish species (*Basilichthys microlepidotus* and *Trichomycterus areolatus*) and two aquatic insects (*Smicridea annulicornis* and *Andesiops torrens*) were sampled in three sites within four isolated drainages. Variation of AFLP (Amplified Fragment Length Polymorphism) was analyzed by using the graph theory. The topology networks showed different number of links for each species, ranging from 15 in *S. annulicornis* and 18 in *B. microlepidotus*. The analysis of extension and compression showed a different pattern for each species. The four species present different pattern of spatial genetic variation drive mainly by dispersal. Due to the low number of links the catfish *T. areolatus* is the most sensitive species in our study. The low connectivity among population among and within drainages predicts a probably decline of the populations in this scenario with environmental changes. Financial support: Fondecyt 1100341, PFB-23, ICM P05-002

S.28-21-O

Drought-adaptation potential in European beech in the face of climate change.

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Rapid evolution based on standing genetic variation is essential for species persistence especially under expected climate change scenarios, such as drier summers in Central Europe. If tree genotypes at the moisture boundary of the species climatic envelope are adapted to lower moisture availability, they can serve as seed source to increase long-term local resistance of forests. We studied potentially adaptive as well as neutral genetic variation in European beech (*Fagus sylvatica* L.) at three dry and mesic site pairs within Switzerland using an AFLP genome scan approach ($N_{ind.} = 241$, $N_{markers} = 517$). Moreover, we linked the genetic dataset with dendrochronological characteristics and environmental variables. Genetic diversity was slightly decreased at dry sites. Overall genetic differentiation was low ($F_{st} = 0.028$) and Bayesian cluster analysis grouped all populations together suggesting restricted historical influence on the genetic dataset. The Bayesian outlier analysis indicated differences in three markers between all dry and mesic sites of which the frequencies of two markers were related to the soil water holding capacity. Within individual regions, additional markers indicated divergent selection between dry and mesic sites. At dry sites, average ring-width was reduced and trees were more drought-sensitive between 1930 and 2006. But in recent years, trees at mesic sites showed increased drought-sensitivity compared to trees at drier sites. The discussion of the joint analyses of the genetic and dendroecological results will improve our understanding of the drought-adaptation potential of European beech for sustainable forest management.

S.28-22-P

Male fecundity and pollen dispersal in populations of a riparian tree species.

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The threatened tree *Frangula alnus baetica* (Rhamnaceae) is largely restricted to the understory of riparian forests along creeks in southern Spain. Previous studies have shown that this entomophilous species is self-incompatible and that populations typically exhibit low seed set due to a limited availability of cross pollen. However, the spatial patterns of effective pollen movement within and among populations remain unknown. We GIS-mapped all reproductive trees in four *Frangula* stands and collected a total of 960 seeds that we genotyped with microsatellites. Paternity analyses and a Bayesian modelling approach were used to estimate trees' reproductive success and pollen dispersal. Results indicate that a few trees within each population are disproportionately fecund while most trees sire only few seeds. This pattern is not related with intrinsic factors such as plant size or age. Although most pollen dispersal spans short distances, movements over hundreds of metres are not uncommon and a notable amount of pollen immigration was detected in all populations. Our study illustrates that extensive pollen dispersal can overcome possible limitations to gene flow imposed by the lineal population structure typical of riparian species.

S.28-23-O

Genetics of colonization and adaptation in *Arabidopsis lyrata*.

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As plants have recolonized northern areas after glacial periods, they have undergone many demographic changes influencing the genome. Many populations have also become locally adapted to their environments and a large proportion of plants show evidence of such adaptation. The detailed genetics underlying this is still poorly known. What is the nature of the loci, do individual loci show tradeoffs, what kind of selection can be detected at the underlying loci? We examine these questions in *Arabidopsis lyrata*, a short lived perennial outcrossing self-incompatible herb. We have conducted reciprocal transplant experiment of populations in Northern Europe, Central Europe and southeastern US to show evidence of local adaptation and to examine traits responsible for the adaptation. F2-generations of reciprocal crosses with different parental cytoplasm were also grown at these sites to examine the genetics of adaptation, especially of phenology. Further, we have analysed sequence variation at candidate genes for flowering time and reference loci to search for patterns indicating selection.

S.28-24-O

Genetics explains population differentiation in a sexual dimorphic plant species.

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Evolution of mating systems in flowering plants results from the interaction among ecological and genetic traits of populations. Variation in reproductive features across the distribution range of species offers opportunities to investigate the factors driving this process. The use of genetic markers allows the assessment of the underlying processes and ecological/evolutionary consequences of variation in reproductive traits. *Narcissus papyraceus*, a common geophyte plant in Western Mediterranean Basin, has long- and short-styled flower morphs within populations in variable ratios. Past work has assessed the importance of pollinator shifts as an ecological factor governing this variation. Other unexplored agents, such as climate or the genetic composition of populations, represent the goal of this study. Using SSR markers applied on a total of 512 individuals from 31 populations across the species' distribution range, we studied the population genetics of the species, and evaluated the relationship between genetic diversity and floral morph ratio. Flower morphs tended to be genetically differentiated from each other and high genetic variability within populations correlated positively with their diversity. Opposite, extreme climatic patterns reduced the short-styled morph frequency. We conclude that the loss of genetic variation and/or the harshness of climatic conditions could significantly reduce the diversity of flower morphs in *N. papyraceus* populations. This effect might be both direct on growth conditions or through climatic influence on pollinator arrays. Furthermore, in genetically diverse dimorphic populations, some ecological factor, such as variation in mating patterns, could account for the incipient genetic differentiation among flower morphs. The ecological and evolutionary implications of these results are discussed.

Dam perturbations on freshwater systems in north-central Chile: testing the effect on *Basilichthys microlepidodus* (Teleostei, Atherinopsidae).

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The diversity of freshwater living organisms is currently in crisis due to the many impact produced by humans. One of the main threats for the biota of these systems is that posed by dams, since they produce both fragmentation and changes of the habitat. In Chile, 64% of the freshwater fish species are classified as threatened; the fragmentation of the habitat has been suggested as one of the principal causes of the vulnerability of the silverside *Basilichthys microlepidodus*. We analyzed five rivers with dams in north-central Chile in order to determine their effects on habitat quality and the consequences of the fragmentation and degradation of the environment on the populations of *B. microlepidodus* above and below each dam. The majority of the physicochemical parameters did not show differences above and below the dams, although in some case there was an increase of available metal downstreams. No genetic differentiation was found between populations isolated by the dams; however, effective population sizes were smaller above the dams. The results indicate that the negative effect of the dams on *B. microlepidodus* would be mainly due to fragmentation and reduced river channels in these Mediterranean semi-arid systems since the interruption of gene flow along the river decrease the effective size of the populations above the dams. Financial support: Fondecyt 1100341, PFB-23, ICM P05-002.

S.29- Sharing and harmonizing long-term ecosystem research and monitoring across Europe: contributions and experiences from the EnvEurope Life + project and the LTER-Europe network in 21 countries.

S.29-01-0

An environmental indicator system for Sierra Nevada LTER site (Southern Spain): conceptual framework and real implementation.

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In the context of the Sierra Nevada global change Observatory, we have designed and implemented an indicator system at this LTER site. In order to design our system, we have reviewed and discussed different ideas and concepts from several international projects, such as GLOCHAMORE, GHOST, U.S. Vital signs, EnvEurope, etc. The obtained conceptual model copes with the local needs of supplying knowledge to managers and scientists and will be compatible at a broader scale with some of the previously mentioned initiatives. In this first stage, our measure target is the habitat type, although we will consider others spatial entities soon (municipalities, catchments areas, etc.) In this study we show the theoretical framework and the steps that we have taken to implement it. Indicators are obtained from 25 different monitoring protocols that are collecting raw data in Sierra Nevada. These protocols provide information of over 100 environmental parameters that can be considered as surrogates of ecosystem functions. The simplest indicator is obtained when a parameter (i.e. 10-min temperature) is processed by a given algorithm (eg. average), and both a temporal range (eg. yearly) and a spatial context (eg. watershed) are added. We obtain an indicator called: annual average temperature in a given watershed. Each indicator is labeled following the OECD Pressure-State-Response framework. We have implemented this theoretical framework using an information system that is able to document, manage and process all the information from the raw data to the synthetic indicators. We show results obtained for the *Quercus pyrenaica* forests. We have designed 16 indicators (9 state; 4 pressure; 3 response). State indicators take into account resilience (4 indicators), function (2 indicators) and structural organization (2 indicators) of the ecosystem. Further developments and applications of the theoretical framework are discussed in terms of adaptive management of LTER sites. Thanks to LTER network, we will be able to test our indicator system and compare it with the system that EnvEurope is developing at a broader scale. LTER is also a unique framework for the development of our system because we can contact with similar initiatives that are carrying out in other nodes.

S.29-02-O

Correspondence trials between fresh and marine waters: opportunities from the EnvEurope-Long Term Ecological Research Network.

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The importance of agreed indicators or parameter sets based on common conceptual background is recognized and requested to promote an efficient governance of ecosystems. Long-term data appear fundamental to select the more easily measurable and most predictive indicators. In addition it is advocated the development of uniform methodologies and calibration systems based on which historical data might be elaborated and new data collected in a consistent way. Freshwater and marine ecosystems may represent a good starting point to test the efficacy of some selected indicators in the ecosystem comparison approach. Several attempts have been made using chlorophyll data to analyse the evolution of water quality. Indeed chlorophyll proved to be effective in describing the trophic state of both fresh and marine waters. Also optical properties can be compared and used to scale up ecosystem process to a global perspective, as for example by remote sensing. Although to date little used, a rising tool may be provided by the stoichiometric approach. The assessment of stoichiometric changes in the biomass of organisms seems also promising in view of the comparison between aquatic and terrestrial ecosystems. In this work we compare, as a case study from Italy, freshwater and marine ecosystems, included in the project EnvEurope and in E-LTER. We aim basically at investigating the opportunities of the trans-ecodomain approach, for: i) evaluating and understanding ecosystem changes through time, identifying common local and regional/global causes; ii) assessing the possibility to integrate and scaling up the environmental information; iii) developing joint scientific hypotheses.

S.29-03-O

Remote sensing products to derive LTER landscape ecological indicators.

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This contribution stresses the need to synergize efforts from LTER-Europe and GMES/SEIS initiatives in order to enhance data quality and provide in situ assessment of usability and applicability of large scale remote sensing products for long term ecosystem monitoring in Europe. The most suitable set of GMES products to be widely used by LTER-Europe network come from the GMES Land Monitoring Service. The main reason behind is the proportion of terrestrial sites (including continental wetlands) versus marine sites in the network. Yet, GMES Marine Environment and Atmosphere Monitoring Services have to be deeply explored as well. Within Land Services, BioPar (Biogeophysical Parameters) integrated in the Geoland Project, match most of the ecological parameters and indicators datasets targeted by LTER-Europe. Obviously, products provided by Euroland, Forest, Agri-Environmental and Land Carbon mapping services, should be considered as potential ancillary products. BioPar products at different spatial and temporal resolutions provide interesting surrogates for ecosystems functioning parameters. GMES products are provided at several resolutions according to source sensors going from 1 km down to 200 m. LTER-Europe sites range from few square meters to hundred of hectares according to ground reference for every measurement. Ground truth-data provided by LTER-Europe sites should have to be disaggregated by using available upscaling approaches. We propose a unified method to upscale ground LTER parameters to landscape scale to be compared with remote sensing products.

S.29-04-O

Carbon budget of a disturbed Norway spruce forest.

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Environment Agency Austria. Environment Agency Austria. Forest Research Center. Forest Research Center. Environment Agency Austria.

Disturbances are major drivers of carbon pools and fluxes in forest ecosystems. We used 17 years of carbon monitoring data from the LTER Site Zöbelboden in Austria together with measurements of soil respiration. We studied two adjacent mountain forest ecosystems. One plot is covered by a dense mature forest and another is affected by disturbances. The structure of the disturbed forest is gradually opening since the year 2004 due to storm damage followed by bark beetle outbreak. We established a carbon budget for both sites using long-term pool and flux data. Presently, the difference between the two sites with respect to CO₂ release from the soil is small. Soil respiration showed only marginal differences (5.7 t C ha⁻¹y⁻¹ for the mature and 5.2 C ha⁻¹y⁻¹ for the disturbed site). Nevertheless, the decline of the carbon stock due to the loss of biomass is already evident. Unlike the mature stand, which is a carbon sink of 1.1 t C ha⁻¹y⁻¹, the disturbed forest shows a balanced C budget. Bark beetle damage is continuing and will lead to a further decline in stand density most probably enhancing soil respiration and turning the forest into a C source. The study illustrates that long-term data is a key to disentangling the natural variation of ecosystem processes from the effects of disturbance.

S.29-05-O

Conceptual framework for indicator assignment and selection for LTER-sites.

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The current state of parameters measured at LTER sites is characterized by a high diversity of reasons and ideas behind. Parameters are covering abiotic and biotic conditions, focusing on ecosystems, biodiversity, structures, processes etc.. A common approach linking parameters to indicators and indicators to overarching concepts is still missing, although there are a lot of indicator initiatives like e.g. SEBI 2010, GEO BON, the EEA core set of environmental indicators etc. often serving specific needs for terrestrial, freshwater or marine environments. We compare the (1) DPSIR model (Driver-Pressure-State-Impact-Response), the (2) concept of ecological integrity and that of (3) ecosystem goods and services and evaluate their suitability for LTER sites. Most of the typical LTER parameters point at the state of ecosystems, which is influenced by e.g. the “pressure” of land use. The state itself is the base for several ecosystem goods and services. The ecological integrity concept turned out to be most convincing in terms of covering the activities at LTER sites. Ecological integrity is defined as a political target for the preservation against non-specific ecological risks, which are general disturbances of the self-organizing capacity of ecological systems based on ecological processes and structures. We demonstrate the application of this concept including the linking to parameters of LTER sites.

S.29-06-O

Wildlife long term monitoring in highly pressured LTER nodes: population trends and land use changes.

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Can Balasc Biological Station- Collserola Natural Park.

Protected nature sites located in areas subject to intense artificial transformation represent an important opportunity to discern at first hand the effects of human pressure on biodiversity and ecological processes. At the Can Balasc Biological Station, situated in Collserola Park, an LTER Site situated in the Barcelona Metropolitan Area, diverse monitoring studies have been undertaken on the population trends of wildlife groups and species that are of interest as indicators for the management of this protected area. Some of these monitoring studies have been ongoing for more than 20 years, basically of fauna, of protected species, but also of conflict species and exotic invasive species. Likewise, using radio tracking methods combined with the elaboration of specific habitat maps for different mammal species, aspects of landscape ecology have also been studied, such as habitat fragmentation and ecological connectivity in relation to urban planning, and the process of changes in the landscape with regard to the development of transport infrastructure and urbanization. The experience obtained from the long-term applied research undertaken in Collserola may be extrapolated to the as yet incipient problems that are being observed in other less pressured protected areas.

S.29-07-P

Methodology of long term studies of forest soil mesofauna.

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Soil mesofauna plays an important role in decomposition of dead organic matter. However, it is rarely included in the long term research programs. Since 1992 studies of the effects of climate warming on soil mesofauna were performed by the Long Term Ecological Research (LTER) network of Latvia. Special methodology was adapted for the studies. To avoid confusion with the climate impact of forest succession, three forest sites of different age were selected for the studies: 30-40 years-old, 60-70 years-old and 150-200 years-old pine forests. To avoid soil disturbance, sampling was performed only once per year when according to previous studies soil mesofauna had the highest abundance and species diversity. To reduce the variation of the data and increase the species richness, sample size for microarthropods was n=100 (the size of soil core 5 sq. cm, 10 cm depth) and for Encytraeidae n=30 (20 sq. cm, 10 cm depth). Systematically random sampling was performed on four parallel transects crossing the sample plot. To avoid holes left by the previous sampling occasions each year transects were moved for 1 m distance. Extraction of microarthropods was performed by high gradient extractor. Wet funnel techniques were used for extraction of Encytraeidae. Species richness of collembola reached 20-30 species and that of oribatid mites 50-60 species per sample. The data obtained provided good background for the analysis and interpretation of the long term effects of climate warming on soil mesofauna. Decrease in species richness of soil collembola and predatory Gamasina mites was found on the background of increase of positive temperature (>+4oC) sums during the ten year period of studies.

S.29-08-O

Low impact on plant diversity after 18 years of grazing exclusion in alpine grasslands.

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Grazing decrease is thought to be a major threat to alpine plant diversity. The aim of this study is to elucidate plant community responses to grazing cessation in alpine grasslands. As part of an LTER program in the Ordesa and Monte Perdido National Park (central Pyrenees), we monitored plant diversity in permanent transects (point quadrat method) within two exclosures and control sites during 18 years. We tested the effects of lack of grazing on species richness, phylogenetic diversity and community composition, as a smooth non-linear function of time using generalized additive models. In addition, temporal variation of phylogenetic structure and life history traits were examined to provide insight into the processes that underpin the observed response. Grazing exclusion did not alter species richness, whereas phylogenetic diversity showed an increasing trend that became significantly different from the original community only after 14 years. Year-to-year plant composition turnover was higher in exclosures than in control sites, and the abundance of some phylogenetically closely related species reversed in absence of grazing. Our results support that grazing from cattle is controlling plant composition of alpine grasslands, but suggest that in absence of grazing, diversity responses are likely to be modest and slow in the medium term.

S.29-09-P

A flexible metadata system to document ecological data from Sierra Nevada LTER site.

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The Sierra Nevada Global Change Observatory is a monitoring program aiming to assess impacts of global change at Sierra Nevada LTER-site (a Biosphere Reserve located in southern Spain). Metadata (i.e. documentation of information) is a key issue to manage both raw data and scientific knowledge in an environmental information's system context. Metadata describe several important aspects of data (content, context, quality, structure, etc.). Herein we summarize a flexible metadata system developed to document ecological data generated by monitoring programs. This system allows both semiautomatic documentation of raw data stored in relational databases, and manually documentation of not standardized information (texts, slides, etc.) of the project. Specifically, our metadata system performs: i) Highly detailed documentation of data according to a metadata internal specification, ii) Storage of metadata files in a searchable catalog, iii) Export metadata files in several international specifications applying crosswalks tools, iv) Validation of metadata, v) Publication of metadata files in scientific international clearinghouses (i.e. NBII, ILTER, GBIF) and replication in Environmental Information Network of the Environment Government Agencies (regional, national, European). Actually this approach allows us to provide metadata both to the ecological scientific community through EML (Ecological Metadata Language) specifications, and to national and regional environment governments using the metadata specifications of the INSPIRE (Infrastructure for Spatial Information in the European Community) Directive. Also, the versatility of our systems allows us to enhance the interoperability with different initiatives that use other metadata specifications .

S.29-10-P

An environmental model repository: Case studies applied to Sierra Nevada LTER site.

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In this work, we present the development of a tool, available from the Internet, to store and execute environmental models, called ModeleR. Using this tool is possible to document an environmental model through a metadata specification. This process takes into account: data sources (internal datasets or EML sources), different algorithms used to execute the model, and the results obtained during the execution of workflow. We use Kepler software as the workflow management system. This allows to remotely execute models. So, an user or computer (via Web Services) selects a model, and this model will execute on a server machine. Once the execution is finished, ModeleR send a email to the user with a link to output data and log file describing the whole process. ModeleR is being used to implement the environmental indicator system that we have developed in Sierra Nevada LTER site. We will show two examples of environmental models integrated in ModeleR. The first example is about the creation of indicators that show the snowpack status in Sierra Nevada (snow duration, onset date, etc.) using MODIS images (MOD10A2 product). The workflow processes each image (1 image each 8 days) and aggregate the snow data for each pixel that covers Sierra Nevada. The second example shows the processing of raw data coming from 65 meteorological stations located in Sierra Nevada. The primary data is received every day via e-mail as attached files, that are automatically downloaded to be normalized and stored in a relational database.

S.29-11-O

Prognosis of climate change effect on ecosystems based on long-term reservoir research.

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Biology Centre, Academy of Sciences, Czech Rep.. Biology Centre, Academy of Sciences, Czech Rep.

Chemical and biological data were gathered in two Czech canyon-shaped reservoirs - LTER sites. We have studied them in three-week intervals since 1958 in Slapy (SL) and 1979 in Římov (RI). They are multipurpose: mainly hydropower generation in SL and drinking water source in RI. They differ remarkably in volume (SL 270x10⁶ m³ and RI 34.3x10⁶ m³), catchment area (12213 km² and 489 km²) and water residence time (38 and 96 days). RI is regularly frozen each winter. Average seasonal cycle of pelagic biota was constructed from long-term data in both reservoirs and the start of the vernal chlorophyll (CHL) peak (day of CHL increase above 5µg L⁻¹) for each year related to the North Atlantic Oscillation (NAO) Index of the preceding winter. A negative correlation ($r = -0.838$) between the onset of vernal CHL increase (days from Jan. 1) and NAO of the preceding winter was found in SL, compared to RI with lower correlation only ($r = -0.721$). On the other hand, the duration of vernal CHL peak in RI positively correlated ($r = 0.810$) with NAO of the preceding winter, whereas no correlation was found in SL. Human activities in catchments of both reservoirs (fertilizers dosage, sewage treatment, pre-impoundments) resulted in changed nutrient loading. Then subsequent changes in phosphorus concentration and phytoplankton development (Cyanophyceae blooms) in reservoirs are documented. It was shown that long-term parallel investigations in morphometrically different reservoirs might explain climate effect upon ecosystem functioning and, consequently, help to propose management measures for maintaining relevant water quality.

S.29-12-O

Long-term development in the ecological status of Lake Päijänne: pressures and responses.

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Lake Päijänne (1 116 km², max. depth 95 m) is one of the largest lakes in Finland. Water quality and aquatic communities of the lake have been monitored intensively since 1960s and the lake belongs to the LTER-Europe network. Through history of the lakewater quality has remained relatively unchanged and ecological status good in many parts of the lake. However, other parts of Lake Päijänne have gone through a pollution / eutrophication development from 1) pre-industrial phase (until early 1900's) to 2) pollution by wood processing industry and municipal wastewaters (from 1930's to 1980's) and finally to 3) the phase of recovery (since 1990's). Therefore, Lake Päijänne offers an excellent opportunity to conduct cause-effect analysis of the historical development of the lake's ecological state using available 1) historical subfossil data on diatoms and chironomid midges, 2) contemporary biological monitoring data on macrophytes, phytoplankton, zooplankton, macroinvertebrates and fish as well as 3) time-series data on water chemistry, nutrient loading and other industrial effluents. Water quality of Lake Päijänne has clearly improved in the areas receiving highest loading of nutrients and pollutants due to changes in the industrial processes and implementation of efficient purification plants for industrial and municipal wastewaters. During the recovery phase of the lake, epilimnial phosphorus concentrations have clearly decreased and hypolimnial oxygen conditions improved in the areas of most intensive loadings. However, nitrogen loading is still considerable and the criteria of good water quality status are not met for nitrogen concentrations in human disturbed parts of the lake. In 1970s and 1980s, phytoplankton and macroinvertebrate communities indicated eutrophic conditions and hypolimnial anoxia in many parts of the lake. Nowadays, aquatic communities are, however, indicating good ecological status in nearly all parts of the lake. Good status of Lake Päijänne is important for the ecosystem services provided by the lake: 1) it is a source of drinking water for over one million people, 2) it is important commercial and recreational fishery and 3) it supports recreational activities for humans and tourism of high economic value.

S.29-13-O

Long term ecological research in practice: challenging the unpredictable in a changing world.

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Since its foundation the LTER programme has aimed at documenting changes in ecosystems and ecological processes and their effects on global environmental health and security. Causes of change are multiparametric, complex and often hidden by confounding factors. Ecosystem responses are rarely linear and most often non-linear with possible phase and regime shifts. Understanding processes and forecasting changes are only possible with combining mechanistic short-term experiments with long-term studies, cross-site comparison and synthesis. This is the former and strong foundation of LTER. New and complex questions are now challenging LTER: atmosphere and climate alterations and the cascade of altered processes and feedbacks, increasing water demand and contamination, biological invasions and species extinctions. Structure and processes of the majority of ecosystems and related services are now threatened by a variety of pressures and impacts (see Millennium Ecosystem Assessment). Global changes in a global world are the most challenging and unpredictable key marks, that underlie non-linear responses of ecosystems and cross-scale phenomena. They can be assessed primarily at large geographic scales and with a long term perspective. However, global processes could be amplified by local factors, whose understanding require a networking approach, with a strong connectivity among sites, where similar questions/phenomena are tackled and with Regional LTER networks such as LTER Europe. Finally, the sustainability and persistence of safe ecosystems and human wellbeing will likely depend on how citizens will perceive ecosystems and their services. However, the primary mission of LTER is to generate and test ecological theory to understand and predict ecological feedbacks to changes at multiple spatial and temporal scales. This scientific background is then a key support to decision and policies to enforce mitigation and adaptive strategies to changes.

S.29-14-P

Morphological and physiological differences in juvenile and mature needles of 3 different conifer species - *Pinus halepensis*, *P. nigra* and *P. pinea*.

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Three different Mediterranean conifer species - *Pinus halepensis* Mill., *Pinus nigra* J. F. Arnold and *Pinus pinea* L. were studied to compare age dependent changes in needle anatomy, physiology and chemical composition. Juvenile needles of seedlings and current year, 1 and 2 year old needles from adult trees were examined. Differences between species are smaller than between age classes. Physiological data are more similar than morphological. Trade-offs between structural and photosynthetic tissue can provide information on conifer needle photosynthetic differentiation along time gradient and explain keeping juvenile needles until necessary for being more fit for drought stress.

S.29-15-O

Spatio-temporal relationships between below-canopy and open-field microclimate.

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What is the temporal relationship between regional weather fluctuations and subsequent changes in below-canopy microclimate conditions? Previous studies reported a general moderating effect of forest canopy on temperature, air humidity and other meteorological parameters. A more thorough understanding of the non-linear linkage between below-canopy and regional microclimate in different settings and contexts is important to evaluate how regional weather translates into a microclimate potentially detrimental for growth of forest plants, particularly tree seedlings. Ultimately, such knowledge allows to evaluate the sensitivity forest ecosystems with regards to climate change. Here we studied how below-canopy microclimate is influenced by regional weather fluctuations at different temporal scales and the extent to which the observed relationships depend on local factors such as forest stand characteristics, physiographic settings (altitude, aspect, slope) and soil properties. Therefore, long-term meteorological data (1997-2011) from 14 sites within the Swiss LWF (Long-term Forest Ecosystem Research), each of them equipped with one meteorological station within and one outside of the stand, was analyzed. Our results show for example that during the growing season, daytime temperatures consistently peaked at lower values and at earlier times below canopy. These differences were more pronounced during hot spells. Minimum nighttime temperatures were only slightly higher and were reached more or less at the same time below canopy as in the open field, irrespective of the prevailing weather conditions. Humidity was generally increased below canopy. During hot spells this effect was much stronger if the preceding period was moist than when it was already dry.

S.30- Ecology and evolution of dispersal in a rapidly changing environment: from understanding to conservation strategies

S.30-01-P

Genetic variability of two lacertid lizard species in fragmented habitats in Bulgaria and Germany.

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Habitat loss, fragmentation, and structural changes of habitats are considered to be the major causes of an increasing rate of species extinction in recent decades. However, some species seem to be at a greater risk in fragmented landscapes than others. To investigate the effect of recent anthropogenic habitat fragmentation, we set out a project analysing the genetic variability of the Sand Lizard (*Lacerta agilis*) and the Green Lizard (*L. viridis*) in Bulgaria and Germany. Both species face severe habitat fragmentation in some regions of their occurrence and are hence suitable models to study the impact of habitat reduction and isolation employing genetic markers. Whereas Bulgaria represents the distributional edge of *L. agilis* and lies within the distributional core of *L. viridis*, the situation is the opposite in Germany. Depending on the occurrence within the distribution area species display more stenoecious or euryoecious characteristics. We hypothesize that depending on these characteristics the sensitivity towards habitat fragmentation differs. Hence we will compare the genetic diversity of Bulgarian and German fragmented populations for both species to reveal insight into possible causes of the differential fragmentation sensitivity. Here we report on the results of the Bulgarian study. We sampled 20 individuals per population in four fragmented and two non-fragmented populations each of *L. agilis* and *L. viridis*. 21 to 24 microsatellite loci were analysed to explore differences in population structure and genetic diversity. Additionally, we characterised the habitats to find potential correlations with genetic results. First results of this analysis will be presented on the poster.

S.30-02-O

Population consequences of movement behaviour in patchy landscapes.

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It is well established that the movement rules that the individual uses determine its dispersal success. A simple model is presented which links between-patch movement with population dynamics in order to explore the effect the dispersal behaviour has on individual success and on the population level indices (such as patch occupancy and connectivity). The animal movement was implemented as a variant of the biased-correlated random walk. We demonstrate that both the perceptual abilities (perceptive range), and more importantly the individuals' response to the perceived landscape are shaped by a spatiotemporal structure of the landscape and may be under different selection pressures at different organisational levels. The results support the plea for inclusion of movement decisions in the demographic models as it may provide a much better mechanistic understanding of population processes.

S.30-03-O

Effects of density and genetic relatedness on the dispersal kernel in *Tetranychus urticae*.

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Academie Louvain. Universite Montpellier II. Academie Louvain. Gent University. Academie Louvain.

Dispersal kernels are defined as the probability density function of the dispersal distance for an individual or population, or the probability that a dispersing organism will travel a certain distance before it settles. They are increasingly used in theoretical and more currently, empirical studies. Dispersal kernels must be considered when studying population dynamics and invasive species, as the individuals who disperse the furthest from their natal habitat will be those with the best chance of starting new populations. Here we test the effects of initial population density and genetic relatedness on the parameters of the dispersal kernel of *Tetranychus urticae*, the two-spotted spider mite. Using four different initial population densities (10, 50, 100, 150 individuals) and two levels of genetic relatedness (0 and 0.2), we performed linear multi-patch experiments to determine how far and at what proportions the mites dispersed. The mites were placed at different densities on an initial starting patch (bean leaf) connected linearly via parafilm bridges to other patches. Our experiment demonstrated that both density and relatedness affect the shape of the dispersal kernel. Dispersal density clearly affects the tail of the dispersal kernel, with longer dispersal distances under high densities. Moreover, a negative exponential kernel emerged in the genetically related populations whereas a uniform distribution kernel was observed in the stock unrelated population. These results indicate that density and genetic relatedness can affect the dispersal kernel and should therefore be taken into account when using modeling to predict the spread of species.

S.30-04-O

A modelling framework for linking individual-based population dynamics and functional connectivity to predict and manage species responses to environmental changes.

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University of Aberdeen. Univeristy of Aegean. Univeristy of Aegean and UFZ. Finnish Environment Institute (Syke). University of Aberdeen.

Habitat fragmentation, land-use changes and climate change are nowadays some of the major threats to species persistence; understanding species responses to these pressures is recognised as fundamental for their management and conservation. In particular dispersal is a crucial mechanism that must be considered and better understood for making reliable projections on species responses to environmental changes. Simulation models can help this understanding. I will present an individual-based modelling framework, which aims to link population dynamics with mechanistic modelling of dispersal behaviour, recognised as a process deeply influenced by the interaction between individuals' characteristics/behaviours and the landscape structure (resulting in functional connectivity). The model includes habitat association and climate requirements thus allowing projections of biodiversity responses to allowing different scenarios of future environmental changes. Therefore this framework, starting from the awareness that ecological processes emerge from individual behaviour, which itself is expressed in interaction with the local environment, offers the potential for understanding and predicting how species will respond to different (and potentially interacting) pressures, for identifying major obstacles to their persistence at the landscape level and for in-silico testing of alternative management strategies.

S.30-05-P

Dispersal evolution during range shifting dynamics.

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Anthropogenic influences like global warming and habitat fragmentation are affecting ecosystems all over the world. Species can either adapt to their changing environment, shift their range or go extinct. My research focuses on the interplay between (evolving) dispersal traits and the spatial configuration a species finds itself in. I try to improve our understanding of the dispersal process using individual based models. Although these models strongly simplify reality they can produce counterintuitive results and help us to gain new insights. For now I am running single species models in different types of fractal landscapes and allow evolution of the mean dispersal distance. I will present insights on how the interaction between landscape configuration and the speed of shifting climate windows affects the evolution of dispersal distance and in which cases this results in evolutionary trapping and rescue.

S.30-06-O

Assessing the importance of dispersal related mechanisms in determining the spatial patterns of the abundance of species.

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CNRS. UQAR. CNRS.

Here, we propose a new framework to model the abundance of species and to disentangle processes underlying presence-absence from those related to a variation in abundance. Using semi-mechanistic approaches, we assess the relative importance of regional drivers, community scale factors and dispersal related mechanisms for plant species distributions in the French Alps. We find that the spatial effect, scaled to the species dispersal distance is the main driver of species presence. The variation in abundance is also sensitive to dispersal related mechanisms but is mainly explained by the effect of the local community. Using a comparison of several predictions in the climatic space, we suggest that the main process would be dispersal limitation. We conclude that it is necessary to distinguish the different scales of processes and account for dispersal related mechanisms to understand and predict species distributions.

S.30-07-O

Evolution and distribution of dispersal probabilities in metapopulations under climate change.

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Wageningen University, Wageningen UR. Alterra, Wageningen UR. Alterra, Wageningen UR. Wageningen University, Wageningen UR. Alterra, Wageningen UR. Plant Research International, Wageningen UR.

To survive climate change populations need to either move or adapt. Dispersal is a key life history trait in both responses. We investigated how genotypes coding for different levels of dispersal probability were spatially distributed in a landscape before, during and after a period of temperature increase. We specifically asked how: - the equilibrium distribution of dispersal probabilities was changed as a result of selection and demographic processes induced by temperature increase, - this process was affected by the level of temperature variation, - the changing distribution was affecting metapopulation size, - the original distribution could be regained after climate change was stopped. For this we used our individual-based and spatially explicit genetic metapopulation model METAPHOR Genetics (Cobben et al. in press *Ecography*). In the model temperature zones were simulated to move across the landscape simulating both temperature increase and temperature variation, following different IPCC scenarios. Reproduction, dispersal and survival rates of the model species were based on population density and habitat quality. Habitat quality was controlled by time and location specific temperature. Genetic inheritance was diploid and the model allowed mutations and recombination. The first results showed that: - under equilibrium conditions the dispersal probability was higher in the range margins, - the genetic composition in the newly colonised area was mainly the result of the demographic process (allele surfing), - this could cause local maladaptation while the range was shifting, leading to decreased metapopulation size, - selection could cause re-establishment of the optimal distribution under certain conditions after temperature increase had stopped.

S.30-08-P

Belowground biota affect short and long distance dispersal of an aboveground living herbivore.

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Plant quality and aboveground herbivore performance are strongly influenced by soil communities. Because dispersal of herbivores is a conditional strategy relative to plant quality, we examined whether belowground biotic interactions, here the presence of root feeding nematodes or arbuscular mycorrhizal fungi (AMF), affect dispersal of an aboveground living herbivore (i.e. the spider mite, *Tetranychus urticae*). Since these herbivorous mites perform unique pre-dispersal behaviour under laboratory conditions, we were able to distinguish long (aerial) and short (ambulatory) distance dispersal strategies. We found aerial dispersal to be positively dependent on the density of mites on the host. When arriving at new leaves, ambulatory dispersal was, however, negatively correlated to the mite density on the colonised, intact leaf. Treating plants with nematodes induced an increase of both dispersal modes, although only rates of ambulatory dispersal were accompanied by a shift in the density-threshold. Individuals that showed aerial dispersal behaviour also dispersed more by means of ambulatory movements than their non-aerially dispersing conspecifics. These results highlight that belowground herbivores are able to affect population dynamics of aboveground living herbivores by altering both short- and long-distance dispersal strategies and that short distance dispersal strategies depend on previous decision-taking during long distance dispersal. AMF-treatment of the plants didn't affect the two mite dispersal modes in a significant way.

Climate-dependence of landscape effects on dispersal behavior.

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Climate and landscape changes are two of the greatest threats to biodiversity. Their separated effects are frequently studied, however the interacting effect of two human-driven environmental changes is rarely considered. Dispersal is of dramatic importance for population functioning, gene flow, species evolution and persistence in face of local extinctions. It is therefore a crucial factor for species tolerance to both landscape and climate changes. Human activities can affect landscapes through both spatial (habitat loss, fragmentation) and temporal (habitat stochasticity) dimensions. Habitat stochasticity drives dispersal by increasing the benefits of escaping local extinctions (e.g. spatial bet-hedging), and by increasing the probability to colonize competition-free patches. On the contrary, habitat loss and decreases in connectivity are supposed to increase dispersal costs, which select against dispersal propensity but favour dispersal ability. Moreover for ectotherms like butterflies, activity is strongly dependent on thermal conditions which shape costs and benefits of movement and may be an important proximal factor of dispersal. However, the effect of thermal environment on dispersal behaviour is seldom known. We examined *M. jurtina* dispersal behaviour in various thermal conditions and along a gradient of agricultural intensification causing both habitat loss and temporal stochasticity. Habitat loss caused a decrease in emigration rates and an increase in the linearity of paths. Climatic conditions changed the effect of habitat stochasticity: individuals responded to stochasticity either with short and frequent movements (i.e. local bet-hedging) or long and rare movements (i.e. long distance dispersal), the choice of which depended on thermal conditions.

S.30-10-O

Inertia: the discrepancy between individual and common good in dispersal and prospecting behaviour.

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The group selection debate of the 1960s made it clear that evolution does not necessarily increase population performance. Individuals can be selected to have traits that make population persistence difficult. At the extreme, the discrepancy between levels of selection is predicted to make traits evolve towards values at which a population can no longer persist (evolutionary suicide). Dispersal and prospecting are prime examples of traits that have a strong influence on population persistence under environmental and demographic stochasticity. Theory predicts that an 'optimal' dispersal strategy from a population point of view can differ considerably from that produced by individual-level selection. Because dispersal is frequently risky or otherwise costly, individuals are often predicted to disperse less than what would be ideal for population performance (persistence or size). We define this discrepancy as 'inertia' and examine current knowledge of its occurrence and effects on population dynamics in nature. We argue that inertia is potentially widespread but that a framework is currently lacking for predicting precisely the extent to which it has a real influence on population persistence. The opposite of inertia, 'hypermobility' (more dispersal by individuals than what maximizes population performance) remains a possibility: it is known that highest dispersal rates do not lead to best expected population performance, and examples of such high dispersal evolving exist at least in the theoretical literature. We also show, by considering prospecting behaviour, that similar issues arise in species with advanced cognitive and learning abilities. Individual prospecting strategies and the information acquired during dispersal is known to influence the decisions and therefore the fate of individuals and, as corollary, populations. Again, the willingness of individuals to sample environments might evolve to levels that are not optimal for populations. This conflict can take intriguing forms. For example, better cognitive abilities of individuals may not always lead to better population-level performance. Simulation studies have found that 'blind' dispersal can lead to better connected metapopulations than cognitively more advanced habitat choice rules: the latter can lead to too many individuals sticking to nearby safe habitat. The study of the mismatch between individual and population fitness should not be a mere intellectual exercise. Population managers typically need to take a population-level view of performance, which may necessitate human intervention if it differs from what is selected for. We conclude that our knowledge of inertia and hypermobility would advance faster if theoretical studies – without much additional effort – quantified the population consequences of the evolving traits and compared this with hypothetical (not selectively favoured) dispersal rules, and if empirical studies were similarly conducted with the differing levels of selection in mind.

S.30-11-P

Modelling the dispersion of Pallas's squirrel (*Callosciurus erythraeus*) in Southeast France: management implications.

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MNHN, UPMC, CNRS UMR 7204. MNHN, UPMC, CNRS UMR 7204. MNHN, UPMC, CNRS UMR 7204. MNHN, UPMC, CNRS UMR 7204.

Pallas's squirrel, *Callosciurus erythraeus*, a native species from Southeastern Asia, has become invasive in most countries where it has been introduced. Few individuals have been released at Cap d'Antibes (Alpes-Maritimes, Southern France) in the late 1960's and since then the population has grown, its range reaching about 1800 ha in 2010. The aim of this study is to compare different scenarios of expansion for this species, based on various scenarios of population management. For this purpose, we developed a spatially explicit individual-based model, which mimics dispersal at the landscape level. The model includes life-history parameters, habitat suitability and carrying capacity estimated in 2009 and 2010 from various methods, including trapping, transect count, and radio-tracking. Reliability of our model was evaluated against existing data on the colonization history of Pallas' squirrels. Projections are accurate and warn against the risk of invasion of this species in Mediterranean landscapes. Our results highlight the importance of such modeling tools in understanding colonization processes of introduced species, and emphasize the need to gather data on life history traits to infer realistic trajectories. Finally, our scenarios will provide management recommendations.

S.30-12-P

Mucilage segregation as a mechanism to reduce seed removal by soil erosion.

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Background and Aims Mucilage segregation in diaspores after wetting has been related to different functions but there has not been an approach to the benefit of mucilage as an adherence mechanism under erosive conditions. We want to understand the advantages of mucilage segregation for plants experiencing soil erosion and to establish a quantitative relation between the phenotypic expression and the success of seed adherence. We also aimed to know if changes in erosive conditions influence mucilage segregation in species and the specific composition of plant communities. **Methods** We related the amount of mucilage segregation with the number of drop impacts needed to remove the seeds under simulated rain in *Helianthemum violaceum* and *Fumana ericifolia* (Cistaceae) and measured seed removal distance because water runoff in seeds with and without mucilage of *H. violaceum*. Also, we compared the amount of seed mucilage segregation of plants living under erosive and non-erosive conditions and the proportion of species with mucilaginous diaspores of Mediterranean semiarid plant communities under those contrasted conditions. **Key Results** The amount of segregated mucilage positively related to longer resisting rain drop impacts in *F. ericifolia* but not in *H. violaceum* seeds. However, *H. violaceum* seeds with intact mucilage layer moved half of the distance because of runoff than those without. Moving from non-erosive to high-erosive sites, near 10% increase in mucilage segregation was found in seeds of *F. ericifolia* but a decrease of 1% in *H. violaceum*. Likewise, the presence of species with mucilaginous diaspores increases 9-28% in plant communities living in those contrasted conditions. **Conclusion** Mucilage segregation by diaspores is an effective way to reduce seed removal by erosion in plants, even if it operates in different ways depending on the species. Intensification of the exposition of plants to erosive conditions produces a quantitative response in the expression of this mechanism in one of two species tested and at community level.

S.30-13-P

Evaluating dispersal assemblage quality by differential germination success in the Spanish juniper.

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We present results of the Quality component in the dispersal assemblage of Spanish juniper forests in central Spain. Our working hypothesis is each disperser provides seeds with contrasting germination and survival opportunities at available microhabitats and environments: mature forest (MF) and new colonization areas (NCA) (abandoned agricultural lands). With this in mind, we have conducted a sowing experiment in which germinability and survival of dispersed seeds under field conditions were evaluated. We collected faeces of main dispersal agents. We sowed a total of 11840 seeds, 25% of *turdus* spp. 50% of carnivorous (marten and fox) and 25% stratified as a control. These seeds were distributed in four microhabitats: beneath adult juniper tree male and female, beneath shrub and in the open. We installed a total of 80 wire netting cages sorted out in five sampling plots in each MF and NCA. The cages were monitored periodically and seedling emergence and survival was recorded. Germinability was affected by dispersal assemblage, microsite pattern and environment. Carnivorous produced more germination than *turdus* spp. Germinability was higher in adult juniper trees and shrubs than, in open areas. Female adult trees had the highest germinability in MF and almost the lowest in NCA. Dispersal assemblage had an effect in seedling survival after the first summer, it was higher for seeds dispersed by carnivorous. MF and NCA had different survival probabilities depending on summer or winter. MF had higher survival after the first summer but NCA had higher survival after the first winter.

S.30-14-P

Reproductive plasticity in response to flight and temperature in fragmented landscapes.

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Habitat fragmentation in anthropogenic landscapes may cause changes in local environmental conditions such as; temperature, water availability and resource distribution. As such, in anthropogenic landscapes, female butterflies may be simultaneously subjected to multiple environmental factors as they fly over wider areas searching for suitable resources during oviposition. To adequately assess a species response to environmental conditions during oviposition it may therefore be necessary to consider the interaction between multiple environmental factors simultaneously. I will present data from a series of laboratory and field experiments performed using the speckled wood butterfly (*Pararge aegeria*) to examine; i) the combined effects of temperature and flight on ovarian dynamics, egg provisioning and reproductive output, and ii) how these effects subsequently influence offspring fitness. Both temperature- and flight- mediated plasticity in female reproductive output were observed, and there were strong temperature by flight interaction effects for the traits oocyte size and egg mass. Overall, temperature had more pronounced effects on ovarian dynamics than flight. Flight mainly influenced egg mass via changes in relative water content. A mismatch between the physiological response of females to high temperature and the requirements of their offspring had a negative impact on offspring fitness via effects on egg hatching success. These findings could have important consequences for *P. aegeria* population dynamics in response to climate change, particularly for populations in fragmented, warmer, drier anthropogenic landscapes.

S.30-15-O

Arrangements of habitat that facilitate range shifting: beyond stepping stones and corridors.

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Many species are already responding to climate change by shifts in their geographic distributions, but many may be prevented from shifting by lack of habitat. Species all have different starting distributions, and are predicted to shift by different distances, in different directions. Also, there is very high uncertainty around predicted range shifts. Therefore, it would be very useful to know whether there are any general properties that make a landscape of habitat easier to colonise by any species. Achieving a range shift in a highly fragmented landscape is about achieving a balance between two vital factors: Habitat clusters that are big enough to support viable populations, and distances between clusters that are small enough to facilitate colonisation. For a fixed area of habitat in a fixed landscape size, there is generally a positive relationship between the clustering of habitat and the expected colonisation time from one edge of the landscape to the opposite edge. However, it is possible to find compromise arrangements which have reasonably high clustering and reasonably short colonisation times. We demonstrate a method of picking restoration sites and show by simulations how this could increase range expansion speed for a variety of species with different dispersal distances and extinction probabilities.

S.30-16-O

Should I stay or should I go? - Rethinking species' responses to rapid climate change.

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Ongoing climate change is assumed to be exceptional because of its unprecedented velocity. However, new geophysical research suggests that dramatic climatic changes during the Late Pleistocene occurred extremely rapidly over just a few years. These abrupt changes might have been faster than contemporary ones, but relatively few continent-wide extinctions of species were documented for these periods. This raises questions about the ability of extant species to respond to ongoing climate change via dispersal and adaptation. We propose that the advances in geophysical research challenge the way we currently perceive species' ability to cope with climate change, and that lessons must be learned for modelling future impacts of climate change on species.

S.30-17-O

Ontogenetic shift in dispersal tactics and habitat preferences of the European eel: Role of social interactions?

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Cemagref. Cemagref. Cemagref. Migado. Cemagref. Cemagref.

European eels migrate between marine spawning and continental feeding areas. Investigations on otolith microchemistry indicate a large variability of movement patterns in continental habitats and raise questions about the factors controlling this dispersal variability. We used a combination of laboratory and field experiments to show that, on one hand, eel continental dispersal may be considered as a conditional strategy in which the nature and cues for movements change over ontogeny. Elvers, the young juveniles, were found to be predominantly upstream colonizers while fully metamorphosed yellow eels were predominantly settlers (i.e. non migratory). On the other hand, an ontogenetic shift was also observed in the eel habitat preferences in freshwaters. However, additional field and laboratory experiments showed no evidence that yellow eels expel elvers from their preferred habitat or trigger elver dispersal. Therefore, eel dispersal diversity in continental habitats may be controlled by an ontogenetic shift from a plastic, upstream migratory stage to a sedentary stage, but the hypothesis that social dominance of yellow eels over elvers might be a triggering factor was not confirmed. Based on a conceptual model of evolutionarily stable conditional strategy, we suggest that changes in population density under environmental change are crucial for the expression and evolution of these eel behaviours. Therefore, intra-stage density-dependent dispersal should be further investigated. These findings also point out important management decisions for the conservation of endangered eel populations.

S.30-18-P

Indefinite dispersal - Arthropod dispersal to ice-free areas on glaciers.

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Island biogeography and metacommunity theories predict species presence and absence due to distances between islands and the mainland. This may be the case for isolated islands in an ocean of hostile water but rarely on terrestrial habitats. Glaciers may be conceived as a hostile habitat to terrestrial species, but they also contain islands of land, so called nunataks and on the glacier surface there are possible dispersal corridors, i.e. moraines and scattered debris. We set out to characterize the process of primary food web assembly on nunataks on Vatnajökull glacier in Iceland. Since the end of the 19th century Vatnajökull glacier has decreased in volume by about 10% and consequently nunataks have increased both in number and size. Thus they combine the restricted boundaries of an island with different degrees of isolation and the chronological sequence within each nunatak, which is excellent for community assembly studies. Flying insects are more commonly found on the moraines than on white glacier, indicating that the moraines perhaps function as some kind of a corridor. Flying insects were also common on the nunataks, especially at locations closest to the moraines despite the fact that most of them were lacking resources to be able to establish. Dispersing but non-colonizing arthropods may be important for primary succession as they provide input of nutrients to the newly created land surface. The first colonizers, establishing before any sign of plant establishment, were small arthropods that can easily be air-borne, probably feeding on detritus and other dispersing arthropods.

S.30-19-P

Unrestricted quality of seeds in European broad-leaved tree species growing at the cold boundary of their distribution.

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- **Background and Aims:** The low temperature range limit of trees may be determined by their ability to produce and disperse viable seeds. In details, biological processes such as successful flowering, pollen transfer, pollen tube growth, fertilization, embryogenesis and seed maturation are expected to be affected by cold temperatures. Aim of the study was to compare the quality of seeds of nine broad-leaved tree species between low elevation sources and sources close to their elevational limit.
- **Methods:** The present study focuses on nine widely distributed European broad-leaved tree species (*Acer pseudoplatanus*, *Fagus sylvatica*, *Fraxinus excelsior*, *Ilex aquifolium*, *Laburnum alpinum*, *Quercus petraea*, *Sorbus aucuparia*, *Sorbus aria*, *Tilia platyphyllos*). For each species seeds were collected from stands close to optimal growth conditions (low elevation) and from marginal stands (highest elevation), replicated in two regions in the Swiss Alps. Measurements involved morphological, physiological and phenological seed traits, namely seed viability, seed weight, seed area, quality of the storage tissues and germination success.
- **Key Results:** Overall, no consistent pattern in traits were detected between low and high elevation seed sources across species. However, the concentration of nonstructural carbohydrates tends to be higher at high elevation. Additionally, in one species, *S. aucuparia*, all measured traits show significant differences towards higher seed quality in high elevation seed sources.
- **Conclusions:** These results are not in agreement with the hypothesis of reduced quality of seeds in trees at their high elevation range limits, and rather highlight that at current climatic conditions, seed quality does not constitute a serious constraint in the reproduction of broad-leaved tree species at their upper elevational limit.

S.30-20-P

Evolution and its consequences for predicting interspecific range shifts.

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Climate change compels species to 'react' in some way for the long-term persistence; possible responses are tracking the shifting climatic conditions or adapt to the new conditions, respectively. Several theoretical studies have investigated this problem, but most of these are restricted to single species approaches, i.e. consider a single species in isolation. However, many species are presumably constrained in their distribution by interactions with other (competing) species. Here we present an individual-based simulation model of metapopulations of two species competing for resources along an existing climatic gradient. For both species selection can modify adaptation to local conditions (niche dimension) and emigration probability; dispersal is limited to nearest-neighbour. Without a gradual climatic change a range border between the two species establishes initially in the middle of the world. When imposing a gradual change (increase in mean temperature) we find different responses, depending on the magnitude/speed of environmental change and species' niche width. Actually, only a restricted range of parameters leads to tracking of the range shift predicted from the moving climate envelope. Over a wide range of conditions the interspecific range border moves much slower due to evolutionary adaptation to changing conditions and in some scenarios it may not move at all. We conclude that evolutionary response has the potential to strongly alter predictions of future distributional shifts in multispecies systems and should not be underestimated in its importance.

S.30-21-O

Determinants of bush-cricket mobility - fixed or plastic?

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Habitat variability, along with habitat fragmentation, is one of the key selective forces for the evolution of dispersal. Temporal variation in habitat quality is expected to select for dispersal, while in temporally stable habitats dispersal may be selected against. Recently, negative genetic consequences were shown in the bush cricket *Pholidoptera griseoptera*, living along stable forest edges, once the amount of suitable habitat dropped below 20% and its proximity decreased substantially at the landscape scale; for the bush cricket *Metrioptera roeselii*, living in unstable grasslands, such a fragmentation threshold was not found. Using the same species in a transplant experiment between fragmented and connected landscapes, here we tested whether (i) species from unstable habitats show larger dispersal distances than those from stable ones, (ii) *M. roeselii* shows larger dispersal distances in fragmented than connected landscapes, (iii) species living in unstable habitats show higher plasticity in their dispersal than species of stable habitats. Our results showed that habitat fragmentation in combination with habitat variability leads to increased dispersal distances. *M. roeselii* from connected habitats, in contrast, showed similar dispersal distances to *P. griseoptera* and no ability to adjust their dispersal when transferred to the fragmented landscape. Also, there was no indication of plasticity in the dispersal of *P. griseoptera*. This indicates that even species from temporally unstable habitats may be threatened by habitat fragmentation when it occurs in formerly connected landscapes. Similarly, this lack of plasticity may render species vulnerable to habitat disturbance that are adapted to generally stable habitats.

S.30-22-P

A null model of individual variability in fruit removal rates - separating the straw from the chaff.

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Improving our knowledge on the functioning and evolutionary consequences of endozoochorous systems requires increasingly complex frameworks and tools. As part of this new paradigm, we need to redefine the null hypothesis traditionally used when addressing fruit removal and its relationship to animal behaviour. To approach this issue I used a model parameterized with real data to simulate fruit removal in the absence of frugivore choice mediated by crop size. Based on three different response variables (the total number of dispersed fruits, the percentage of dispersed fruits, and “relative dispersal”, a fitness surrogate relating number of fruits dispersed by each plant to the mean number dispersed in the population), my results show that a statistically significant relationship between crop size and fruit removal arises even without crop size selection by frugivores, particularly when high removal rates are predominant (i.e. when plants compete for dispersers). This effect is stronger for total number of dispersed fruits than for the other two variables. Additional simulations addressing the effect of spatial heterogeneity in removal rates (unrelated to crop size or previous removal rates) resulted in considerable variation in the slope and spread of the crop size-fruit removal relationship. Future studies should incorporate adequate null models that take due account of the intrinsic relationship between these two variables in a spatial context and its dependence on spatial heterogeneity.

S.30-23-O

Genetic signature of population fragmentation in a Kenyan cloud forest archipelago: a temporal approach.

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Habitat fragmentation can restrict geneflow, reduce neighbourhood effective population sizes, and increase genetic drift and inbreeding in small, isolated habitat remnants. The extent to which habitat fragmentation leads to population fragmentation, however, differs among landscapes and taxa. Commonly, researchers use information on the current status of a species to predict population effects of habitat fragmentation. Such methods, however, do not convey information on species-specific responses to fragmentation. Here, we compare levels of past population differentiation, estimated from microsatellite genotypes, with contemporary dispersal rates, estimated from multi-strata capture-recapture models, to infer historic changes in mobility over time in seven sympatric, forest-dependent bird species of a Kenyan cloud forest archipelago. Next, we analyze changes in genetic admixture over a recent, fifteen year (post-fragmentation) interval in the cooperatively-breeding *Phyllastrephus cabanisi*. Overall, populations of sedentary species were more strongly differentiated and clustered. However, five of seven species with broadly similar levels of genetic differentiation nevertheless differed substantially in their current dispersal rates. Post-fragmentation shifts in genetic admixture among isolated *P. cabanisi* populations showed an increase (rather than decrease) in population connectivity. We conclude that post-fragmentation levels of mobility, without reference to past population connectivity, may not be the best predictor of how forest fragmentation affects the life history of forest-dependent species. As effective conservation strategies often hinge on accurate prediction of shifts in ecological and genetic relationships among populations, conservation practices based solely upon current population abundances or movements may, in the long term, prove to be inadequate.

S.30-24-P

Does individual variation matter? Detecting individual dispersal behaviour from collective data.

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Understanding individual dispersal behaviour is important to make predictions about population spread. Individual tracks are often too short to make convincing statements and conclusion about individual behaviour is typically made from collective data. However patterns observed in collective data are not necessarily the same as at individual level. We analyzed a large dataset on walking behaviour of black bean aphids in homogeneous conditions. By scaling individual tracks to the same typical move duration and pooling tracks together we were able to demonstrate that individual aphids moved in a predominantly diffusive manner while the collective data displayed superdiffusive characteristics. We also show that it is possible to detect whether the structure in the data (organisation of data in tracks) is important without estimating parameters of the individual tracks. For more than a decade it has been hotly debated whether animal movement can be described as a Lévy flight (a type of movement when movement time/lengths are drawn from a power law distribution which leads to superdiffusive movement). In our study the observed Lévy flight-like pattern results from the cross-over between the individual dispersal behaviour and variation between individuals. This variation is likely to be even more prominent in field conditions and might play an important role in the spread of populations.

S.30-25-P

When to go prospecting? A manipulation experiment of nesting opportunities to pinpoint when information is gathered by Collared Flycatchers.

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Informed dispersal should be favored over unconditional dispersal since it can minimize the cost of failure at the individual level. For migratory birds, collecting information might be time constrained because to be successful breeding should start soon after arrival at the nesting site. Most time for prospecting is likely to be available between the end of the breeding season and winter migration. Indeed evidence suggests that birds gather information during this time in order to inform next year's dispersal decision. However, information gathered late in the season is of lower quality, since 1) offspring that could indicate the success of conspecifics have fledged already, 2) the environment resembles less the conditions at the breeding season, and 3) juveniles have lost already the guidance of the parents to explore the environment. To address these issues, I conducted a field experiment to pinpoint when prospecting occurred in the Collared Flycatcher and to study how information might influence the dispersal decision of the birds in the following year. These birds are obligatory hole-breeders. Therefore, available nest-holes are important and prospecting should gather this information. I manipulated the density of available artificial nest-holes in 18 wood lots starting at different stages during the breeding season: (1) when feeding started, (2) when fledging started, and compare this with wood lots where no special information on hole density was provided. My main hypothesis is that birds which did not find enough holes while prospecting increased their dispersal distance and dispersal rate, and that males returned earlier from their winter quarter due to their expectation of more intensive competition on the limited box. Analyses are expected to also show whether there are differences in the timing of prospecting across age classes and sex. I will discuss how the timing of prospecting could impact the schedule of migration and how it improves our insight in the decisions involved in natal and breeding dispersal.

S.30-26-O

Role of long-term history for plant species distributions across the Panama land bridge.

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Climate is generally regarded as the major determinant of species distributions at broad geographical scales. However, dispersal limitations reflecting long-term historical events can have large impacts on biodiversity patterns. About three million years ago, North and South America were connected with the formation of the Panama land bridge, resulting in extensive biotic interchange between the two continents. Now the question is: are migration lags at this very large time scale still limiting the distribution of plant species in Panama? With a combination of data from the largest botanical dataset for the New World to date, information from the paleorecord and species distribution modeling, we assess the relative roles of dispersal limitations and current environmental conditions in shaping species distributions across the Panama land bridge. We also evaluate whether the importance of history is related to species dispersal traits. Finally, we discuss the potential implications for our understanding on species' ability to track suitable areas under current rapid climate change, as well as the uncertainty migration lags pose to distribution models being used to assess the impacts of climate change on biodiversity.

S.30-27-P

Non-equilibrium with climate and vertical / horizontal distributions of evergreen broad-leaved tree species in Japan.

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To assess the effects of historical range shifts on 22 dominant/common species in the evergreen broad-leaved forests of Japan, we focused on the following two questions: (1) how about occupancy of the actual altitudinal and latitudinal ranges for each of the species in comparison to their potential habitats?; (2) how about the relationships between geographical gaps and ecological features for each species? We predicted potential habitats under the current climate using a generalized additive models. The presence/absence records of the each species were extracted from the Phytosociological Relevé Data Base as response variables, and four climatic variables (warmth index, minimum temperature of the coldest month, summer precipitation and winter precipitation) were used as predictor variables. We then compared the actual and potential distributions for (1) the 90-99% values of the northern latitudinal limit and (2) upper altitudinal limit. This study revealed that 12 target species had not reached the potential northern range limits, while almost all the species had reached their potential altitudinal upper range limits. As the results of meta-analysis based on ecological features, the geographical gaps of generalist species (high cold hardiness and low landform dependency) were relatively smaller than the specialist species. These ecological traits could be related to maintain a relict population in cryptic refugia during the glacial periods. Our results suggested that postglacial dispersal limitation caused by physical barriers and northerly relict population during the glacial periods were important in determining the geographical distribution of target species.

S.30-28-P

Dispersing acorns under the moonlight: the importance of rodent shelter.

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Different environmental factors may influence the foraging behaviour of seed dispersers which could ultimately affect seed dispersal process. In this study, we examine whether moonlight levels and the presence or absence of rodent shelter affect rodent seed removal (rate, handling time and time of removal) and seed dispersal in a rodent-dispersed oak species. The presence or absence of safe microhabitats was found to be more important than moonlight levels in the removal of seeds. Bright moonlight caused a different temporal distribution of seed removal throughout the night but only affected the overall removal rates in open microhabitats. Seeds were removed more rapidly in open microhabitat (regardless the moon phase), decreasing the time allocated to seed discrimination. Only in open microhabitats did increasing levels of moonlight decrease the time allocated to selection and removal of seeds. As a result, a finer seed selection was made under shelter, due to lower levels of predation risk. Open microhabitat was found to increase dispersal distances and seed survival (higher when farther from shelter). Proportionally more seeds were dispersed to shelter but had shorter dispersal distances and higher predation rates. Despite this, shelter is needed to ensure rodent presence and seed caching, so that structurally complex habitats with open microhabitats and shrub cover will favour oak regeneration.

S.30-29-P

Are invasives facilitated by self-compatibility? Empirical evidence from plants in their native and invasive ranges.

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A longstanding hypothesis (“Baker’s rule”) is that plant invasiveness is facilitated by an ability to forego outcrossing sexual reproduction, e.g., by floral self-compatibility rather than self-incompatibility. If the degree of self-compatibility varies among individuals, this idea further implies that invasive species found to be variably self-incompatible in their native range might be self-compatible in invading or weedy populations due to natural selection on the mating system. We compared mating system between native and invasive ranges for two major world invasives, one annual (*Echium plantagineum*) and one perennial (*Solanum elaeagnifolium*). For an additional annual species (*Centaurea solstitialis*) we compared wild and weedy populations in the native range. No species was strongly spontaneously self-pollinating, but the degree of self-compatibility after hand pollination varied dramatically. Both annuals were self-incompatible in native populations but self-compatible in invasive or weedy ones; the reverse was true for *S. elaeagnifolium*. Individuals within populations of the two annuals also varied in their degree of self-compatibility, suggesting a basis for natural selection, and populations of the same species sharing a status (native, invading/weedy) varied in average self-compatibility. These results suggest that the invasiveness of ancestrally self-incompatible species may occur via propagules originating from more self-compatible parents, but that this might be less important in perennials, which experience multiple opportunities for sexual reproduction. Overall, however, mating system may not predict plant invasiveness independent of other aspects of physiology, morphology and life history, a conclusion at odds with Baker’s rule.

S.30-30-P

Do disperser preferences determine directional seed dispersal? The importance of individual variation and habitat heterogeneity.

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Seed dispersal by animals often results in directional seed dispersal, caused by disperser's habitat preferences. However, directional dispersal may not be apparent if dispersal is distance-limited (e.g. low movement speed or short retention time) at a scale that is inferior to habitat spatial structure - or if disperser habitat preferences vary among individuals. Here we explore the contribution of these factors for directional seed dispersal using an epiphyte-marsupial dispersal system from the austral forest of Chile. Using animal movement data (N=16) and habitat characteristics (mapped using a 20x20 m grid, N=440), we analysed habitat selection strategies of the disperser (*Dromycips gliroides*), modelled its consequences for the dispersal of plant's (*Sarmienta repens*) seeds, and compared them with scenarios representing different habitat configurations. Multivariate analysis (k-select) detected variation in habitat preference by individual animals, which could be assigned to three habitat-selection strategies. We classified habitat types according to these preferences, and modelled dispersal by combining dispersal distances (derived from the disperser's movement speed and the seed retention time) with the disperser's habitat preferences. Modelling scenarios differing in the proportion and spatial distribution of preferred habitat indicated that the most important determinant of directional seed dispersal is the proportion of favourable habitat. Interactions between the proportion and spatial configuration of favourable habitat also had considerable effect, possibly reflecting the scale at which the animal habitat preference operates. Our results emphasize the importance of "viewing" the landscape from the disperser's eyes when trying to understand and predict the spatial consequences of seed dispersal by animals.

S.30-31-P

Does regeneration niche at the landscape scale compensate for climate change? A case study with *Ononis hackelii* (Fabaceae).

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Manuel J. Pinto¹ & M. Amélia Martins-Loução^{1,2} ¹ University of Lisbon. National Museum of Natural History. Botanic Garden. ² University of Lisbon. Faculty of Sciences. CBA - Centre for Environmental Biology In a five-year field study (2007-2011) we evaluated reproductive individual recruitment in several natural populations of a fast-growing annual plant species *Ononis hackelii*, under diverse environmental constraints in an rural Mediterranean landscape. Along several grassland-type transects, cohort density was estimated. During the study period, new founded populations were very rare, suggesting strong spatial dispersal limitation. Co-structure between habitat and climatic variables was evaluated through a three-table ordination method coupled with permutation significance testing. Dry climatic conditions force cohorts to go dormant. Persistent dormancy is not evenly distributed in the landscape and mostly, it is stimulated by long-lived vegetation encroachment. Along time, recruitment in larger and smaller cohorts diverges, likely relating the different distribution levels of dormancy and breaking-dormancy disturbance. At each meteorological year, a disturbance-adjusted climatically responsive mosaic of germinability is formed. Long-term dormancy is a temporal dispersal strategy to cope with climate irregularity, but in face of the generally accepted vulnerability and extinction risk of small populations, we discuss whether habitat management and disturbance would compensate for detrimental climatic changes.

S.30-32-P

Floristic corridors in Western Iberian Peninsula.

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The recent floristic evolution in Western Iberian Peninsula is the result of glacial and interglacial climate changes interactions with orographic variability and biogeographic behaviors. Four biogeographic behaviors are involved in this dynamic: paleo-euroasiatic, neo-euroasiatic, paleo-mediterranic and neo-mediterranic. In the present work, the dynamic of these biogeographic tendencies is analysed by the hypothesis of corridors. These corridors emerge by the effect of the climate changes in glacial and interglacial periods. A relation of 130 taxa, with those biogeographic behaviors as well as exotic taxa, is exposed to different climatic scenarios. Maxent is the algorithm applied for this characterization, and the results obtained pointed out the floristic dynamic referred above for Western Iberian Peninsula. The numerical matrix employed contains more than 6.000 records for the work area. Each point is geo-referenced and this information is intersected with bioclimatic information. Worldclim database is used for this intersection, and a bioclimatic matrix is obtained per taxon. That bioclimatic matrix is finally exposed to cooler (-21.000 years) and warmer scenarios (for 2020, 2050 and 2080, with two different CO₂ concentrations each). The results show the atlantic adaptation for neo-euroasiatic dynamic, continental-north distributions for paleo-euroasiatic, continental-east for paleo-mediterranic and southwest distributions for neo-mediterranic dynamic. Biogeographic behaviors of exotic taxa are adapted to this floristic dynamics.

S.30-33-P

Predicting seed dispersal by frugivores in real-world landscapes: from disperser physiology to habitat preferences at multiple scales.

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Seed shadows mediated by frugivores are influenced by (1) the seed-deposition times following fruit ingestion, (2) the movements of the disperser, as determined by its activity and behaviour, and (3) the landscape configuration of each site. Here, we compare three study cases of seed dispersal mediated by territorial frugivorous lizards in island ecosystems, in which we evaluate the relative importance of both the gut-passage time of seeds (as a proxy of seed deposition times), and the movement (based on radio-tracking data) and habitat preferences (based on radio-tracking and small-scale surveys) of the disperser. We combined this information in spatially-explicit models to evaluate whether these processes leave a lasting signature in the spatial distribution of dispersed seeds (“seed shadows”) and at which scales they operate. In the three cases, seed shadows were predominantly determined by the interaction between the disperser’s patterns of space utilization and the landscape structure. In contrast, seed gut-passage rate and its effects on germination, as well as the disperser’s speed-of-movement and activity rhythm, were of minor importance. Simulated seed shadows were strongly anisotropic, with interspersed high- and low-deposition areas that were partly associated to the vicinity of reproductive plants and to landscape features that favour disperser visitation. Our results suggest that zoochorous-dispersal models should incorporate the interplay between the landscape structure, the multi-scale activity of frugivores and the spatial distribution of reproductive plants.

S.30-34-O

A trade-off between dispersal and immune function in the Glanville fritillary (*Melitaea cinxia*) butterfly.

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Organisms in the wild are constantly faced with a wide range of environmental change, for example, in resource availability. Severity, frequency, and unpredictability of environmental change has increased dramatically in recent years due to human caused phenomena, such as habitat fragmentation, habitat degradation and climate change. Variation in resource availability can directly influence individual quality (condition) and life history, and even affect population persistence. Poor nutritional conditions influence life histories via changes in individual resource allocation patterns, and more emphasised trade-offs between competing traits. In this study, we specifically assessed the influence of nutritional restriction during development on two energetically expensive traits: dispersal ability (flight metabolic rate) and immunocompetence (encapsulation rate). Additionally, we examined the direct cost of flight on individual immune function and whether such costs are more evident under restricted environmental conditions. Results will be discussed in relation to the (meta)population dynamics of the study species, the Glanville fritillary butterfly, in Finland. Dispersal in this system is a key life history trait, as sufficient amount of dispersal is required for the persistence of the entire (meta)population. This is because population turnover in general is very high, and extinctions of the local population need to be compensated by re-establishment of new populations. Immunological costs of dispersal in natural populations may increase phenotypic variation in dispersal and influence its evolution in this system.

S.30-35-O

Modeling seed shadows in zoochorous systems: steps towards an integrated approach.

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Traditional approaches to the study of seed dispersal by animals have emphasized the role of and consequences for the plant partners. The three dominant approaches have built, respectively, on these simplifications: (i) ignoring habitat heterogeneity to build 1D (or isotropic 2D) dispersal kernels, (ii) ignoring spatial structure, extrapolating the differential deposition in different habitat types into putative estimates of directed dispersal, and (iii) discarding the landscape (and individuals) interspersed among fragmented (meta)populations, to derive putative estimates of long-distance dispersal from the migration rates across them. These simplifications have proved extremely useful in advancing our knowledge of zoochorous dispersal; however, they are also constraining our current efforts to understand and predict its drivers and consequences in real-world landscapes. In our view, future efforts to study and/or model seed dispersal by animals should address and integrate the dynamic inter-relations among: (1) the physiology and behavior of the disperser; (2) the structure of the habitat matrix, at various scales; (3) the dual role of reproductive plants as seed sources ("dispersal cores") and resource providers (thus influencing disperser behavior); (4) the inter-relationships between the demographic processes of the plants and the dispersers; and (5) the influence of temporal variation thereupon. The combined use of new technologies, such as remote sensing and telemetry, geostatistics, molecular analyses, and software engineering offer promising tools to address these challenging topics. We will present a methodological framework developed explicitly for the development of integrated seed-dispersal models, and illustrate its different components with examples of work developed in a variety of ecological systems.

S.30-36-P

Just quality vs. quantity? Trade-offs between reproductive allocation, seed weight and dispersal ability in mediterranean pines.

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Forest tree species are on the focus of intense research due to their intrinsic importance and also because they provide valuable information to answer relevant questions in evolutionary ecology. Particularly, the interplay between dispersability, reproductive allocation and seed quality along environmental gradients can shed light on the possibilities of migration and adaptation under climate change. *Pinus pinaster* and *P. halepensis* are two wind-dispersed mediterranean pine species naturally distributed in the Mediterranean basin as a result of contrasting migration histories. Also their winged seeds and pioneer behavior make them invasive in other Mediterranean climate areas away from their natural range. These species show a wide ecological breadth, and patterns of local adaptation have been described for drought tolerance, phenology and reproductive strategies. We investigated whether a trade-off between seed number and size exists in these species and how is seed morphology (i.e. dispersability) linked to those and other life history traits. Data were collected from range-wide populations for both species, grown in common gardens. In *P. pinaster* results showed a positive relationship between intense reproduction and enhanced dispersal ability irrespective of seed weight. On the contrary, data in *P. halepensis* suggested an unexpected negative correlation between reproductive allocation and dispersal, lacking also a trade-off between seed size and number. Results are discussed considering the ecology of both species, their population and metapopulation dynamics, and the interplay between the measured traits on local adaptation and colonization, stressing the ecological factors that can override the expected trade-off between quantity and quality of seeds.

S.30-37-P

Interspecific interactions drive community response to climate change.

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Species responses to climate change alter dynamics of communities and their composition due to e.g. species-specific habitat requirements or dispersal limitation. Here, we demonstrate that interspecific interaction itself is a mechanism, which strongly impacts community response to climate change. Particularly different types of interspecific interactions (mutualism, commensalism, parasitism) provoke specific community responses both, during and after climate-induced habitat shifting. In a grid-based metapopulation model with spatially shifting habitat suitability due to climate change, we analyse spatiotemporal dynamics of two interacting species: an obligate species that depends on its host species. This hierarchy implies that obligate species always profit from interspecific interactions. The interaction impact of obligate species on their hosts defines different community types. Positive impact constitutes mutualism, neutral commensalism and negative parasitism. Our results demonstrate that mutualism alleviates the negative effect of shifting habitat on community persistence, whereas parasitism enhances it. Recovery time of communities, that survived the period of changing climate, is independent of the type of interspecific interactions. Further, we find species-specific effects: Relative patch occupancy of obligate parasites declines stronger than that of obligate mutualists during habitat shifting. But, after the period of climate change, mutualist hosts take longer to recover than hosts of parasites. Thus, climate change affects differently the species in a community, and even differently between community types. We explain the species-specific response with interaction-driven 'delayed invasion' of obligate species resulting in intrinsic transient segregation of host and obligate species. Therefore interspecific interactions strongly affect community dynamics and species assemblages.

S.30-38-O

Integrating species life-history traits and landscape connectedness to identify dispersal bottlenecks and solutions for habitat fragmentation.

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Many habitats have become increasingly fragmented and isolated, forming a major threat to many plant and animal species. Although there is a growing body of evidence that both landscape connectedness and species' life-history traits are important factors determining dispersal, they have seldom been studied simultaneously. Most studies have either focussed on a single species and its life history attributes or deal with the landscape configuration without incorporation species' traits. Our goal is to incorporate species traits and landscape features into one conceptual model to help define under which circumstances dispersal is an actual bottleneck. Using a spatially explicit simulation model we identify to which degree variation in life history traits related to departure, transfer and settlement affect connectivity in relation to changes in landscape configuration. Our results demonstrate that variation in life-history traits related to reproduction, behavior at boundaries and mobility may drastically alter connectivity in landscapes with similar statistical spatial properties. If dispersal is an actual bottleneck for species it depends on their life-history attributes whether improving habitat quality of existing patches, increasing habitat area, improving matrix conditions or increasing landscape connectedness will most reduce the sensitivity of populations towards habitat fragmentation. This research will result in a practical tool for restoration and conservation stake-holders to identify restoration goals based on the target species pool.

S.30-39-O

Correlated responses of selection for aerial dispersal in *Tetranychus urticae*.

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The twospotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) is an important agricultural pest species. As a result of climate change, its range is gradually expanding northwards. At the expanding range margin, a selection pressure for the propensity to disperse (by air) takes place. This trait is known to be genetically heritable and behavioral properties are often complex and polygenic. The selection pressure on aerial dispersal behavior is thus assumed to also cause correlated responses. To detect these responses, spider mites were artificially selected for their propensity to disperse by air (preceded by a unique predispersal behavior). Two selection lines were created: a line with a high and a line with a low propensity to disperse. For these two lines (and a third, unselected control line) three life history traits were compared: diapause incidence, ambulatory dispersal and the amount of fat reserves. Mites with a high propensity to disperse by air displayed a higher diapause incidence and a higher amount of fat reserves, but a lower propensity for ambulatory dispersal. In this range-expanding arthropod, selection for higher dispersal abilities are thus associated with correlated traits that allow them to cope with environmental uncertainty.

S.30-40-P

Genetic structure and seed-mediated dispersal rates of an endangered shrub in a fragmented landscape: a case study for *Juniperus communis* L. in northwestern Europe.

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We quantified successful seed-mediated dispersal of the dioecious shrub *Juniperus communis* in a fragmented landscape across northwestern Europe by using amplified fragment length polymorphism (AFLP) markers. Furthermore we investigated the genetic diversity and structure on two spatial scales: across northwestern Europe and across Flanders (northern Belgium). We also studied whether seed viability and populations size were correlated with genetic diversity. Contrary to expectations, estimated seed-mediated dispersal rates were quite high and ranged between 3 % and 14 %. No population differentiation and no spatial genetic structure were detected on the local, Flemish scale but a significant low to moderate genetic differentiation between populations was detected at the regional, northwest European scale ($\Phi_{PT} = 0.10$). High levels of within-population genetic diversity were detected but no correlation was found between any genetic diversity parameter and population size or seed viability. In northwest Europe, landscape fragmentation has lead to a weak isolation-by-distance but not to genetic impoverishment in common juniper. Substantial rates of successful migration by seed-mediated gene flow indicate a high dispersal ability which could enable *Juniperus communis* to naturally colonize suitable habitats. However, it is not clear whether the observed levels of migration will suffice to counterbalance the effects of genetic drift in small populations on the long run.

S.30-41-P

Woody corridors enhance the dispersal of arthropod metacommunities in urban landscapes.

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mnhn. mnhn. mnhn.

Potential spaces for biodiversity remain in cities but urban landscape is very fragmented. Ecological corridors are landscape elements which prevent the negative effects of fragmentation, however their effectiveness and ecological functioning have never been clearly validated in urban landscapes. We analysed the role of corridors in urban context samplings: woodlots considered as sources for many species, woody corridors and domestic gardens connected or not to corridors. We examined 3 metacommunities of arthropods (spiders, carabids and staphylinids) on 3 levels: species richness, taxonomic and functional compositions. These groups are sensitive to fragmentation and play a major role in ecosystems. We focused our analyses on domestic gardens, analysing both landscape and local scales. For the 3 groups we clearly identified a corridor effect. Taxonomic compositions of connected gardens were closer to source and corridor than those of disconnected gardens. Analyse of functional compositions revealed that woodlots, corridors and connected gardens were associated with forest specialist species. Lower specific richness in disconnected gardens were significantly lower only for staphylinids. In garden, pattern of composition and functional traits were mainly explained by landscape scale. Our results clarify the effectiveness of corridors in urban landscape and thus have direct implications for the ecological management of cities.

Acorn dispersal pattern by jay (*Garrulus glandarius*) in a Mediterranean shrubland.

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Jay (*Garrulus glandarius*) is the major disperser of several oak species. Holm oak (*Quercus ilex*) is more frequently recruited under the canopy of the shrub retama (*Retama sphaerocarpa*) than in gaps in retama shrublands of the centre of the Iberian Peninsula. In this communication we analyse the role of acorn dispersal by jay in this recruitment pattern. Acorn dispersal was studied by radio-tracking, inserting transmitters inside acorns, which were located in feeders placed 1) inside the oak forest, 2) at the edge of the forest with the retama shrubland, and 3) in isolated oaks inside the retama shrubland, located at several distances from the forest. Jays preferred to disperse the acorns to the forest when acorns were placed in the feeders inside and at the edge of the forest. Jays cache acorns in forest gaps in the same proportion they occupied in the forest. When acorns were placed in isolated oaks located inside the retama shrubland, jays avoided the forest and concentrated acorn dispersal into shrubland, caching more acorns under retama canopy than in gaps, in spite of that the former was less abundant. We conclude that jays contribute to the expansion of holm oak in retama shrublands due to selective acorn dispersal from isolated trees to under shrubs, which are safer microsites for seedling performance than gaps. Additionally, jays promote forest closure when feeding from trees both inside and in the edge of the forest because acorns are also cached in gaps, which are usually low intraspecific competition microsites.

S.31-Applications of ecological models in biodiversity conservation and monitoring in a rapidly changing world

S.31-01-P

How uncertain are climate impacts for African vertebrates? Exploring consensus in projections.

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Africa is predicted to be highly vulnerable to 21st century climatic changes, warranting more research to assess the impacts of these changes on the continent's biodiversity. Assessing such impacts is, however, plagued by uncertainties. Markedly different estimates of changes in climatic suitability for species can be generated from alternative bioclimatic envelope models (BEM), greenhouse gas emissions scenarios, or global climate models. Using an ensemble forecasting framework, we examine future projections of bioclimatic envelopes and their uncertainties for over 2,500 mammal, bird, amphibian and snake species in sub-Saharan Africa. We explore the variability in species turnover projections arising from seven BEMs, as well as from alternative future climates for three emissions scenarios, obtained by clustering co-varying climate model simulations from a set of 17 models. BEMs emerge as the main source of overall uncertainty, affecting species turnover projections in Northern regions down to Congo, where projected non-analogue climates cause BEMs to differ in how they extrapolate. Five consensus methodologies tested to summarise agreements among BEMs outperform most single-models in accuracy, and generally provide consistent turnover estimates. In turn, the variability arising from alternative emissions scenarios increases towards late-century, when storylines diverge more, and affects particularly high-turnover regions in Southern Africa. Our results lend support to the use of ensemble forecasting to enable more informed conservation decisions, as it provides a means of exploring and reducing uncertainties in projections of climatic suitability for species.

S.31-02-O

Rome wasn't built in a day - Scheduling protected area selection to assist climatic species range adjustments.

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An enduring concern for conservation policy is that of how to safeguard that current protected areas are not only effective now, but will continue to be so in a changing future. Global warming impacts over biological systems include species range shifts and this is expected to attenuate protected area effectiveness. A new conservation paradigm for selection of areas to protect is urgently required. We offer a quantitative method to assist this requirement. The framework applies different budgets for area acquisition, schedules the acquisition and release of areas over time and indicates how species will disperse between those areas in order to attain the greatest species persistence. The set of targeted areas defines dispersal pathways. Their effectiveness is assessed based on the performance to retain species suitable climates over time, and on the ability of species to disperse between targeted areas and persist into the future. We applied the framework to nine Iberian species and considered four climate change and budgetary scenarios. Climate change scenarios assuming reductions of greenhouse gas emissions had relatively modest gains in species retention areas. But larger budgets for area selection attained significantly better retention levels. Nevertheless, our framework identified species that, despite the high conservation efforts attained with an unlimited budget, have a very limited ability to disperse to climatically suitable areas. Connectivity enhancement and assisted colonization could be considered for such cases.

S.31-03-P

The effect of grazing cessation in temporal changes of plant diversity in mountain pastures.

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Grazing is accepted to be a central, pivotal issue for mountainous grasslands, linking their conservation, productivity, economic use and management for biodiversity. In fact, the abandonment of grazing activity in areas that have a long history of grazing is considered a disturbance, leading to loss of plant diversity and spread of shrubs. However, very few works have tested the effect of long term grazing exclusion on plant diversity changes, controlling the variance explained by environmental conditions. In this work, we address the following question: How does diversity change when grazing is totally excluded from a seminatural mountain pastures? For that purpose, we established 4 permanent fenced plots in 2005, and a grazing zone was defined close to each enclosure to obtain two treatments (grazed, non-grazed). We recorded data on floristic composition monthly along the grazing period (from May to October) of 6 years (2005-2010). In 2008, a datalogger was installed inside each enclosure to record daily environmental conditions (air and soil temperature, relative moisture, precipitation and water content in soil). Some diversity measures were used in the analysis: Chao2 estimator of species richness, Simpson index and shared species index. Temporal trends and predictions in species restitution and decreases or increases of diversity are discussed.

S.31-04-P

Responses of Chihuahuan Desert plants to Climate Change.

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Climate changes have occurred several times throughout the Earth's history; however, current global warming episode may be occurring at a faster rate. Species may respond to this changes by adapting to the new conditions or by shifting their distributions tracking their niches spatially. Recent studies projected climate change effects in Mexico concluded that one major spatial foci of serious effects of global warming on biodiversity would be the Chihuahuan Desert. We analyzed if two desert species have tracked their niches in drastic climate change events: 1) in the past (across the Pleistocene-Recent transition), 2) present and 3) future (2020, 2050 years). We used ecological niche modeling to project geographical distributions across these periods, and fieldwork to support our findings. Results show that during the last glaciation the two species were restricted to few sites where environmental conditions were suitable. In the present, we detected evidence of species' responses at the population level, as we found low abundances and recruitment rates in sites where models predicted unsuitable environmental conditions, and recent colonization in new suitable areas for a species with high dispersal rate and successful establishment, but no range expansion for a species with low dispersal capacity. Finally, future projections suggest high risk for the species with current restricted distribution.

S.31-05-O

Testing the application of a spatially-explicit dynamic model to an endemic engendered bird (*Pyrrhula murina*) under scenarios of laurel forest management in the Azores.

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The Azores bullfinch (Priolo), *Pyrrhula murina*, is an endemic bird of São Miguel Island (Azores Archipelago), currently threatened by two major causes of biodiversity loss: invasion of native ecosystems by exotic plants and habitat destruction by land use changes. Since the species persists in a sensible threshold with habitat constrains it was assumed as an ecological indicator, with a close relation with the biological integrity of the native laurel forest. The aim of this research was to test a stochastic-dynamic ecological model (StDM) as an adequate framework to predict responses of the species to scenarios of future rehabilitation of the native forest. This was done by combining two complementary tools: StDM dynamic simulations, supported by a multi-model inference framework, and Geographic Information Systems for the final analysis of the spatial outputs. The simulation results are encouraging since they seem to demonstrate the reliability of the framework in capturing the species responses to changes in its habitat, highlighting a range of areas where habitat management seems to be effective. Using an expeditious interface with GIS, which makes the methodology more instructive and credible to decision-makers and environmental managers, we intended to help governmental agencies and non-governmental organizations in preparing management plans and strategies for the conservation of the Azores bullfinch, through restoration of its natural habitat.

S.31-06-P

Climate change impacts on native plant diversity in Ireland - model performance, projecting changes and informing adaptation measures.

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Ireland's biodiversity is currently facing a multitude of threats including land-use change, habitat fragmentation and the introduction of non-native species. Future conservation strategies will increasingly need to consider the potential impacts of a changing climate, in particular shifts in the ranges of species under different climate change scenarios. Here we report on a project using a range of species distribution modelling (SDM) techniques to assess the potential impacts of climate change on the future distribution of Ireland's vulnerable vascular plant and bryophyte species. In particular, we examined species characteristic of plant communities found in habitats protected under the Habitats Directive. Our results showed that model performance depended on the SDM technique used, the geographical distribution and the ecology of the species. We also showed that model performance could be improved by including additional variables on topography and habitat. Significant differences in the projected species range contractions and expansions (suitable climate space) were also shown to be related to species ecology and distribution, allowing us to prioritise species and habitats for future conservation effort. The Habitats Directive requires that a "favourable" conservation status of protected species and habitats is maintained. The on-going refinement and improved interpretation of ecological models is therefore essential to the development of appropriate adaptation and mitigation strategies.

S.31-07-P

Grazing management or physiography? Disentangling the causes of land degradation variation in a Mediterranean landscape.

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Despite the importance of extensive grazing in the shaping of Mediterranean grasslands, its intensification and abandonment are increasing the risk of degradation for these ecosystems. The inability of vegetation to recover after significant rainfalls is one indicator of degradation. However, the high variability of these systems makes physiographical and management effects and their interactions hard to disentangle and quantify. Our study aimed to identify the relative importance of these factors for the spatial trends in vegetation responses. We studied a dehesa grassland grazed by cattle and horses in which humid and dry habitat types could be distinguished. After excluding points with presence of woody vegetation, the difference in vegetation cover between spring and summer (vegetation response) was evaluated using a Spectral Mixture Analysis with high spatial resolution (2.4m) Quickbird images. Boosted Regression Tree models were generated for each habitat type in which management variables (accumulated cost distance to points of livestock concentration and water points) and physiographical variables (slope, moisture, distance to the closest tree and orientation) and their interactions were considered. The models had a much better predictive capacity for humid areas than for dry ones. The main factor determining the vegetation response was the habitat type. Management predictors and their interactions were more important than physiographical predictors in humid, but not in dry areas. Vegetation response peaked at intermediate cost distances for humid areas, suggesting the existence of an optimal level of grazing pressure in these zones, while in dry areas, it increased consistently with cost distance.

S.31-08-P

Climate change and plant communities composition in the Chihuahuan Desert during Late Pleistocene and Holocene.

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North American deserts have been subject of several researches to explain their establishment and evolution. One event to consider are the climate changes occurred during the Pleistocene because they led a changes in the environment and in the composition of biotic communities that comprise it. What happened during the last glacial with desert species and vegetation community remains little known. We drew taxon occurrence data from fossil records (Last Glacial Maximum -LGM-, 21,000 years ago \pm 3000 years) and from present localities. These data were incorporated into ecological niche models based on present-day and LGM climatological summaries. We projected the predicted potential distributions for each species at present and at the LGM. The output for each time period was projected onto the 'other' time period, and tested using independent known occurrence information from that period. During the LGM species considered typical of arid environments succeeded in maintaining and reproducing populations and conformed communities different from today coexisting with species of temperate affinities. With the subsequent deglaciation, forest species were confined in small areas with isolated populations and, many species adapted to arid conditions began to expand its areas. Understanding how have changed the distributions of species under climate change in the past, may allow to analyze the effects of current global warming will have on biodiversity and reveal patterns and processes and the relationship between past and present distribution of species and climate parameters may provide the basis for estimating how future climate changes may influence the distributions of species.

S.31-09-P

Habitat suitability models to assess windfarms potential cumulative impact on birds and bats.

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The rapid expansion of windfarms across Italy requires the development of adequate conservation decision-support tools to identify areas of high impact on birds and bats. To evaluate this impact at a local scale we implemented sensitivity maps for four bird species (*Milvus milvus*, *M. migrans*, *Circus pygargus*, *Coracias garrulous*) and six bat species (*Pipistrellus kuhlii*, *P. pipistrellus*, *Hypsugo savii*, *Eptesicus serotinus*, *Nyctalus leisleri*, *Tadarida teniotis*) threatened by collision and habitat loss. We produced habitat suitability models for the south-eastern Molise region (southern Italy) currently under large-scale wind farm development. The digital suitability maps were produced by reclassifying the CORINE Land Cover map (IV level, 1:25000) obtained through the interpretation of recent high resolution digital orthophotos. To define the areas at higher risk we considered a buffer surrounding planned and existing wind turbine locations (their radius was 150m for bats and 800m for birds). Finally we overlaid maps of wind farm influence with maps of bird and bat suitability to assess the specific habitat loss of each wind farm to identify those determining major impacts. Overall, 1511ha and 7041ha of habitat suitable respectively for five bat (12,1% of total suitable area), and two bird species (56% of total habitat available in the area) were affected. These results highlight the potential threats posed by both existing and planned wind farms to bird and bat communities, both in terms of habitat loss and collisions, and the utility of developing such tools to plan new wind farms saving areas of special impact risk.

S.31-10-P

Spatial heterogeneity in the effects of climate change on the population dynamics of a Mediterranean tortoise.

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IMEDEA. IRTA. UIB. IMEDEA. UIB. IMEDEA.

Climatic shifts may increase the extinction risk of populations already suffering from other anthropogenic impacts, but our ability to predict the consequences of climate change on organisms is limited by our scarce knowledge on the effects of climate variability on population dynamics and the uncertainty of climate projections. Here we analysed a long-term monitoring programme of Hermann's tortoise (*Testudo hermanni*) an endemic reptile of the Mediterranean region in order to evaluate the consequences of the changes in climate predicted for this area on the demography of this threatened species. Capture-recapture modelling allowed us to assess the effect of climate variability on tortoise's survival. Winter rainfall was found to be the major driver of juvenile mortality whereas adult survival remained high and constant across the study. Furthermore, climate simulations for this and ten additional Mediterranean locations where tortoises occurred provided us with climate forecasts, which were used to simulate the fate of these populations under different scenarios. We show that a shift to a more arid climate would increase quasi-extinction risk due to a lack of recruitment, but these processes varied depending on the population and scenario we considered. Our results suggest that unless other human-related causes of mortality are not suppressed, climate variability will increase extinction risk within most of the specie's current range.

S.31-11-P

Quantifying and understanding the divergence between correlative and process-based species distribution models.

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CEFE/CNRS. CEFE/CNRS. CEFE/CNRS. AMAP/INRA. CEMAGREF. CEFE/CNRS.

Numerous clues of climate change's impacts on plant species distributions have already been recorded. Today, ecosystems managers are in need of realistic long term projections of distribution and composition of forest communities. In this context, vegetation modelling is certainly the most efficient way to elaborate such estimations. Such projections are so far provided almost exclusively by correlative species distribution models (SDMs). However, concerns regarding the reliability of their projections for the future are growing so that several authors advocate the development of process-based SDMs or hybrid SDMs, i.e. partly correlative and partly process-based. In this study we compared the projections of a correlative SDM, Stash, and two process-based SMDs, LPJ and Phenofit for three major European tree species, beech, and common oak and Scots pine for the present and for two SRES scenarios. Our results showed that process-based SDMs can perform almost as well as correlative SDMs in the present despite their statistical handicap, and that their accuracy could be improved by integrating a more realistic representation of the species resistance to water stress. Despite their consistency in predicting species present distributions, model projections diverge tremendously in the future. Our results highlight the need for model comparisons to provide more robust projections of species range shift in the near future through the development of new generation of hybrid SDMs or consensus statistical methods to mitigate projections uncertainties.

S.31-12-O

Does agriculture intensification spare land for nature? A new methodology to overcome scale limitations.

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The impact of Land Use and Land Cover Change (LULCC) is a major issue in conservation biology. In the last 30 years, 85% of undisturbed Chaquean xerophytic forests has been converted to pastures and agricultural lands or is undergoing secondary succession. Land sparing, or the intensification of an export-oriented agriculture to respond to increasing world food demands while sparing land for nature conservation, supports the dominant current land use strategy for the Argentinean Chaco, which is suffering high rates of land use change mainly from forests to soybean plantation fields and shrub lands. This hypothesis predicts recovery of degraded forests due to rural-urban migration, a process that accompanies agricultural intensification. However, there are mixed evidences that either support or reject Land sparing actually taking place. One possible source of divergence is the scale of analysis. Using the Province of Santiago del Estero in the Argentinean dry chaco as an example, we test a methodology to determine if and at which scale land sparing occurs. In a three-step analysis we consider the crucial variables playing a role in the process (forest recovery, protected areas, rural-urban migration) and plot their slope of change in time against the increment in land surface of intensive crops. We use time series of NDVI from MODIS and census data from 2001 and 2010. Preliminary results validate the present methodology as useful to determine the critical scale at which Land sparing occurs.

S.31-13-O

Optimizing the conservation and monitoring of Iberian biodiversity under scenarios of ecological change.

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Additional authors (2): - Miguel B. Araújo (Universidade de Évora, Portugal & MNCN Madrid, Spain) - Antoine Guisan (University of Lausanne, Switzerland) Tracking and forecasting biodiversity change across scales of space and time is at the forefront of modern ecological research due to the global biodiversity crisis. Nonetheless, resources allocated by governments to strategic ecological monitoring are very limited and there are still no consistent international solutions for the funding of global biodiversity monitoring. In this context, optimal allocation of limited resources for conservation and monitoring is crucial to buffer the impacts of major drivers of biodiversity decline, to promote the positive effects of conservation actions, and to provide regular estimates of the state of biodiversity relevant for technical and political decision. Ecological models have been used to describe, explain and predict the spatial distribution of species and the patterns of biodiversity indicators, as well as to forecast their dynamics under scenarios of ecological change across scales. We propose to discuss how models can be valuable to optimize the spatial and temporal allocation of conservation and monitoring efforts. We use examples from the Iberian Peninsula, an important hotspot of European biodiversity, to illustrate how models and scenarios concerning distinct drivers of change can be used to support strategic decision and action on conservation planning, adaptive management and ecological monitoring. Finally, we discuss persisting caveats and research priorities for an adequate application of models and their predictions across a range of scales and processes.

S.31-14-O

The impacts of sea level rise on the East Asian-Australasian migratory shorebird flyways: graph theoretical approach.

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Sea level rise is one of the most prominent threats of climate change in this century. Migratory shorebirds are known for their unusually long distance flights to cover thousands kilometers between their breeding and wintering habitats. Previous research on the impacts of sea level rise on shorebird survival only focuses the loss of habitats. In this paper, we explicitly modeled the network structure of migratory shorebirds in East Asian-Australasian Flyway (EAA Flyway), and estimated the impacts of sea level rise on the carrying capacity for each of them using graph theoretic framework. The application of graph theory for ecological process so far has been focused in the context of meta-population model, but not to migration modeling, where non-spatial approach is still dominant. The loss of intertidal areas for 224 internationally important sites for ten taxa was estimated with GIS. We applied maximum flow algorithm to evaluate the robustness of flyway network against sea level rise. We show the impact of sea level rise significantly depends on the structure of a network, and the sum of affected areas does not capture the magnitude of the impact to migratory species.

S.31-15-P

From static population models to individual behavior: Combining species distribution models with agent based models using Tawny owls as a case study.

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Understanding causes and effects of ecosystem dynamics is much like finding needles in a haystack. Most often we try to simplify the processes, looking for predictors that affect mean values of a population, e.g. mean mortality risk as a function of the distance to a road. Such approaches, however, do not consider individual behavior and interactions with the environment from which the dynamics arise. Agent Based Models (ABMs) allow individuals to interact with each other and with the environment, giving new insight into population dynamics and ecosystem functioning. In a previously developed SDM we have predicted the distribution of the Tawny owl (*Strix aluco*) throughout Denmark at the scale of individual breeding territories. We speculated that some of the areas predicted to be occupied by the SDM were out of reach for the species due to behavioral traits and population dynamics and that our SDM predictions could be fine tuned by incorporating it into an ABM. We therefore built an ABM to simulate the distribution of the Tawny owl in Denmark, using the model predictions from the SDM to form a spatially explicit map of more or less suitable areas. The landscape consisted of patches (square grid cells) of 600 by 600 meters covering all parts of Denmark. Each patch was assigned a quality defined as the likelihood of a patch being a breeding territory for the tawny owl as predicted by the SDM. We allowed the individuals to perceive the landscape as a mosaic of more or less suitable territories, and disperse, settle and die according to their immediate surroundings (environment and presence of other individuals). Combining predictions from a SDM may simplify complex behavioral rules that would otherwise have to be incorporated in the dispersal functions in the ABM. We simply created a landscape of more or less suitable patches and let the individuals be most likely to move to better patches. Our most conservative AGM predicted local extinctions of the Tawny owl in parts of Denmark where it is supposed to be present according to our SDM. Less conservative estimates of adult mortality allowed the population to persist at higher numbers and throughout a larger range, and only unrealistically high mortality and reproductive rates allowed the population to persist in all the areas the SDM had predicted to be occupied. Our results suggest that ABMs can be used to fine tune predictions of SDMs.

S.31-16-P

An approach to functional aspects of material flows in landscape ecology: the basis of further evaluations.

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Most studies of landscape structure and the implications thereof in ecological processes are based on the analysis of its fragmentation and spatial heterogeneity. Most of them, however, focus on specific processes (displacement capacity of animal populations, dispersal of spores, seeds, etc.) in a given territory, according to the characteristics of the patches (type, frequency, area, maturity, state of conservation, etc.) and their degree of spatial connection, fundamentally measured by the physical distance or travel time between them. But they do not consider the ecological functioning of the landscape as a whole, measured as the structural and functional matter flows occurring among the patches making up the landscape. This work explores the ecological implications that, at landscape level, result from changes in land uses and in their spatial patterns. We drew up a set of indices to estimate the structural and functional flows occurring among land use patches making up the landscape. These indices combine the composition of patches and the connections that can occur among them through their boundaries, based on their relative topographic positions and on their differences in ecological maturity. The application of these indices in a mountainous region enabled us to establish how changes in land uses can modify the flows taking place among patches and therefore to establish measures for the maintenance of connections that might very well be fundamental in the functioning of the landscape.

S.31-17-P

Scenario tools for ecological modeling.

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Herbert Kahn's phrase "The most likely future isn't" succinctly lays out the motivation and imperative for methods that allow us to explore the future. The phrase embodies the notion that what we think will happen in the future probably will not, since the basis of our thought-process is itself flawed: our thinking being limited by personal experience, prejudice and other forms of bias. Scenario analysis has emerged as a means of characterising the future and its uncertainties through structured, but imaginative thinking as a process that pushes us beyond the axioms and norms that are the constraints of conventional wisdom. Scenarios have been defined as 'plausible and often simplified descriptions of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces and relationships' (MA, 2005) and can be qualitative, quantitative or a mix of these. This paper will provide an overview of a range of scenario techniques that have been applied, or could be of interest to ecological models. These include both explorative and normative scenarios methods, participatory approaches, and various modelling approaches to quantify scenario outcomes. Here, examples will be provided of both European modelling studies and methods for downscaling techniques, as well as promising bottom-up methods, including Agent Based Modelling. The paper will conclude with a set of recommendations and challenges for ecological models when addressing change.

S.31-18-P

The role of biotic interactions and life traits in species distribution modelling. A case study of heathlands in the Cantabrian Mountains (NW Spain).

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The distribution of heathlands in the Cantabrian Mountains, NW Spain, has traditionally been linked to human activities. However, biotic interactions are also likely to affect their distribution at a regional scale, and this influence should be considered when managing heath formations of high conservation interest in the area. In this study, we analyzed the spatial variation in the effect of biotic interactions on the distribution of two heath formations, dominated by species with different life traits (*Calluna vulgaris* and *Erica australis*, respectively specialist and generalist species within the study area). We built predictive models for each formation, based on different environmental, biotic and remote sensing variables, using the Maximum Entropy algorithm (MaxEnt). We compared the areas of predicted co-occurrence of the target formations with their observed distribution, and then compared the environmental characteristics of these overlap areas with areas where occurrence of only one formation was predicted. Formations dominated by *C. vulgaris* prevail where both are predicted to occur, whereas those dominated by *E. australis* tend to occupy areas where the presence of *C. vulgaris* is not predicted, possibly reflecting the variability of species-specific limiting factors within the areas of co-occurrence. Distribution models including biotic interactions yielded more accurate predictions at a regional scale for both formations, when compared to models considering environmental and remote sensing variables only. Such predictive models may represent a powerful, spatially explicit tool available to land managers, providing valuable information about the environmental, biotic and human factors controlling the geographical distribution of heath formations.

S.31-19-P

A novel method for assessing the completeness of biodiversity databases: the case of Ordesa National Park.

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Analizing information of natural history collections of species distribution is often difficult due to the bias caused by variation in recording effort. Nevertheless this information is needed for mapping spatial distribution of biodiversity for conservation planning, because in many cases, these databases are the only biodiversity information available. We describe a novel method to assess the degree of sampling effort for correcting the bias in biodiversity databases. Here we propose the inclusion of this coefficient in distribution models for species diversity to take into account the bias due to variation in recording effort. This coefficient is obtained through the first derivative value estimated from a Generalized Additive Model applied to the species acumulation curves. The model has been validated using Ordesa National Park vegetation database. This new method demonstrate a higher accuracy in discriminating well sampled regions than the most popular approaches used up to now.

S.31-20-O

Modeling the response of biodiversity to global change: challenges and perspectives.

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We are facing a biodiversity crisis loss, but the dimension of the crisis is still uncertain. Some scenario models project that approximately half of existing species may be committed to extinction by the end of the century, while other models project that less than 1% of the species will go extinct. Some of this uncertainty is due to limitations on existing biodiversity observation datasets, but there is also room for improving the models used in the projections. I present two recent developments in models of biodiversity change: the countryside species-area relationship and the integration of ecophysiological and population models with correlative models. Land-use change has received less attention than climate change from the modeling community, and I discuss how these new modeling developments can help bridge that gap. The countryside species-area relationship generalizes the species-area relationship to landscapes with multiple habitat types or land-uses, and recognizes that different groups of species have different vulnerabilities to land-use change. The integration of process-based models with correlative models allows for a species by species assessment of vulnerability, but incorporates stronger causal relationships between drivers of global change and population dynamics. I conclude with examples of the application of these modeling approaches to plants and vertebrates at the local and regional scale, and with a discussion of the challenges in generalizing these models across scales.

S.31-21-P

The viability of marine resource exploitation: a Solomon Island case study.

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In a rapidly changing world, biodiversity conservation is gaining from more integrated, multidisciplinary and collaborative approach and especially within the coastal zone area where sea and land constitute a highly intricate system. A rapidly changing world insinuates a planet where human population, technology and communication are spreading fast leading for instance to more impact by efficient fishery techniques to supply the increased demand. In such a context accentuated by climate change impact, biodiversity conservation needs more adaptivity and reactivity. This paper will focus on the Solomon Islands case study where adaptability and reactivity is critical. Reactivity in such region constitute a challenge since the biological and socio economical data are lacking. Adaptability is crucial since the land is fragmented and scattered forcing management to rely mostly on the community level. In order to enhance reactivity and adaptability in this data-less context, simple models based on an integrated, multidisciplinary and collaborative approach can be applied, especially ones that would bind the adaptation potential synergistically of both biological and social systems. To do so, a model designed within the viability framework is presented. The viability framework link the ecosystem and the socio economical system by the exploitation rate of the former on the latter and enable to find the conditions that guarantee the ecological needs as much as the socio economical needs. The model capture the main drivers of the Solomon Island coastal system including stochasticity of the marine biological and demographical processes complemented by a cyclone probability with its related impacts on the whole system. By optimisation of intrinsic adaptability of ecosystems and society, the model produce viable scenarios. The input of the model can be modified depending on the evolution of the situation, the output of the model illustrate different scenarios of adaptation policy which can be used in a participation process in order to make wiser resources use management decisions.

S.31-22-P

Modelling the distribution of Roesel's bush-cricket (*Metrioptera roeselii*) in a fragmented landscape.

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The development of conservation strategies requires knowledge about the species life history and distribution patterns. This is, however, often lacking as collecting biological data may be both time-consuming and resource intensive. Using Geographic information systems (GIS) and modelling techniques species distribution can be inferred by using ecologically relevant environmental data. In this study, we model the distribution of the non-native bush-cricket *Metrioptera roeselii* that inhabit fragmented agricultural areas in Sweden. We use landscape data from the CORINE land-cover maps and occupancy data from large-scale surveys that cover 2 554 km². The aim of the study is to understand how species distribution is affected by environmental variables in a fragmented agricultural landscape and to evaluate the performance of landscape data at two different spatial scales. Models that included data on a scale of 1 x 1 km were able to explain more of the variation in species distribution than data collected on the local scale (10 m buffer on each side of surveyed road). The amount of grassland in the landscape, estimated from the area of arable land, pasture and rural settlements, was a good predictor of the presence of the species on both scales. The measurements of landscape structure were ambivalent and did not fully support a correlation between dispersal ways and species presence. Our findings form a good base for future distribution predictions of *M. roeselii*. Known similarities with *M. roeselii* and other grassland-living Orthopterans indicate that the method could be useful for other related species.

S.31-23-O

European deciduous tree species are currently filling their thermal niche: implications for climate change projections.

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For the high elevation or high latitude margins of the life form 'tree' in general, low temperature is likely to represent the main constraint. However, the mechanisms controlling the elevational or latitudinal limits of tree species that do not reach the tree limit are still poorly understood and several temperature-driven limitations may affect these limits. This study aims at comparing the upper limits of 18 dominant deciduous tree species along elevational gradients in the mountainous regions of Switzerland and the latitudinal limits in N-Europe. More specifically, we hypothesize that species exhibit the same relative position along elevation and latitude gradients and thus, arrived at similar elevational and latitudinal temperature limits. This is to be expected if climate and more specifically temperature is the only factor controlling elevational and latitudinal distribution. Our results suggested that the poleward limits in Europe of most of the study species might have tracked regional temperatures well during postglacial recolonization. Hence, this elevation vs. latitude comparison speaks against incomplete range filling along latitude with respect to the thermal limits for most of these species, as suggested by previous studies. Contrasting again previous findings, these results thus suggest that dispersal rates must have been sufficient for most tree species to track past climatic changes, within the precision of such an assessment. Despite species could respond differently to rapid ongoing climate change, our results could provide new insights to improve future projections of species distribution.

S.31-24-P

If niche models only tell half the story: does demographic variability influence species responses to climate change?

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Organisms are under pressure to shift ranges under projected climatic changes. These range shifts are typically predicted by niche models, which use a statistical correlation between current climate and distribution to predict future suitable habitat. However, basing a species susceptibility to climate solely on future suitable habitat is an oversimplification. In order to include more realism into these models, we combined a niche model with a spatially explicit stochastic matrix model for *Carlina vulgaris*. We first developed a life history model with species specific average fecundity and survival rates. A comparison of the expected minimum abundance under stable climate and with shifting habitat provided a more accurate assessment of the species vulnerability to climate change. We then varied the matrix values based upon demographic rates of individual populations. Each geographic area was assigned a different matrix, determined by field measurements. Finally, matrix values were varied in time. Fecundity and survival rates were gradually changed depending on climate predictions. These values were based upon the response of translocated individuals to novel climates. The aim of the study was to provide a fuller understanding of species responses to climatic changes. This will inform conservation efforts, directing resources more efficiently. The following questions were addressed by the study: 1) Do models incorporating life history traits into species distribution models change model predictions and provide further insight into species responses to climate change? 2) Is averaging life history traits across different populations an oversimplification which affects results? 3) How are niche model outcomes influenced by intraspecific demographic variability? Does variability mitigate or exacerbate the impacts of shifting habitat?

S.31-25-P

Application of Dynamic Energy Budget theory for conservation relevant modelling of bird life histories.

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Some 12% of bird species are threatened with extinction. Conservation and decision making processes require information regarding a variety of life-history traits for as many species as possible. Although birds are currently one of the best known groups of animals in the world, there is a considerable amount of information lacking for most of the species. In order to overcome this, the use of allometric relationships became quite common. However, allometric scaling relationships, of an exclusively phenomenological nature, assume similarities between species based mostly on body mass and do not result from any consistent approach that could bring an insight on the underlying causality. They are also highly sensitive to the inclusion or exclusion of particular groups of organisms. The application of the Dynamic Energy Budget (DEB) theory may provide new life-history traits estimations for those bird species for which much information is still unknown, starting from a biologically reliable basis. DEB theory may also allow for a shift of focus in avian life-history research and yield some interesting results on the existing trade-off's between different life-history traits. Allocation ratios and maturity thresholds ratios, as they result from DEB theory application are expected to differ between groups of bird species or even species within the same group, and they may help to understand which environmental factors influence life-history traits such as clutch size or reproductive effort variation. DEB theory may also contribute for the understanding of how these life-history traits have evolved throughout time.

S.31-26-O

Environmental change and conservation priorities in the Iberian Peninsula.

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Nowadays conservation actions are implemented without considering the effects of environmental changes on biodiversity. However, large changes in climatic conditions as well as changes in land use and vegetation cover are predicted in the Iberian Peninsula. In this study we identify which Iberian bird species are expected to be more vulnerable to such environmental changes by combining information on ecological models and other characteristics such as biological traits and conservation status. By identifying bird species that a) are predicted to lose environmental suitable conditions in the future, b) possess characteristics that render them particularly vulnerable to environmental changes like low reproductive rates, and c) are already categorized as 'threatened' we can ensure that conservation efforts will focus on those species which are threatened under both current and expected future conditions.

S.31-27-O

Ensemble forecasting of distribution shifts for fluvial bryophytes in Portugal under scenarios of climate and fluvial changes.

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Recent and future environmental changes affecting ecosystems may have an extended magnitude in freshwater ecosystems, so understanding responses of species to those changes is a key challenge towards long-term conservation strategies. Species distribution models are used to understand and forecast impacts of environmental changes. Aquatic communities are a product of local environmental filters and larger scale filters, such as the interactive effects of climate change with other anthropogenic stressors. Changes in the geographical patterns of distribution and abundance or even extinction of freshwater species are highly probable in the next decades. We used species distribution models to understand current patterns of distribution of seventy-two bryophyte species in NW and CW of Portugal, addressing the relative importance of local ecological and regional environmental predictors. Some of these populations of freshwater bryophytes are particularly important since (i) the northwest streams correspond their suitable habitat in Portugal, (ii) are amongst the species most threatened by and responsive to changes in thermal conditions and hydrological regimes, and (iii) their populations in Portuguese territory correspond to their southern limit of distribution. Using the BIOMOD R statistical software, we calibrated, from species distribution data, ensemble forecasting models fitted with nine different modeling techniques. We present the results obtained from such models and from the simulated outcomes of climate and fluvial change scenarios. By exploring the effects of changes in drivers of distributions of bryophytes, we will evaluate the effectiveness of the current network of protected areas to accommodate changes in the distributions of threatened freshwater species.

S.32- Ecological and ecotoxicological effects of oil spills and plastics in the marine environment

S.32-01-O

Single and combined effects of an oil component (fluoranthene) and a noxious and hazardous substance (aniline) to the marine microalgae *Tetraselmis chuii*.

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The transport of oils and hazardous and noxious substances(HNS) by sea raise concern on their potential spills and consequent effects on marine ecosystems. In the case of this type of environmental accidents, marine organisms may be exposed for short periods to high concentrations of the released chemicals. At the present, there is a considerable lack of knowledge on the effects of mixtures of substances that may be simultaneously spilled during shipping accidents, such as oil components and NHS. Thus, here, the effects of fluoranthene, a polycyclic aromatic hydrocarbon (PAH) that is a component of oils, and aniline, one of the main HNS transported by sea, on the microalgae *Tetraselmis chuii* that has been used in Ecotoxicology to assess the risks of chemicals for marine producers, were investigated both isolated and in mixture. Acute toxicity tests based on growth inhibition of *T. chuii* cultures were carried out for 96h and ecotoxicological parameters were calculated. The results indicate that both substances were able to reduce the algae growth at the concentrations tested and toxicological interactions occur when the algae is simultaneously exposed to fluoranthene and aniline.

S.32-02-O

New developments for risk assessment of oil spills in the marine environment.

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Evaluation of the risks associated with maritime accidents is an issue of growing concern due to increasing maritime traffic worldwide. In the EU, the AMPERA initiative has been established to find a common strategy to cope with this kind of incident. RAMOCS (Implementation of Risk Assessment Methodologies for Oil and Chemical Spills in the European Marine Environment) was one of the funded projects to integrate transnational cooperation between 5 European research institutions. The primary objective is to evaluate the existing and research needs in fingerprinting tools for heavy oils and oil products, and to assess their risks in different European regional seas in the event of a spill. In this regard, the analytical methodology developed by European Committee for Standardization (CEN) and revised by OSINET (CEN/TR 15522-2) has been evaluated in different scenarios, with particular reference to the recognition of weathering processes. The toxic compounds, prioritized by *in vitro* receptor assays, have been tested using different bioassays with sensitive species representative of different marine ecosystems. The toxic compounds identified will be analysed in the most commonly transported oils in the EU. The selected bioassays will include bivalves, sea urchin embryogenesis, and benthic crustaceans (shrimp and crayfish assays). Finally, the risks associated with oil spills will be evaluated from the PEC/PNEC ratios for sensitive species exposed to different oils under different European marine environmental conditions.

S.32-03-O

Temporal Analysis of microplastics concentrations in plankton samples.

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IMAR FCT-UNL. IMAR FCT-UNL.

Microplastics are plastic debris smaller than 5 mm in size, that pose a threat to coastal environments due to their capacity to adsorb persistent organic pollutants (POP), which may cause have toxic effects in the environment. Microplastics debris are potentially dangerous to marine species because they are mistaken for food, being possibly a cause of pollutant magnification over the food chain. The characteristics that make plastic materials so useful are the same that are prejudicial to the environment (Bockhorn et al., 1999). Polymers have several advantages as lightness, transparency, insulation, soundproofing and electric insulation. As disadvantages polymers easily combust and release toxic gases in this process; have poor heat resistance and high static electricity. Many plastic polymers also contain chemical additives such as flame retardants, stabilizers, among others, that enhance the toxicity of plastics. Since polymers have long chemical chains, they are persistent (slow degradation). Because of its low density plastic easily floats in water bodies. Since plastics are exposed to all kinds of weather conditions, they will experience degradation processes, such as photo oxidation (ultraviolet radiation), mechanical, chemical and thermal degradation. In 2010, we started analyzing plastic contents in plankton samples collected by IPIMAR in 2002, 2006 and 2007. We wanted to investigate if in 2002 there were already microplastic fragments in samples trawled in the Portuguese coast. We started analyzing 117 plankton samples, collected off-shore Aveiro in 2002, in the North of Portugal. The samples were collected using Neuston nets (335 µm) and LHPR nets (280 µm) at different depths (ranging from 0 to 10 m). After analyzing a few samples and discovering that each one had microplastics, we decided to study more sampling sites in different years, in order to identify a correlation. Microplastic samples were photographed and registered for posterior analysis using micro-FTIR spectroscopy, in order to determine their chemical spectra. Examining plankton samples from different areas and different campaigns will provide a better insight regarding the presence of plastics in surface waters, as well as information about the plastic/plankton ratios through time and the main types of plastic polymers present along the Portuguese coast. Still, research developments are necessary in order to provide more information both scientific and social wise.

S.32-04-O

Why is short-term exposure of marine organisms to oils ecologically relevant?

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The exploration, transformation and transport of oil by sea have been increasing and projects exist for the exploration of new areas in the next future. Thus, it is very important to increase the knowledge on the toxic effects of oils and their individual components in marine organisms to improve ecological risk assessment of oil spills. Oil spills reaching shores, estuaries and coastal lagoons are most concerning events due to the physical-chemical properties and toxicity of these complex mixtures, the ecological importance of these areas, especially as nursery and feeding places for a high number of species, and the economic relevance of the services that these ecosystems in general provide. Short-term exposure at ecological relevant concentrations of oil components, such as polycyclic aromatic hydrocarbons and metals, are able to induce mortality and impair ecological and physiological functions with direct and indirect negative impacts on the natural rate of population increase (r). Here, the question is discussed based on results obtained in species with different ecological functions. Acknowledgements: Presentation in the scope of the project "RAMOCS - Implementation of risk assessment methodologies for oil and chemical spills in the European Marine Environment" funded by FCT and FEDER funds (ERA-AMPERA/0001/2007) in the framework of the EU AMPERA ERA-NET (ERAC-CT2005-016165).

S.32-05-O

Oil and plastics: current and future concerns for marine ecosystems.

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Oil and plastics: current and future concerns for marine ecosystems Ketil Hylland University of Oslo, Norway In addition to harbouring numerous ecosystems and thousands of species, the oceans are used as transport ores and recipients of incomprehensible amounts of waste. It has become clear over the past decades that there is a potential for dramatic ecosystem effects caused by acute oil spills or gradual releases of recalcitrant particulate material, i.e. plastics. Both oil and plastics are continuously introduced into marine ecosystems. Whereas oil is readily degradable, plastics will be slowly broken down into smaller particles with a largely unknown fate. Depending on the source and degree of modification or breakdown, oil will have variable toxicity and impacts on marine organisms and processes. In contrast to the clearly toxic effects of polycyclic components, the alkane component of oils may act as a carbon source to some bacteria under some conditions. In addition, the physical properties of oils affect organisms ranging from plankton to seabirds. Similarly, microplastics will affect marine organisms ranging from zooplankton to seabirds. Accumulation of non-digestible plastics may clearly have deleterious effects in marine ecosystems, but there is a need for a discussion on the concentration of such particles in different parts of marine ecosystems and the susceptibility of organisms foraging there. The large surface area of marine plastics clearly make them an ideal matrix for accumulating hydrophobic compounds, but there is still limited knowledge of whether this actually leads to increased accumulation of hazardous substances in exposed organisms. Present and future consequences for both environmental stressors will be discussed.

S.32-06-O

How can we measure tiny bits of plastic in a big sea?

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Initial pioneering studies have detected microplastics in the marine environment - in surface waters (usually top 10 cm), in marine coastal sediments and on beaches. Microplastics are commonly defined as synthetic polymer particles "less than 5 mm" but can often be much smaller than 5 mm. Most detection has been on a visual basis with staff sitting at the microscope manually separating the microplastics from other types of debris collected in the neuston nets or floating in buckets of sediments with high salinity water. Many studies to date have not confirmed that the microdebris assumed to be plastic is actually a synthetic polymer, and it is unknown how much microplastic is not counted with current methods. This paper takes a closer look at the nature and quality of information we can derive from different approaches to sampling and analyzing microplastics in the marine environment. We will briefly compare analytical methods (such as FTIR and Raman microscopy) for analysis of microplastics in environmental samples, including biota. What are the size limits of plastic particles we can measure with the current approaches to sampling and analysis? Which size categories are potential threats to marine organisms and are we measuring or missing these size categories with current approaches? These important questions will be addressed and recommendations given for future research and development in this emerging field of study.

S.32-07-O

Monitoring long-term environmental effects of the Louisiana oil spill in the NW Gulf of Mexico.

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Once again the fragile ecological balance of a Large Marine Ecosystem represented by the Gulf of Mexico was threatened by the greatest oil spill in the history of the US's oil industry that occurred in the deep-waters off the Mississippi Delta on April of 2010. This massive oil spill augmented by an unprecedented use of chemical dispersants both in shallow and deep-waters raised great environmental concern for the neighboring countries that share the Gulf's resources. Beyond the local and direct deleterious environmental caused by such regrettable accident upon vital coastal areas, there was a need to assess the dispersion of the oil plume by the prevailing seasonal circulation patterns in the GOM. Surface currents in the GOM have paths to the northwest and the south when cold fronts prevail in autumn and winter. According to our own projections the shelf and continental slope of northeastern Mexico were susceptible of receiving in the short term signs of the spill. Throughout a long-term monitoring program of the general oceanographic conditions of the NW GOM we attempt to establish a physical-chemical and biogeochemical base line to recognize levels of possible alteration caused by the oil spill. Preliminary interpretations made in the summer of 2010 did not detect environmental disturbances attributed to this phenomenon. This multidisciplinary research effort continues in 2011-2012.

S.33- Mediterranean forests and global change

S.33-01-P

Site-dependent responsiveness of earlywood anatomy to climate in Iberian populations of deciduous ring-porous oaks.

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Earlywood anatomy provides information on the changes of hydraulic conductance of deciduous ring-porous oak species in response to climatic stress during late winter and early spring. We compared earlywood anatomical variables (vessel area and density, conductive area) and their responsiveness to climatic stress among sites with contrasting water availability considering four oak species (*Quercus robur*, *Q. pyrenaica*, *Q. canariensis*, *Q. faginea*) widely distributed in the Iberian Peninsula. We hypothesize that earlywood anatomy will respond more to climatic stress in xeric than in mesic sites. We constructed chronologies of earlywood anatomical variables considering the common period 1960-2004. For each species ten trees were sampled in two sites (X, xeric; M, mesic) with contrasting water availability. The eight site residual chronologies of each earlywood feature were related to monthly climatic variables (T, mean temperature; P, total precipitation) from the previous September up to May of the year of tree-ring formation using correlation analyses and response functions. Vessel area and conductive area showed a significant positive association with March (*Q. canariensis*, *Q. faginea*) and April (*Q. robur*, *Q. pyrenaica*) temperatures but they were also negatively related to winter temperature in the mesic *Q. robur* site. Vessel area and conductive area decreased in response to high April precipitation. In the driest locality (*Q. faginea* xeric site) mean vessel area was smaller than elsewhere and decreased in response to high April temperature. Vessel density did not respond consistently to climate. Earlywood anatomy showed different responsiveness to spring climate between xeric and mesic sites.

S.33-02-P

Species-specific tree effects on N and P fluxes in declining oak forests.

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Cork oak forests (*Quercus suber* L.) in the South of Iberian Peninsula are experiencing changes in the plant community structure because of problems on tree establishment and decay. However, the specific effects of this specie on N and P fluxes in the cork oak forest is still unknown. Understanding the relationships between N and P cycles and the composition and abundance of the forest canopy would permit us to predict changes in the ecosystem which may follow the replacement of the dominant specie caused by the forest dieback. In this preliminary work we studied effects of individual trees with different decay degree and other co-existent trees on NH₄⁺, NO₃⁻ and PO₄₃⁻ soil availability in Los Alcornocales Natural Park (Cádiz and Málaga, Spain). We studied mixed forests of cork oak and wild olive (*Olea europea* var. *sylvestris* Brot.) in drier sites and Algerian oak (*Quercus canariensis* Willd.) in wetter sites with different levels of tree decay. At a neighborhood scale (10m). Preliminary results showed a differential species effects on the studied soil properties, suggesting that if the plant community changes, alterations of nutrient fluxes could be expected. However we need to include other factors like seasonal changes on soil moisture, soil texture or the presence of shrubs which may modify the effects of tree canopy.

S.33-03-P

Relationship of aba and proline in stages of drought response in pinus pinaster ait. Of oria provenance.

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Fundación CETEMAS. SERIDA. CETEMAS. SERIDA. CETEMAS/SERIDA.

Climate change studies predict an increase in seasonal drought in Mediterranean environments in the immediate future. It is therefore of interest to study the mechanisms of adaptation to water deficit in order to preserve forest species and improve their growth under these conditions. The trial was conducted using nine-month-old clones of *Pinus pinaster* Ait., from five different families of Oria provenance (Almeria, Southern Spain). The plants were kept in a growth chamber under controlled conditions from November 2009 to September 2010, and two levels of water stress, moderate (MS) and severe (SS) (35% and 20% field capacity, respectively) were applied sequentially. Various water, morphological and biochemical parameters were evaluated. Under MS, the hormone abscisic acid (ABA) was correlated with water (predawn needle water potential (Ψ_{pd}), leaf water content, (LWC) and soil water content) and while under SS, proline content showed a stronger correlation with morphological parameters (height growth and leaf elongation). The restricted water supply reduced the water consumption as well as plant growth, both in terms of height and leaf elongation. Drought stress also modified biomass allocations probably related with the increase of ABA levels. The results suggest that the hormone acts as a signal in the early stages of drought and that proline is then responsible for active osmotic adjustment at the foliar level.

S.33-04-P

Impact of land use change on ecosystem functioning: a case study about *Pinus halepensis* expansion on leaf litter decomposition process.

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In the French Mediterranean region since the early twentieth century, the rural depopulation promotes strong reforestation with pioneer and expansionist species, such as Aleppo pine (*Pinus halepensis* Mill.). Owing to its richness in secondary metabolites, Aleppo pine may play an important role in plant succession through several processes, such as needle decomposition. The decomposition of litter, a key process connecting ecosystem structure and function, is governed by different biotic and abiotic factors. Among these factors, secondary metabolites are known to affect the activity or presence of detritivorous organisms (mesofauna) and decomposers (bacteria and fungi). In this context, we propose to study, during decomposition, the dynamics of secondary metabolites contained in Aleppo pine litter from pine forests with different stages of maturity. Our results show, during decomposition, a succession of invertebrates and microbial communities, determined by changes in the composition of litter secondary metabolites. Moreover, we observed a higher content of total phenols in the litter of young pines, especially certain compounds known to be allelopathic (e.g. gallic acid or p-coumaric). The abundance of decomposers is therefore lower in these litters, resulting in a slower decomposition process compared to other stages.

S.33-05-P

Post-Fire ecophysiological and anatomical processes: *P.halepensis* strategies inferred from $\delta^{13}C$, $\delta^{18}O$ and QWA.

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Wildfires are an important disturbance phenomenon in the evolution and dynamics of Mediterranean-type ecosystems and most Mediterranean woody species display mechanisms for surviving fire. Here, we presented the preliminary results of a study where we investigate the effects of fire on tree growth and where we hypothesize that post fire recovery strategies involve physiological and anatomical adaptations. We measured tree-ring width, $\delta^{13}C$, $\delta^{18}O$ and anatomical features of *Pinus halepensis* L growing in two sites of Southern France, where the trees experienced more than one fire. In order to estimate the role of the external variables on tree growth (such as climate) we also analyzed trees in selected control plots in a surrounding area not interested by fires. After the fires, the surviving trees showed growth suppression with very narrow tree rings or locally absent rings. The mean sensitivity (characterizing the year-to-year variability) and the inter-trees variability increased during the years after the fire events. The isotopic signatures improved an understanding of physiological and ecological responses of trees to heat-related damage, showing significant changes in the survived trees in the period soon after the fire. Furthermore, quantitative wood anatomy (QWA) provided further information on how tree growth reacts during the same season of the fire event and in the following years. Microscopy analyses were aimed to identify those anatomical traits more sensitive to heat-related damage and to interpret them in a functional perspective.

S.33-06-P

Patterns of *Pinus sylvestris* recruitment under climate change scenarios: insights from altitudinal and latitudinal surveys.

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Global change has profound effects in forest composition and structure, and species located at their distribution limit are particularly vulnerable to them. This is the case of Scots pine (*Pinus sylvestris*) in the Mediterranean Basin, where the already dry climate is expected to become even drier. Factors controlling the recruitment of Scots pine are poorly known, and their variation over wide geographic and altitudinal ranges is not well understood. The aim of this work is to fill this knowledge gap about the factors involved in the recruitment patterns of Scots pine and the likely shifts along latitudinal and altitudinal gradients in its southernmost limit of its distribution area. Seedlings and saplings of three different *Pinus sylvestris* forests, located along a latitudinal gradient in Spain (Sort in the pre-Pyrenees, Valsain in the Central Mountain Range, and Sierra Nevada in the South), were censused in 30-36 plots per site. These plots were established along the whole altitudinal range of the pine at each site, and variables related to the abiotic environment, the potential fecundity of adult trees and the inter and intraspecific competition were recorded at each plot. Generalized Linear Mixed Models revealed significant elevation shifts with important mismatches between seedlings and saplings in their relative abundances as the species is present at higher altitudes at southern locations. These shifting regeneration patterns along elevation and latitudinal gradients have deep implications for the future distribution of the species under climate change scenarios.

S.33-07-O

Land use change consequences for biodiversity.

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In a context of global change, the present challenge is to develop approaches that allow the prediction of species responses to further change and develop new paradigms of planning and management guidelines compatible with the novel ecosystems concept. However, the prediction of species responses such as shifts in species distribution patterns or ecosystem resilience is not an easy task as many interacting factors constraint current species distributions. We aim at developing an ecological and modelling framework that accounts for uncertainty in the study of the responses of Mediterranean ecosystem to a wide range of environmental pressures dominated by climate change, land use change (i.e. abandonment or urbanization) and fire disturbances. The integration of these elements in modelling platforms and methodological approaches to reproduce the responses of landscapes and species distributions to variability in the perturbation regime is a step forward. Model development has been implemented in a Mediterranean region, Catalonia, North-eastern Spain, with predominantly non-productive, forest dominated systems in a mosaic of other productive or more heavily used areas related to agriculture and urban settlements. We use two main tools to develop scenarios and evaluate their impact on biodiversity. A) Spatially explicit landscape models (SELM) aiming at developing hypotheses of future landscape changes under the simultaneous impact of different global change drivers, and B) Dynamic species distribution models (DSDM) allowing the integration of different ecological processes in the prediction of species distribution changes following environmental changes. Our approach involves the integration of current knowledge of forest system response to abandonment and fire and aims at building potential future scenarios that serve as reference for management decisions at different landscapes scales. Such scenario building strategy allows a new paradigm in decision-making in which decisions are not taken in relation to an absolute reference target (i.e. natural untouched system), but after evaluating the different alternatives of change and expected outputs under different possible future trajectories.

S.33-08-P

Contingency shapes the response to climate change and atmospheric CO₂ across the distribution range of *Abies pinsapo* forests: variability in land use matters.Carreira, José Antonio. Ochoa, M^a Victoria. Lamrani, Mostafa. Viñepla, Benjamín. Linares, Juan Carlos. Camarero, Jesus Julio.

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The response of forest ecosystems to climate change and rising atmospheric CO₂ may be contingent on stand structural attributes beyond species composition, such as the size-spectrum and spatial arrangement of tree individuals. These attributes are strongly affected by land use changes and determine mean intensity and asymmetry of the competitive environment that trees experience. In turn, competition affects the water and carbon budgets of the trees and, thus, their adaptive capacity to environmental change. Therefore, density-dependent factors should be explicitly taken into account when assessing the vulnerability of forest ecosystems to global change drivers. To assess this conceptual frame, we selected *Abies pinsapo* forests since (i) this fir species show a high sensitivity to climate in its relic distribution area in mountains at the north and south coasts of the Gibraltar strait; and (ii) land uses show distinct features at both coasts. In this work, we extend our previous studies to the whole geographic range of the species. We analyzed tree-ring width and δ¹³C, spatially explicit stand structural attributes, and climate and land-use changes across the Baetic and Rift Ranges. Spanish populations experienced abrupt land use changes (type, intensity) and showed more complex growth trends and recent decline patterns. Moroccan populations, subjected to low intensity traditional uses by local inhabitant, showed stable and cyclic growth patterns and low vulnerability to climatic stress. All populations showed increasing trends of water use efficiency in response to atmospheric CO₂, but the trend rate and its recent uncoupling were dependent on the land-use context.

Do thinning and reduced rainfall affect soil CO₂ efflux in a Mediterranean mixed oaks forest? Temporal variations of soil respiration under *Quercus ilex* and *Q. cerrrioides* after selective thinning and rainfall exclusion.

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Forest soil is a key component in the global carbon cycle because of their potential to store and release carbon depending upon vegetation type, forest management practices and climate change. Precipitation patterns are likely to play a particularly important role in regulating soil respiration in water-limited ecosystem, such as the Mediterranean region where the seasonal pattern is characterized with a significant summer drought. This study addresses how thinning and reduced rainfall alter seasonal and diurnal soil C flux by measuring soil respiration under evergreen species (*Quercus ilex*) and deciduous species (*Q. cerrrioides*) from 2004 to 2008 with an experimental design of selective thinning and 15% rainfall exclusion. The results showed that reduced rainfall had negative effect on soil respiration under both species, with a significant reduction during the growing season. Generally thinning increased soil carbon flux in the first year but then showed a reverse effect. Regarding tree species, thinning significantly reduced the soil respiration under *Q. ilex* during the whole experimental period whereas soil respiration under *Q. cerrrioides* increased in the first 1.5 years. Soil respiration was strongly related with temperature with a Q₁₀ value of 2.08 when soil water content was higher than 10%, and then the Q₁₀ value decreased consequently to 1.97 and 1.28 when soil water content was 5-10% and

S.33-10-P

Response of leaf phenology to changes in climatic variables in four species of the genus *Quercus* in Mediterranean climates.

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Phenological observations are a very useful tool for determining how different species respond to climatic conditions; this means that they have now become an integral part of any study related to climatic change. The aim of the present work was to compare leaf phenology patterns in four species of *Quercus* (*Q. pyrenaica* Willd., *Q. faginea* Lam., *Q. suber* L. y *Q. ilex* L.) with different habits and longevities, and to analyze the possible relationships between the phenological behavior exhibited by the leaves of each species and the different climatic factors with a view to predicting possible future repercussions of climate change. Our species displayed an early emergence, concentrated in a major or even single flush, completing their leaf mass in a short period of time. The only exception was *Q. suber*, whose leaf deployment seemed to require higher temperatures, the phenophase starting around one month later with respect to the other species. This rapid and early emergence could respond to a strategy aimed at both protection against herbivory and as a way to start assimilating CO₂ while weather and soil conditions are still favourable. Among the different study years, we observed intraspecific differences as regards the dates of senescence and leaf abscission in the case of the two deciduous *Quercus*, which also matched differences in some of the climatic variables. Our results suggest the existence of a threshold of maximum daily temperatures along the autumn under which the leaves are shed, apparently because they cannot maintain positive assimilation rates along the day. In the two perennial species, the highest leaf mortality rates are observed during the dry season, coinciding with a decrease in predawn water potential as well as in the minimum leaf water potential at midday. Although preliminary, our data suggest that climate change could lead to changes in leaf phenology with very different repercussions in the different species. Greater mortality of the leaves of the two perennial *Quercus* species during the summer as a result of the increase in drought intensity, together with an increase in the life-span of the leaves of the two deciduous species in response to the increase in autumn temperatures, could help to reduce the differences in the duration of the productive period between both types of species, improving the competitive capacity of the deciduous *Quercus*, whose patterns of distribution could be altered to the detriment of the perennial species.

S.33-11-O

Threats and opportunities of global change for Mediterranean Basin ecosystems.

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The planet is undergoing rapid and profound changes due to human activities. Some drivers of global change are especially affecting the Mediterranean region, such as climate warming, land use change and wildfires. However, principal threats to the region may come from the combination and feedbacks among drivers. As a representative example, abandonment of traditional practices favours invasive species, typically competitive with strong dispersal, establishment and growth, is also leading to an increased risk of devastating fires due to accumulation of fuel, to a decrease in water availability, and even to other novel environmental pressures such as the de-fragmentation of the landscape. The spontaneous re-connection of forest patches separated during decades or centuries by agricultural practices is opening many challenging questions. On the other hand, the special characteristics of the Mediterranean Basin could improve our understanding of global change through its feedback to the Earth system and the impacts expected. The Basin experiences not only increasing temperatures but also drought, wildfires and soil degradation, which coupled to its inherent landscape and biological diversity makes it both a scientifically unique and an environmentally critical place for global change research.

S.33-12-P

Detection of Mediterranean forest canopy areas vulnerable to droughts by integrating remote sensing and climatic variables.

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Nowadays drought remains a phenomenon that affects a wide variety of natural areas in many parts of the globe. Droughts are considered the abiotic factor with most harmful effects on forest areas, thus it is especially important to identify the locations with highest potential impact. Its temporal and spatial distribution, as well as the different types of drought defined, makes difficult its prediction and the impact degree that their appearance involve. Climatic drought, characterized by a temporal sequence with a higher frequency of atmospheric conditions that are unfavorable to the development of precipitation over a region, is the trigger of the process associated with the risk of biological drought. The methodology used to identify periods of climatic drought is mainly based on the analysis of climatic variables such as precipitation or temperature (in our case from the Digital Climatic Atlas of Catalonia). However, these analyses don't take into account the physiological state of vegetation, a highly important variable that should be used to monitor the status of forest ecosystems vulnerable to droughts. Our aim is to evaluate the potential of satellite images regarding the identification of Mediterranean forest areas that could potentially have had a maximum affection during drought periods. We have integrated a series of images of TM/ETM+ sensors onboard Landsat 4-7 satellites, for the period 1984-2008 together with climatic data to detect drought in forest canopies. This integration may provide a readily applicable methodology for identifying the most vulnerable areas affected by droughts.

S.33-13-P

Seasonal variation of photoprotection mechanisms in *Juniperus thurifera* trees.

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Climatic conditions prevailing in Mediterranean ecosystems are characterised by a dry summer, when water economy is essential for plant success and a period in which low winter temperatures can also be limiting factors for plant survival. In the present work, we aimed to study the responses of the photoprotection mechanisms of a Mediterranean tree: the thuriferous juniper (*Juniperus thurifera* L.) to the seasonal changes in environmental conditions. A relevant trait of this species is that wax accumulation occurs in leaves of some trees, and because of this, it can be easily distinguished the existence of glaucous and greenish phenotypes. Measurements were performed in Sierra de Cabrejas (altitude 1300 meters, central Spain, Europe), a site characterised by a cold continental Mediterranean climate. Photoprotection parameters and defoliation were determined in both phenotypes from January 2006 to January 2010. The most stressful period in terms of photoinhibition was winter. During this winter, the most defoliated trees also showed a higher photoprotection demand. Furthermore, the greatest difference in reflectance between both phenotypes was also found in this month, being the glaucous phenotypes the more defoliated. During January 2010, a deeper analyses based on fluorescence rise curves according to the JIP-test were done. We conclude that photosynthetic performance in *J. thurifera* is more affected by the cold in winter than by the hot in summer.

The impact of climate change and forest structure on the trade-off between reproduction and vegetative growth on the exotic invasive *Acacia longifolia*.

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Several species of *Acacia* are noxious weeds in many parts of the world, especially in Mediterranean climate regions. In Portugal, *Acacia longifolia* is one of the most aggressive invasive plant species and causing major ecological problems. The objective of this study is to understand the ecophysiological response of *A. longifolia* to different climatic conditions and understand how different climatic conditions can affect vegetative and reproductive investments of this invasive species. Indeed, biological invasions may be considered one of the most important threats to biodiversity and ecosystem functioning within global change. The study was conducted at two different sites, north and south of Portugal, where we have different climate conditions: southern location drier and northern location more mesic and humid. Moreover, these two sites are also characterized by different forest structure, with more dense forest in the north than in the south. Both sites are sand dunes typically occupied by *Pinus pinaster* plantation and they are infested with *A. longifolia*. In each plot were performed leaf water potential and gas exchanges measurements in three occasions: March, June and July. Carbon and nitrogen isotope composition analysis at leaf material was also performed. Phenology was monitored by measuring shoot elongation and by counting leaves, flowers and fruits. The results pointed out for no differences in leaf water potential between sites. However, *A. longifolia* in under higher humidity conditions north site were more sensitive to drought period, displaying lower values of A and g_s than the south plants. Moreover, the results of leaf $\delta^{15}N$ showed significant lower values in the north side than in the south side and the leaf %N showed the same trend. Significant differences between study sites appeared in the magnitude of growth and in the flowers and fruits production. In the northern *A. longifolia* showed higher reproductive investment and lower growth rate comparatively with southern forest. In this work we presented evidence that Mediterranean forests (such as pine forests) invaded by *A. longifolia* under more mesic conditions but with relative higher biomass and higher resources competition might be more stressful for *A. longifolia*, and as a consequence we observed a lower physiological performance and higher reproductive costs than in more drier conditions. These results are special important for the understanding of the factors that can determine the reproductive costs in *A. longifolia*, emphasizing a potential differences in the invasive pattern according to forest management and climate change.

S.33-15-P

Acorn production in Mediterranean oaks: disentangling the effects of phenology, airborne pollen availability and water stress.

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Many plant species as oaks (*Quercus* sp.) exhibit an extreme inter-annual variability in seed production often synchronized at large geographical scales (masting). As this reproductive behavior is mainly observed in wind pollinated plants, pollination efficiency has been invoked as one hypothesis to explain masting: i.e. extreme events of pollen release in the atmosphere would enhance seed production than regular but moderate episodes. Conversely, other studies have pointed out resource tracking as an alternative to explain extreme and irregular seed crops. The aim of this study has been to analyze the relationship between meteorological characteristics, airborne pollen presence for 17 years and acorn production for 12 years in mixed evergreen-deciduous oak forests (*Quercus ilex* and *Q. pubescens*) in Collserola (Barcelona, NE Spain). As expected, there was a negative correlation among pre-flowering temperatures and flowering onset. The crop size of immature acorns (fertilized female flowers) was positively influenced by pollen production. In the two oaks, mature acorn crop size was negatively influenced by the hydric deficit in spring and positively influenced by a later date of flowering for *Q. ilex* and negatively for *Q. pubescens*. These results suggest that flowering phenology and water stress, rather than total pollen load, do better explain the amount of mature acorns produced. Interestingly, although pre-flowering temperatures have not varied for the last 17 years, a progressive delaying flowering onset is observed for both species. The influence of other environmental factors in this process and, whether it may change under new climatic change scenarios deserves further attention.

S.33-16-P

Changes in floristic structure and dynamics of regeneration of the hygrophilous forest in the Chilean Mediterranean ecosystems.

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This study determined the floristic structure and dynamics of the hygrophilous forest, that grow along permanent water courses in the coastal range of Central Chile. Is a closed forest community evergreen trees 12 to 18 m. in height, dominated by *Beilschmiedia miersii* (belloto del norte). In south-facing, low to moderate slopes, *Cryptocarya alba* ("peumo") is the most important tree the sclerophyllous forest, occupying less humid habitats than the hygrophilous woods. Three deep creeks were studied: La Madera (32°36'S-71°10'W), El Pedernal (32°36'S-71°12'W) y El Infiernillo (32°42'S-71°04'W). The floristic structure was obtained by Twenty six censuses of vegetation according to Zürich-Montpellier methodology. And dynamics of regeneration was obtained from the diameter structure graphics (Veblen 1992). The floristic richness comprises 79 vascular plants species, distributed between Pteridophyta (8 species), and Angiospermae, including Dicotyledoneae (60 species) and Monocotyledoneae (11 species), of the 79 plants; 43 are endemics, 25 native and 11 exotic therophytes plants. The most important species are *Beilschmiedia miersii*, *Cryptocarya alba*, and the herbaceous *Loasa triloba*, all endemics of the Chilean Mediterranean forests. The diameter structure of *C. alba* shows evidence of continuous regeneration and *B. miersii*, on the other hand, show a scant regeneration. We conclude that the presence of exotic therophytes, and the dynamics of regeneration indicate that the hygrophilous forests ("Belloto del norte forests") are in a transitional stage to become a sclerophyllous forest ("Peumo forests"), if current conditions of human intervention and climatic change continue to favor the drying of the deep creeks in the Chilean Mediterranean ecosystems. Key words: hygrophilous forests, sclerophyllous forest, Mediterranean forests, floristic structure, dynamics regeneration.

S.33-17-P

Patterns of leaf morphology and leaf N concentration in relation to winter temperatures in three tree evergreen species.

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The competitive equilibrium between deciduous and perennial species in a new scenario of climate change may depend closely on the productivity of the leaves along the different seasons of the year and on the morphological and chemical adaptations required for leaf survival in the different seasons. The aim of the present work was to analyze such adaptations in the leaves of three evergreen species (*Quercus ilex*, *Q. suber* and *Pinus pinaster*) and their responses to differences among environments in the intensity of winter strength. We test the hypothesis that the rigours of winter contribute to enhancing the leaf traits that allow the leaves to persist. The results showed that as the winter strength increases a decrease in leaf size occurs in all three species, together with an increase in the concentration of nitrogen per unit leaf area and a greater leaf mass per unit area, which seems to be achieved only through increased thickness, with no associated changes in density. *P. pinaster* was the species with the most intense response to the harshening of winter conditions, undergoing a more marked thickening of its needles than the two *Quercus* species. Our findings thus suggest that the drop in temperature in winter involves an increase in the cost of leaf production of the evergreen species, which must be taken into account in the estimation of the final cost and benefit balance of evergreens. The cost increases would be more pronounced for those species that, as *P. pinaster*, show a stronger response to the winter cold.

S.33-18-P

Modulating factors of the growth responses to climate warming in Iberian *Pinus uncinata* forests during the twentieth century.

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It is expected that the increasing climatic variability and temperature rise will alter the growth dynamics of mountain pine forests. Previous studies evidenced that trees showed elevation-dependent sensitivities to climate variability throughout the past century. We evaluated if such responsiveness is more mediated by site conditions (elevation) or by tree features (basal area, height, age, sapwood area). We sampled 651 trees in 27 forests from the Pyrenees and the Iberian System, and we studied their growth trends using dendrochronological techniques. The original tree-ring width series were converted to basal area increments (BAI) to study relationships between growth and other variables for the 20th century and considering two equivalent periods: the first (1901-1947) and second (1948-1994) halves. We used Structural Equation Models to select the most appropriate statistical model explaining BAI variability. Trees were older at high than at low elevations, and the amount of sapwood decreased as trees aged. During the 20th century (1901-1994), BAI variability was positively related to sapwood area. We detected that BAI increase as a function of sapwood area increment was higher in the period 1948-1994 than in the period 1901-1947, despite BAI trends of both periods showed the reverse pattern. Our results highlight the relevance of tree physiological conditions in modulating growth responses to climate warming. These findings suggest that climate warming will induce a lower BAI enhancement in slow-growing high-elevation trees than in fast-growing low-elevation trees which produce more sapwood amount than the former.

Forest landscape connectivity metrics as indicators of recent woodpecker expansion in the mediterranean (NE SPAIN).

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In the Mediterranean region of Catalonia (NE Spain), woodpecker species have significantly expanded their ranges in the last decades of the 20th century. This process is closely related to forest maturation following large-scale decline in traditional uses. Disentangling the role of forest structure and its connectivity at the landscape scale in driving species colonization is fundamental to anticipate and contribute to mitigate global change impacts. This study assessed the role of forest landscape connectivity in the colonization of two woodpecker species through graph theory and habitat availability (reachability) metrics. Data on breeding bird atlas at 10x10 km and forest inventories were considered. The probability of connectivity metric was computed at different dispersal distances (10, 20, 30 and 40 km), separately quantifying how individual landscape elements can contribute to overall habitat connectivity and availability (intra- and interpatch connectivity). These models were compared with a more simplified approach that averaged forest structure variables on neighbouring localities at different spatial scales. After correcting for sampling effort differences, the best models of colonization events (against non-occupation ones) were those considering the more detailed landscape connectivity metrics. Colonization events of the most specialist species (*Dryocopus martius*) were strongly linked to landscape connectivity of mature forests, while for *Dendrocopos major* this pattern was less evident. Regardless of the distance considered, colonized localities were those that were estimated to receive a higher amount of area-weighted dispersal flux (interpatch connectivity). Results underpin the need to consider landscape connectivity criteria for biodiversity conservation in Mediterranean forests under global change. Current research focuses on analyzing forest structure connectivity at finer spatial scales and on considering species ecological traits.

How to apply ozone critical levels for southern european vegetation communities?

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CIEMAT. CIEMAT. CIEMAT. CIEMAT. CIEMAT. CIEMAT. CIEMAT.

Tropospheric ozone (O₃) is the most widespread air pollutant in the Mediterranean area. The typical climatic conditions of this region - high temperatures and solar radiation levels, combined with stable air masses and high emission of air pollutants- favour the formation of secondary pollutants such as O₃. Ozone concentrations in the Northern hemisphere have increased in the last century and are expected to keep rising, though depending on future precursor emission scenarios and climate change. Ozone is a highly oxidant gas, able to induce negative effects on vegetation upon absorption through the stomata of the leaves. Plant physiological effects induced by O₃ include leaf visible injury, reduced above and below ground growth, accelerated leaf senescence, reduced flower and seed production, increased sensitivity to other abiotic stresses, etc. These negative effects could result in yield reductions of sensitive crops, decreased forest growth or changes in pasture species composition. The Convention on Long-range Transboundary Air Pollution of the UN/ECE (CLRTAP) is an international effort aiming at limiting and, as far as possible, gradually reducing and preventing air pollution. The Convention has developed protocols for air pollution abatement negotiated on the basis of preventing adverse effects according to present scientific knowledge. In agreement with this objective, O₃ critical levels to protect vegetation, values above which direct adverse effects may occur, have been established for crops, forest trees and semi-natural vegetation. Ozone critical levels have been expressed as the cumulative exposure to O₃. However, empirical data show that O₃ negative effects are more related with the flux of O₃ entering the leaves through the stomata. Thus, a new set of flux-based critical levels have been adopted recently for some vegetation receptors (UNECE, 2010). These new critical levels based on the cumulative stomatal flux of O₃ absorbed by plants incorporate modifying factors of plant O₃ sensitivity such as species type, phenology and environmental conditions. Flux-based critical levels constitute a new tool for estimating risks of ozone damage from a global change perspective. However, their application for Mediterranean vegetation is still under development. This work reviews the current knowledge about the application of O₃ critical levels to protect the different plant communities found in the Iberian Peninsula, pointing to current uncertainties and research needs. References UNECE, 2010. Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends. Convention on Long-Range Transboundary Air Pollution. Available on line at: www.icpmapping.org.

S.33-21-P

Demographic bottlenecks for plant recruitment in woodland remnants within an extremely fragmented landscape.

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Very few studies have assessed the net effects of habitat fragmentation on plant recruitment integrating its multiple demographic processes. Using data from a four-year field study, we analyze how habitat fragmentation affects particular demographic processes and the overall magnitude of plant recruitment. We use as a case study the bird-dispersed shrub *Myrtus communis* in Mediterranean woodland patches within an extremely fragmented landscape (~1% woodland cover). By means of observations and experiments, we quantified fecundity, fruit removal by frugivores, seed rain, post-dispersal seed predation by rodents and seedling emergence and survival. We considered the life cycle to be a combination of consecutive life stages connected by transitional processes with specific probabilities. We calculated the overall probability of recruitment for each patch as the product of all of these probabilities. The demographic processes negatively affected by fragmentation were bird-generated seed rain and seedling emergence and survival, which were attributable, respectively, to lower fruit abundance and poorer habitat quality in the smaller patches. The negative effect of fragmentation on *M. communis* recruitment became stronger when all the demographic processes were integrated. Seedling emergence and, above all, seedling survival were clearly bottlenecks for recruitment that were associated with habitat fragmentation. The available evidence suggests that the impoverishment of habitat quality associated with habitat fragmentation (edge effects and disturbances associated with management) may explain these results. Given that restoration at a landscape scale is likely to be extremely difficult, initial management actions should aim to improve habitat quality in the smallest woodland remnants.

S.33-22-P

Four tree species co-occurring in a continental Mediterranean forest differ in their radial growth responses to climatic stress and rising atmospheric CO₂.

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Summer drought and winter cold play a key role in Mediterranean plant performance and, thus, in community composition and dynamics. Different tree species are expected to have distinct growth sensitivity to both stresses, which could explain species coexistence. We aimed to: i) quantify radial-growth variability in four sympatric tree species (*Quercus ilex*, *Q. faginea*, *Pinus nigra*, *Juniperus thurifera*); ii) assess if growth has changed over the last three decades in response to climatic trends and rising atmospheric CO₂ concentrations; and iii) evaluate how growth is affected by severe droughts and by the combined stresses of summer heat-drought and winter coldness experienced by Mediterranean species. We sampled mature trees of the four species growing in forests from central Spain (Alto Tajo) and used dendrochronology to cross-date wood samples. We measured earlywood, latewood and tree-ring widths and related these variables and basal-area increment to climatic variables and CO₂. The results revealed that the four species significantly differed in their growth patterns. Growth rates were minimum for *Q. ilex* and maximum for *P. nigra*. During the last three decades, *J. thurifera* showed positive relationships with increased CO₂. *Q. faginea* presented the opposite effect and the other two species did not show variations in response to increasing levels of CO₂. *P. nigra* was the species most negatively affected by drought, even though all the species showed significant growth reductions after severe droughts. We discuss the role of these different growth responses to climatic stresses and rising CO₂ for the future coexistence of these species.

S.33-23-O

Drought effects on damage by forest insects and pathogens: a meta-analysis.

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In the context of climate change, the effects of prolonged or more severe droughts on pest and pathogen damage is a major concern for Mediterranean forest ecosystems. To date there is great uncertainty about the direction, magnitude and sources of variation in responses to drought by insects and fungi. We report the outcomes of a meta-analysis of 100 pairwise comparisons of insect pest or pathogen damage to water-stressed and control trees from 40 publications. The type of feeding substrate for insects and fungi and the water stress severity emerged as the main factors influencing the level of damage in water stressed trees. Overall, primary damaging agents living in wood caused significantly lower damage to the water-stressed trees compared to the control whereas primary pests and pathogens of foliage caused more damage to water stressed trees, in all cases irrespective of stress severity. In contrast, damage by secondary agents increased with stress severity, which was best estimated by the ratio between the predawn leaf water potential in stressed trees and the xylem pressure inducing 50% loss in hydraulic conductance due to cavitation, a species-specific index of drought tolerance. Insect and fungus feeding behaviour, affected tree part and water stress severity are therefore proposed as three important predictors of forest damage in drought conditions.

S.33-24-P

Testing the island biogeography theory in a high mountain Mediterranean community.

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Past climate-warming events seem to have promoted shifts in plant species and biomes towards the poles or higher altitudes. However, the extent of current forest vulnerability to climate change presents large uncertainties and within-range tree responses to regional warming and drought worsening remain poorly understood. We tested whether ideas from island biogeography theory predict upward migration success for five endangered tree species (*Abies pinsapo*, *Acer granatense*, *Quercus alpestris*, *Sorbus aria*, and *Taxus baccata*) in a high mountain Mediterranean community dominated by *Juniperus sabina*, in an effort to provide guidance on how to allocate conservation resources. In the study area (the summit of the Sierra de las Nieves Natural Park, South Spain), vegetation cover occurs as *Juniperus sabina* patches embedded in a bare ground matrix. Our hypothesis is that patchy structure of tree regeneration in high mountain Mediterranean vegetation is a consequence of facilitative interactions, which involve strong localized effects on microclimate, soil properties and herbivores pressure likelihood. We sampled tree species diversity, tree density, and tree age and size structure inside and outside the juniper patches. Naturally colonizing trees inside the juniper patches were modelled as a function of patch size (juniper area), mean juniper height and tree position (minor distance to juniper borderline). Soil nutrients content was significantly higher inside the juniper patches, compared to the bare rock matrix. Trees regeneration occurs mainly inside the juniper patches. Tree species richness and tree density increased with increasing juniper area, and were very lower in the bare rock matrix. Tree size structure was dominated by adult trees. Tree species richness and density were positively related to connectivity (mean distance) with remnant forest. Neither patch size nor connectivity with remnant forest were related to a differential density of wind-dispersed tree species (*Abies pinsapo* and *Acer granatense*) comparing to bird-dispersed tree species (*Quercus alpestris*, *Sorbus aria*, and *Taxus baccata*). The presence of juniper patches was significantly related to endangered trees regeneration, but much of the variance in tree density and size structure remained unexplained. Given the reduced presence of seedling and sapling of the studied species, our results provide weak support for the predictions of island biogeography theory and the hypothesised recent upward migration of drought sensitive tree species.

S.33-25-O

The “Birch effect” and the soil nitrogen cycle in Mediterranean forests: from the hillslope to the riparian zone.

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The “Birch effect” states that, when dry forest soils are rewetted, there is a burst of soil mineralization and CO₂ release. Little is known, however, about how water pulses control nitrogen (N) availability in forest soils subject to drought. We analyzed the influence of water availability on the soil N cycle in Mediterranean forests by measuring net N mineralization (NNM), net nitrification (NN), and soil N availability in three forest plots: a wet hillslope forest (beech), a dry hillslope forest (holm oak), and a riparian forest (alder). On average, soil N cycling was slow on both holm oak (NNM=0.75 µg N/g/d; NN=0.31 µg N/g/d) and beech (NNM=0.51 µg N/g/d; NN=0.10 µg N/g/d) forests compared to the riparian zone (NNM=1.27 µg N/g/d; NN=1.23 µg N/g/d). Both hillslope forests experienced a “Birch effect” switching behavior coupled to water pulses. Storms enhanced both NNM and NN in the holm oak forest, but only burst NNM in the beech forest, where soil available N was extremely low. In the riparian forest, no “Birch effect” was observed because the relatively high soil moisture and low C:N ratios promoted a fast N cycling and high soil N availability. These results suggest that, referring to soil N cycling, hillslope forests experience hot moments, while riparian forests are hot spots. In the Mediterranean forests, the progressively warmer conditions coupled to changes in forest type distribution may cause profound alterations of the soil N cycle and may increase N losses from catchments to downstream ecosystems.

S.33-26-P

Ecosystem services in mountain regions: highlighting balances and trade-offs - A case study from Portugal (Serra da Estrela).

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We present an ecological and economic assessment of ecosystem services provided in a Portuguese mountain region. Our study aims, primarily, at contributing to broaden the use of economic valuation of ecosystem services in a context of nature conservation while discussing methodological challenges and policy implications based on our findings. The study area comprises 7,200 ha, corresponding to a primary watershed, located within the Natural Park of the Serra da Estrela (Portugal). Despite its relatively small size, the Cascade is highly representative of the ecological value of Serra da Estrela. For instance, 15 of the 30 habitats mentioned under the EU Habitats Directive are represented within the study area. Inventory of ecosystem services was based on the ecological characterization of the area, published references and unpublished studies, statistical data, expert opinions, data from our own field work and from a one day participatory workshop in which relevant stakeholders have been involved. The following ecosystem services have been identified: power generation, water supply for human consumption, food and wood production, fire risk avoidance, recreational fishing and biodiversity. Our findings, regarding economic valuation, clearly indicate that power generation is the most valuable service provided by the study area. A time horizon of 20 years and a discount rate of 5% have been considered for our purpose. In a per hectare basis, and assuming a linear relation between the net present value and the study area, we obtained a value ranging from 15,851€/ha to 17,649 €/ha.

S.33-27-O

Drought and Mediterranean forests.

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Water availability affects vegetation distribution and growth worldwide, from deserts to tropical ecosystems. Mediterranean vegetation is in principle well adapted to seasonal water shortage. At the same time, however, Mediterranean regions are predicted to undergo a particularly marked increase in drought frequency and intensity during the current century as a result of climate change. In this context, it is important to know to what extent Mediterranean forests are likely to change in the following decades and whether they are inherently more (or less) vulnerable to drought-induced changes than other forest types (e.g., temperate forests). In this paper I will (1) briefly review the evidence showing drought-induced effects in Mediterranean forests, and (2) compare the water-use strategies and the resistance and resilience to drought of Mediterranean forests with that of other vegetation types. The evidence thus far suggests that, contrary to some interpretations, Mediterranean forests may be less vulnerable to drought than forests from moister biomes and that within a given region, the effects of drought will frequently be more severe in relatively wet than in already dry areas.

S.33-28-P

Microhabitats can influence seedling phenology in Mediterranean forests.

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Although climate change has regional or global dimensions, it may interact with the structure of the community on a local level. In Mediterranean forests, microhabitat conditions may favour the phenological ability of seedlings to cope with summer drought and, as a result, indirectly attenuate effects of predicted warming and drying on regenerating co-existing species. We have investigated soil moisture and temperature, seedling phenology and aerial development of two co-occurring Mediterranean *Quercus* species growing under different canopy and litter covers, during one growth season including a drought period. Our results suggest that the dense cover (dense canopy and deep litter) acts as a shelter and promotes soil moisture during the drought period, but also acts as an intercepting layer diminishing soil moisture during wetter seasons. *Q. pubescens* showed early budburst timing and great foliar development before summer drought, which is a typical strategy for Mediterranean winter deciduous species. In contrast, the evergreen *Q. ilex* showed a high autumnal activity that enables this species to tolerate the dry period and to take advantage of post-dry summer precipitation events. While *Q. ilex* rather featured a more conservative phenological strategy, the phenological response of *Q. pubescens* was strongly dependent on canopy cover and presented a low tolerance to interactive shade and drought stresses. This lower sensitivity to canopy effects and specific phenological strategy may provide *Q. ilex* a broad ecological niche and considerable competitive advantages considering the predicted seasonal changes of climate in northern Mediterranean regions.

S.33-29-P

Water use efficiency and growth of *P. sylvestris* and *Q. pubescens* in the Pyrenean region.

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P. sylvestris and *Q. pubescens* mixed forests have roused ecophysiological interest for several reasons. On one hand, *P. sylvestris* is a widely distributed species adapted to a large range of climatic conditions. Although CO₂ fertilization has enhanced its primary production in some areas, it remains unclear whether such pattern will continue in the mid-term future under the projected Climate Change conditions in the region (increase in temperature and decrease in rainfall trends). In fact, high mortality rates associated with recent drought episodes have been reported in many European Scots pine populations including Mediterranean ones. On the other hand, *Quercus pubescens*, considered a sub-Mediterranean species adapted to xeric conditions, is expanding in some montane areas in detriment to pinewoods, probably due to a more efficient water supply and higher resistance to cavitation events. Thus, analyzing evapotranspiration trends of both species seems important in order to forecast their vulnerability under increasing drought conditions. Even more, shifts in forest composition related to sub-Mediterranean species expansion have put them in the spotlight like Climate Change sensors. This work explores the development of two pinewoods and an oak forest in the Pyrenean region. It analyses water use efficiency (WUE) from two different approaches: isotopic discrimination ($\delta^{13}C$) and tree-ring growth to evapotranspiration ratio. Besides, climatic signals are evaluated in order to identify possible bottlenecks for *Q. pubescens* and *P. sylvestris* growth. A general increment in WUE, different relationships between isotopic and structural approximations in both species and lower climatic signals in Pubescent oak are expected.

S.33-30-P

The influence of wet-dry cycles in N pools in two Mediterranean ecosystems.

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The episodic nature of water availability has significant consequences on nutrient cycling. Water pulses may directly affect the frequency and duration of 'wet-dry cycles' in the soil. These wet-dry cycles may indirectly control activity of soil organisms, which will ultimately determine nitrogen (N) turnover and ecosystem productivity in Mediterranean and other semiarid ecosystems. Rapid soil microbial response to incident moisture availability often results in almost instantaneous N mineralization, followed by shifts in C/N of microbial available substrate. Seasonal distribution of water pulses can lead to the accumulation of mineral N in the dry season, decoupling resource supply and microbial and plant demand. We have studied the continuous changes in soil N analyzing pools in fresh soil of dissolved organic nitrogen (DON), microbial biomass-N (MB-N), NH₄⁺ and NO₃⁻ and inorganic N availability by using ion exchange resin membranes (IEMs). The soil sampling was followed at weekly intervals during a year to explore the complex dynamics of N availability in soils depending on rapid changes in moisture availability in two Mediterranean ecosystems. The results showed a high variability within each month depending on the number of rain events. The variability of the soil N variables was higher during the first wetting period after the summer drought than during winter and spring, but rapid changes in the pools of most soil variables were also found as response of episodic rain events during the summer. However, rapid changes in DON and microbial biomass were also found unrelated to changes in water availability, suggesting that other variables are driven the size of these pools in Mediterranean ecosystems.

S.33-31-P

The likely changes in spatial distribution of some invasive plants under different climate change scenarios in the Valencian Community, Spain.

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The Valencian Community, located in the East of the Iberian Peninsula, is a region with a high diversity of flora, in which there is a number of threatened species and high endemism. Habitat loss and degradation, lack of protected areas, lack of a good management, human pressure and climate change processes are the major threats to plant diversity. However, alien plant species that invade natural areas and which compete with local species may be the biggest threat in the future especially within the context of climate change that may provide the adequate conditions for their expansion. This study intends to analyze the likely change tendencies in spatial distribution of some invasive plants under different climate scenarios at the Valencian Community scale. From registered data of presence of invasive plant species within the valencian territory, the potential distribution of those species was modelled using physical and climatic variables. Then a projection in the future was made by changing the current climatic variables by the new ones obtained from the climate change scenarios, to determine if the likely future climatic conditions simulated by a Global Climate Model have an effect on the spatial distribution of those invasive plants.

S.33-32-P

Current Mediterranean forest regeneration depends on land use in the recent past.

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Ecosystems dynamics is not only a consequence of current ecological processes, but is also influenced by historical effects and sorting processes. Internal ecological memory, as historical component of resilience, consists of biological legacies in that site and includes surviving organisms, organic materials, and environmental patterns that persist in time and serve as foci for regeneration and re-colonization. The ecosystem transformation associated with intensive forestry drastically reduces the biological legacies within the planted area, including remnant native woody plants and their propagules. Consequently, the recuperation of community diversity within plantations strongly depends on both internal, in situ biological legacies, and external, well-conserved nearby areas, as a source of propagules. Our study system is pine plantations. These forest ecosystems are widely distributed in Mediterranean basin and worldwide, and their naturalization is a current problem for ecologists, land managers and landscape restorers. Land use and seed source distance prior to the plantation establishment (1956) are aspects related to biological legacy in this site. The effect of these features on current *Quercus* species regeneration under pine plantation has been analysed at plot level in Sierra Nevada Mountains (south Spain). Our results show a potential regeneration gradient in pine plantation strongly related to previous land-use intensity (crops, pastures, mid-mountain shrubland and *Quercus* spp). Propagule source distance in 1956 also condition current regeneration presence-absence. Our results support a prevalent role of ecological memory; the recuperation of community diversity within plantations strongly depends on the internal ecological memory, although nearby, well-conserved areas which can also provide propagules for colonization from outside the plantation.

S.33-33-O

Feedbacks between forests and the atmosphere.

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There is a strong influence of climate on vegetation distribution and functioning, but vegetation also exerts influence on climate through biogeochemical processes (affecting atmospheric composition) and biophysical processes (altering the ecosystem energy balances and fluxes). Mediterranean vegetation feedbacks to climate were studied during spring and summer 2010 at 4 locations in a climatic gradient from a dry site with low vegetation in Monegros to a wet site with tall vegetation in Montseny. The campaigns involved both ecologists and atmospheric scientists. Foliar gas exchange fluxes were measured with leaf chambers. Samplings for atmospheric chemistry as well as micrometeorology were conducted by means of three different platforms, up to 10 meters using masts, up to 400 meters using balloons, and from 400 m up to above the boundary layer using aircrafts. A flux tower (micrometeorological station) on the ground was set to establish the energy balance. We aimed to study the sensible and latent heat fluxes as well as the fluxes of gases such as CO₂, O₃, CH₄ and, with a more emphasis, VOCs. We will use gradient and variance methods for the gas flux estimation. We will relate the water, energy and gas fluxes to the corresponding vegetation footprint, assessing increasing landscape scales. We will also try to link all these results to changes in vegetation remote sensing traits monitored with MODIS. The information obtained will be used to tune the MEGAN model for Mediterranean vegetation as well as to develop tools for VOCs emission modelling. It will also enlighten the pending question of vegetation effects on local climate.

S.33-34-O

Mediterranean woodlands: are they really resistant to plant invasions?

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Woody habitats in the Mediterranean Basin have been considered especially resistant to invasion due to environmental constraints (e.g. drought) and a long history of anthropogenic disturbance. Recent studies based on large datasets confirm that evergreen forests and scrubs are among the least invaded habitats in the Mediterranean region. However, there is growing evidence that invasibility might not be an intrinsic property of habitats but it might be largely modulated by a set of factors. In particular, disturbance regime and propagule pressure have been suggested as primary correlates of habitat invasion, but their effect might be highly modulated by landscape structure and dynamics, species' life strategy and invasion pathway. It should be noted that Mediterranean woodlands are not pristine but subjected to large disturbance due to their long history of land cover change and fire regime. Moreover, changes in the adjacent landscape might increase propagule pressure from agricultural and urban areas, thus enhancing woodland invasion. It remains largely unknown, however, how these factors interact with species' biology and introduction pathway to produce particular invasion patterns. Our aim was to review available information to produce a first conceptual map identifying the primary correlates of plant invasion in Mediterranean woodlands, their relative effects and their interactions at diverse spatial and time scales.

S.33-35-P

How increasing temperatures over the last decades have affected growth of a relict floodplain forest in NE Spain.

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Riparian forests have been widely studied because of its ecological importance as ecotone areas. In this context, the Roureda de Tordera is one of the Tordera River's wetlands areas flooded about 5 months every year (from February to May). The floodplain is covered by Ash (*Fraxinus angustifolia*) and Pedunculate oak (*Quercus robur*), which is in the southern limit of its distribution. Algerian oak (*Quercus canariensis*) is also found, but not in flooded areas. In this case this species is in the northern area of its distribution. The aim of this project is to evaluate how increasing temperatures and changes in groundwater table over the last decades affect tree growth of these species. Since these species are in their limit of distribution the study may indicate their vulnerability to global change. Tree cores samples from the three species were taken over a gradient of water availability to analyze tree growth (as stem basal area increment) and correlate them with climatic data. The growth of *Q. canariensis* has been affected by increasing temperatures during last decades, while same temperatures have had a positive effect in *Q. robur* growth due to the high water availability that it has in flooded areas. Nevertheless, in areas with long flooding periods the number of individuals of *Q. robur* is scarce (reduction of more than 90%). *F. angustifolia* has a similar pattern to *Q. robur*. An increment of temperatures and a reduction of flooding periods, with its water availability, may have negative effects for these species' growth.

S.33-36-P

Ectomycorrhizal fungal communities of *Pinus pinaster* Ait. in a fire chronosequence.Santamaría-Pérez, Blanca. Carrillo, Álvaro. Ocaña, Luis. Rincón, Ana M^a.

ICA-CSIC. TRAGSA. TRAGSA. ICA-CSIC.

Recurring fire is a major disturbance of Mediterranean forest ecosystems. Mediterranean pines often show fire-adaptive traits such as post-fire massive seed dispersal. However, the symbiotic association of roots with soil ectomycorrhizal (EM) fungi is a main requisite for subsequent plant regeneration. Our objective was to characterize the EM-fungal community of post-fire regenerated *P. pinaster* in a fire chronosequence (unburned 60 year-old forest, burnt in 1994, and burnt in 2005), located in adjacent sites at El Rodenal (Guadalajara-Spain). Three replicated plots per site were sampled for mycorrhizas of 3 and 14 year-old plants. We hypothesized fire to alter the structure of the EM-fungal community by decreasing fungal diversity and triggering the replacement of species depending on the elapsed time after fire. Samples were highly mycorrhizal and 67 different fungi were identified. Basidiomycetes predominated over Ascomycetes, the ratio decreasing in the burnt sites. Significantly fewer fungi per sample were observed in the burnt sites, and fungal richness and diversity progressively increased as the elapsed time after fire increased. EM fungal community in the unburned forest was dominated by the families Russulaceae, Cortinariaceae and Thelephoraceae. The generalist *Cenococcum*, plus unknown fungi, and fungi with high dispersal abilities (i.e. *Rhizopogon* and *Tuber*) dominated the burnt sites, where more specialized fungi such as *Inocybe* or *Russula* were significantly less frequent.

S.33-37-P

Dendrochronology of *Juniperus* from the Western Mediterranean: results from the Moroccan Expedition of the project MEDIATIC.

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The project MEDIATIC “Climate change over the Western Mediterranean and Atlantic Islands: a dendroclimatic and genetic survey of the genus *Juniperus*”, was financed by the Portuguese Ministry of Science, and started in May 2010. Within the climatic and biogeographic connection between the Western Mediterranean and the Atlantic Islands of Madeira and Azores, the genus *Juniperus* represents a dendrochronological link that could be used as a natural proxy for precipitation, temperature and NAO index at annual and seasonal scales. We present the first results from the Moroccan Expedition with dendrochronologies of *Juniperus thurifera* from several populations of the Atlas Mountains, and its potential use in dendroclimatology. Dendrochronological information can also be useful to understand growth patterns and stand age population dynamics of *J. thurifera* that can support conservation and restoration of those woodlands. Juniper stands are found associated with semi-arid and subhumid cold winter bioclimates. Stands have a marked open structure and grow in poor soils, with browsing and anthropogenic pressure fundamental aspects of these landscapes. In most of the North African stands, regeneration is nowadays very low. Our preliminary analysis showed that most of the populations have ca. 200-years-old, while a few have more than 400-years-old, and a few others are much younger (with 70-80 years-old). Thus these chronologies have prospective information for climatology and forest ecology of the Moroccan juniper stands.

S.33-38-P

Seasonal and daily pattern of carbon assimilation dynamics by twigs of *Q. cerroides* and *Q. ilex*: Effect of rainfall reduction and selective thinning.

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Future climate change scenarios project an increase of temperature and a likely decrease of precipitation in the Mediterranean region. The objective of this study was to examine whether or not the predicted changes affect the dynamics of carbon assimilation of Mediterranean broadleaved trees. Hence, a combination of thinning and 15 % rainfall reduction was applied in a post-fire mixed forest stand of *Quercus ilex* (evergreen) and *Q. cerrioides* (deciduous) in Catalonia, north-eastern Spain. Measurements of leaf gas exchange of the two tree species were conducted in order to estimate the carbon assimilation dynamics in twigs. The field campaigns were carried out seasonally over four consecutive years (2004-2008). As a result, seasonal as well as daily cycles of carbon assimilation are presented: In spring can be found the best growth conditions with the highest carbon uptake while in summer water availability becomes the constraining factor. The water availability in autumn is comparable to conditions found in spring, although light energy is becoming a more limiting factor. The latter has obviously in winter the strongest impact on the carbon assimilation, when the deciduous species is in the dormant phase while the evergreen *Q. ilex* is still able to maintain a minimum activity. The differences of the two species are rather small, though showing a higher total carbon uptake by *Q. ilex*. Daily variations of gas exchange are correlated with temperature and the resulting curve of daily photosynthetic recovery shows a hysteresis depending on the experienced stress.

S.33-39-P

Energy constraints in winter bird abundance - an experimental approach in montane Mediterranean oakwoods.

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Energy availability is a major driver of global patterns of biodiversity and species distribution, this relationship resulting of special interest in a global change scenario. In spite of this, the test of species-energy relationship needs further development using fine-grained approaches involving the use of different functional groups of species and small geographical scales of known characteristics. Here we investigate a homogeneous guild of tree-gleaning birds wintering in Mediterranean oakwoods of Guadarrama Mountains (Madrid). We carried out an experiment over a broad range of environmental conditions to disentangle the effects of two different energy measures on the small-scale variation of bird abundance: one directly related to food resources (manipulated food availability with artificial feeders), and another related to thermoregulatory costs (directly measured night temperature). The spatial variation in abundance of this guild was positively related to both components of energy availability, even in these Mediterranean forests of southern Europe of relatively mild climate. Nevertheless, food availability seemed not to be very limiting in this system, as its effect on bird abundance was mediated by vegetation structure and the consumption of food provisioned by artificial feeders was not tightly related to spatial variation in temperature. This study highlights the prominent role of the energy-related factors, over habitat structure, in determining winter abundance of the studied tree-gleaning guild. Global warming may exert a positive influence in woodland temperate avifaunas, favouring winter residency and enhancing winter survival, which might explain the positive population trends observed in the last decade in the region.

S.33-40-O

Assessment of Forest Vulnerability and Resilience through ecological models.

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Forest Research Center Madrid.. Forest Research Center Madrid.. Forest Research Center Madrid.. Forest Research Center Madrid.

Global Change is one of the main threats for the maintenance of biological diversity and ecosystem services integrity. In Spain, land use transformations and climate change are considered two main drivers of Global Change. Bioclimatic models predict a drastic decrease in potential forest occupation area and progressive decrease in productivity in middle and South Iberian Peninsula. These models, however, ignore key biological processes such as local adaptation, plasticity, demographic rates, species dispersal and non-equilibrium dynamics. Here, we report results from several ongoing studies in which we show the effects of one or more of these processes on ecosystem vulnerability and system's buffering capacity. Chiefly, our results show that local adaptation can derive into important intra-specific divergences in tree species responses to climate change; demographic rates and dispersal can increase community and ecosystem resilience. Habitat loss and fragmentation, however, can revert some of these trends in directions which are functional-type specific. Finally, we discuss the development of cost-benefit approximations to assess the feasibility of alternative forest adaptation measures in the face of Global Change.

S.34- Stress ecology of soil invertebrates

S.34-01-0

Direct and combined impacts of fire and drought stresses on earthworm community in a mediterranean ecosystem.

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We studied the dynamics of earthworm populations in a fire prone forest environment in Mediterranean France from 2005 to 2011. Species diversity, worm number, size and biomass and worm casts size, number and spatial distribution were measured in an experimental design including 33 plots, with various fire regimes combining 2 fire frequencies (few fires vs many fires in 50 years) and 3 dates for the last fire (1, 4 and 15 years ago) and unburnt control plots. The follow up included a period of repeated drought (2003-2007) followed by a period of normal climate (2008-spring 2011). The two last fires (2003 and 2007 occurred respectively at the beginning and at the end of the dry period, which allowed assessing the drought-fire stress interaction. Worm populations, diversity and activity were reduced by fire as well by repeated drought. The reduction was higher in case of repeated fires. Fire and drought mutually increased their respective impact, showing a strong interaction. Worm activity, size and spatial distribution gradually recovered in 4 years after the end of drought but remained lower than normal in recently or frequently burned plots. Population spreading from refugees was studied too and proved to be slow (2-3 m/year).

S.34-02-0

Effects of changing traditional grazing activities and wild boar rooting on alpine earthworm communities in Central Pyrenees.

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Land use changes are currently one of the major environmental concerns worldwide. In alpine grasslands, these changes mainly involve shifts in traditional grazing activities. Pyrenean alpine grasslands are one of the most valuable habitats in Europe, due to their bio-geographic position that involves high biodiversity rates. These grasslands are currently undergoing a gradual but profound change in pastoral use. Since the 60s, sheep herding has declined and in turn cattle herding has increased. This has led to a widespread abandonment of many grasslands, since cattle graze smaller areas than sheep. These changes in grazing regimes have recently been related to an increase in wild boar rooting affection to Pyrenean alpine grasslands. Temperate grasslands are known to support high density and biomass of earthworms. These earthworms communities are known to be a preferred food of wild boar. Investigating the effects of cattle grazing and trampling on the community of earthworms is thus a key step to determine and predict the future impact of wild boar rooting in their search for underground feeding resources. Our study aims to analyze and quantify the abundance and diversity of earthworms with respect to grazing change and the increased in the occurrence of wild boar rooting in three selected areas of the Central Pyrenees. The results will allow us determine the potential impact of wild boar rooting on vegetation structure and its relation to livestock management, and will therefore provide useful guidelines for the management of sensitive Pyrenean grasslands under soil disturbance regimes.

S.34-03-O

Isopoda reproduction as an indicator of environmental stress.

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Reproduction of organisms is one of the most important life history components. All individuals of species populations try to make the greatest contribution to future generations. All life history components affect this contribution. Links between life history traits and habitat characteristics, environmental effects, influence reproductive investment through energy allocation among life history components. Clear trade offs can be recognized e.g. between fecundity and survival, too. Terrestrial isopods are excellent model species for the investigation of these trade offs as gravid females carry their developing offsprings in a brood pouch till final release. Number, size, survivorship of ovarian oocytes, marsupial eggs, embryos and larva (manca) stages can be followed easily. Loss of the certain stages is a good indicator of environmental stresses. We used oosorption, oocyte resorption and juvenile numbers for quantification the influence of different environmental effects, such as light, temperature, extreme weather conditions, sublethal effects of chemical stressors (heavy metal, insecticide). Both field and lab data showed clear trade offs between reproduction and survival, growth potential for reproduction in the future could be stated in all cases. The species studied were *Porcellio ficulneus*, *Trachelipus rathkii* and *Porcellio scaber* (Isopoda, Oniscidea).

S.34-04-O

Soil zoological studies on the recultivation after the red mud pollution in Kolontár, Hungary.

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In October, 2010 a heavy chemical pollution occurred in the Kolontár Devecser-region (Veszprém county, West Hungary) due to an industrial accident. The pollutant was red mud, a highly dangerous by-product of aluminium-industry created during bauxite processing. The red mud spill had a strong caustic effect due to its very high pH caused by its high sodium hydroxide content. Further adverse effects may occur due to the high Na-levels (secondary salinization), depending on the recultivation measures taken. In this paper, we show the background of some recultivation treatments and present the soil zoological results (e.g. nematode community structure analysis and collembolan tests) of a preliminary survey performed in late April 2011. Samples were taken in three different localities: A.) a site recultivated with removal of the polluted topsoil and planting willow trees (as energy plantation) with rye as undercrop, B.) a polluted and then untreated field covered with grass and fruit trees C.) a pasture unreachd by the pollution as a control site. According to the first results, nematodes were the most abundant in the control (C) and the least abundant in the recultivated site (A), while collembolans showed a significant preference for soil from the control (C) against the untreated field (B) and soil from the recultivated site (A) against the untreated field (B). This work was partly supported by the Hungarian Scientific Research Fund (OTKA K 81401)

S.34-05-O

Temporal changes in soil nematode community structure under heavy metal stress in an Irish mining site.

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The effects of heavy metal (cadmium, lead and zinc) contamination on terrestrial nematode community were investigated in Silvermines, Co. Tipperary, in Ireland. This is a currently abandoned mining area but with centuries' long mining activity and thus high levels of heavy metal contamination. Four contaminated sites were sampled in the area over three years (2008, 2009, 2010) and the nematode community was analyzed from the upper soil layer (0-20 cm); a non-contaminated site was also sampled, approximately 5 miles away from the core contamination area. Significant differences in soil variables (soil moisture, organic matter content, pH and heavy metal levels) were detected between the contaminated and non-polluted sites. Similarly, there were significant changes in nematode community in correspondence to the levels of contamination and the soil conditions. Nematode diversity in Silvermines was detrimentally affected by high levels of cadmium and zinc (compared to that at the non-contaminated site), but not by lead. Changes in the structure of functional groups did not relate to the heavy metal contaminants under investigation. The total maturity index (SMI), the total maturity index 2-5 (SMI2-5), the fungivore/bacterivore ratio (f/b), and the % c-p groups were found to be good indicators for temporal soil recovery from heavy metal contamination in the investigated area. These findings are significant and will be discussed in the context of the Silvermines Rehabilitation Project.

S.34-06-O

The use of fluctuating asymmetry analysis to evaluate the effects of metal-pollution (Cd, Pb, Zn) on Porcellio scaber (Crustacea, Isopoda) living in contaminated woody habitats.

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LGCgE- Groupe ISA. LGCgE- Groupe ISA. LGCgE- USTL. Ecologie, Evolution, Symbiose - Université de Poitiers. LGCgE- Groupe ISA. LGCgE- USTL.

Among soil invertebrates, woodlice are especially interesting because of their major role in the decomposition of litter and their high tolerance to trace elements (TE). The aim of this field study is to evaluate the effects of metal-polluted woody habitats on *Porcellio scaber* especially in the neighborhoods of old smelters. For this, woodlice and litter were collected from metal-polluted woody sites located in the vicinity of the former lead smelter of Metaleurop Nord and compared with others situated away from metal pollution sources. The use of fluctuating asymmetry (FA) level previously showed relevant results for other invertebrates and for woodlouse (*Trachelipus rathkii*). Thus the FA analysis was selected to evaluate the efficiency of this parameter as a biological monitor of environmental stress on *P. scaber*. Some soil physico-chemical parameters that could have potential effects on woodlouse populations, TE concentrations in the litter and the metal body burdens in woodlice were also measured in order to evaluate TE transfer and the degree of impregnation of woodlice. FA levels on individuals were performed on 9 traits according (1) to each site and (2) to two habitat types (contaminated and uncontaminated). Results showed close correlations between litter TE concentrations and TE body burdens in woodlice. However, in spite of a high degree of individual impregnation the results did not highlight the existence of a metallic stress according to FA level. Contrary to the initial hypothesis that TE pollution would induce an increase in FA level, this seemed to be lower for individuals from contaminated habitats than for those from uncontaminated habitats, and particularly for males.

S.34-07-O

Deterioration of soil environment in the vicinity of metallurgical plant Kovohuty, a.s., Krompachy (Slovakia).

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Parasitological Institute. Parasitological Institute. Parasitological Institute.

Abstract: Mining and copper production has a long history in Krompachy (eastern Slovakia). After expansion of the copper production at the beginning of the 20th century an impact on the local ecosystem was considerable and the metallurgical plant still represents one of the most important sources of emissions of the region. As a result of processing of polymetallic ores, recycling of copper waste and its reintroduction into the production cycle, the soils near the plant have become heavily polluted. Heavy metal load of these soils using soil organisms - nematodes were recently studied. Soil samples were collected from the permanent grasslands at four different distances from the plant, namely at 0, 2, 4 and 6 km in the direction of prevailing winds. Nematodes were isolated from the soil sample, identified to the generic level and classified into trophic and functional groups. Several environmental indices (e.g. S, MI, MI2-5) were applied to assess an impact of heavy metals on nematode communities as well as the state of maturity of the soil environment. The content of traced elements (As, Cd, Cu, Pb, and Zn) in soil samples were analyzed by mass spectrometry (ICP-MS). The results showed significant differences ($P = 0.05$) among particular sites, especially between the site A, located close to the pollution source and the most distant locality D. All concentrations of total and bioavailable heavy metals significantly exceed the slovak limit values for soils at locality A, but they gradually decreased towards the locality D. The only As concentrations remained slightly above the established limit. It was found that the most abundant trophic groups were bacteriovorous and plant feeding nematodes comprising more than 50% of the nematode community at particular sites with decreasing trend towards the locality D. Omnivores and predators represented the least numerous nematode group, however, their proportion increased significantly with increasing distance that could indicate their potential sensitivity to heavy metal pollution. The ecological indices MI and MI2-5 as a preferred tool for environmental assessment, first decreased mainly due to rapid increase of population density of lower c-p groups, but with increasing distance, indices increased significantly. High concentrations of heavy metals caused significant decrease of nematode species diversity and significant variations of their abundance in particular sites. The B/F ratio reached their maximum at the site B and its trend was influenced mainly by fluctuations in proportion of fungivorous nematodes. Our results suggest that simultaneous use of MI, MI2-5 together with diversity and trophic group profiles in studies of the nematode community structure could provide another appropriate tool for indication of soil pollution. Acknowledgement This work was supported by grant agencies APVV project no. LPP - 0085 - 09 and VEGA project no. 2/0136/10.

Disturbance and stress in urban soils.

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Disturbance and stress in urban soils Katalin Szlavec Johns Hopkins University, Baltimore, USA Urbanization is considered to be a major cause of decline of species diversity and homogenization of flora and fauna. Urban soils are highly modified due to past and present landscape fragmentation and degradation, and to various land management practices. These practices are often, but not always stressful for the soil biota. Human activities can deliberately or accidentally promote successful colonization of some species while leading to extinction of others. This filtering process results in altered community composition, abundance and ecosystem functioning. In this presentation I will first discuss how the metacommunity concept can be applied to understand community assembly in urban environments. I will then illustrate how altered soil fauna leads to altered ecosystem functioning. I will use three examples from the Baltimore Ecosystem Study Long-Term Ecological Research site: (1) Effects of earthworms on the fate of roadway derived dust. We carried out mesocosm experiments using conditions observed in bioretention cells receiving direct storm water input. Earthworms influenced the roadway contaminant distribution and increased the trace metal (Zn) availability; (2) Earthworm species effects on nitrogen cycling. We compared three large earthworm species (*Eiseniodes loennbergi*, native; *Lumbricus terrestris*, European; *Amyntas hilgendorfi*, Asian) in their effect on N-mineralization and nitrification rates. While all three species increased the rates significantly, the Asian species had the largest effect both in natural and in engineered soils; (3) Effect of forest fragmentation on carrion beetle (Silphidae) communities. This study showed that the likelihood of carrion burial was decreasing with declining species diversity.

S35- Advances in Eco-hydrology

S.35-01-P

Runoff-driven soil water redistribution on the basis of eco-hydrological relationships.

Arnau-Rosalén, Eva. Molina-Sanchis, Isabel. Lázaro-Suau, Roberto. Ladrón de Guevara, Mónica. Boix-Fayos, Carolina. Calvo-Cases, Adolfo.

Estación Experimental de Zonas Áridas EEZA-CSIC. Centro de Edafología y Biología Aplicada del Segura CEBAS-CSIC. Universidad de Valencia UVEG.

Eco-hydrological relationships are crucial and complex in semiarid Mediterranean ecosystems because of the variable and limited amount of water and the existence of thresholds in several key processes. Runoff-driven soil water redistribution constitutes the first modulating effect on the water availability for plant use. The high spatial heterogeneity promotes a complex and non-linear hydrological response. Increasing knowledge on response thresholds and hydrological connectivity become essential to deal with the ecosystems functioning. For this purpose, a promising approach is to consider the spatial distribution of vegetation and other soil surface components, supported by the conceptual model of discontinuous overland flow at hillslope scale. In the general aim of study the vegetation-patterns influence over the overland-flow connectivity at hillslope scale, we analyze: (i) precipitation threshold conditions to runoff generation and (ii) characteristic runoff response of discretized spatial configuration features. In the experimental site of Balsa Blanca (Almería, SE-Spain) with a Mediterranean-semiarid-climate, 16 contiguous plots along a hillslope base 30 m wide have been applied following three criteria in the collectors splitting: (I) grain-size of the vegetation pattern; (II) vegetation typology and (III) degree of complexity in the bare soil patches. Results show that I_{60max} is the precipitation index that best define trigger-threshold generating runoff. The obtained threshold value resulted for a wide range of rainfall volumes is c.a. 4 mmh⁻¹. Runoff responses show differences according vegetation type; bare corridors complexity and grain-size patterns, thus fine grain-sizes, in the two vegetation domains (*Macrochloa* and *Brachypodium*), are less efficient in retaining water-resources than coarser ones.

S.35-02-O

Spatial Pattern, Diversity, and Water Balance in Semiarid Mediterranean Plant Communities. A Microcosm experiment.

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Universidad de Alicante. Universidad de Alicante.

Functioning of Mediterranean drylands is limited by water availability and is increasingly threatened by land use and climate changes. Understanding the relationships between ecosystem structure and function is of crucial importance for the conservation and restoration of these ecosystem. This work has used manipulative experiments to investigate the relationships between structural and functional features of semiarid plant communities, focusing on key processes and functions in semiarid ecosystems such as water fluxes and plant productivity. The specific objectives of the work are: (1) Determine the effect of both plant pattern and diversity on soil moisture dynamics and plant growth; (2) Analyse the interaction between plant pattern and diversity on these two processes; (3) Analyse intra and interspecific interactions as a function of plant pattern. To achieve these objectives, two types of plant communities (monospecific vs diverse) and spatial patterns (aggregated vs regularly spaced) have been installed in medium-size (40 x 40 x 40 cm) microcosms, where water flows and plant growth have been monitored during nine months. The results show that diverse communities were less productive than the monospecific communities, suggesting stronger interspecific than intraspecific competition. On the other hand, aggregate patterns increased plant growth and reduced evapotranspiration.

S.35-03-O

Relationship among biological soil crusts, rainfall characteristics and runoff at plot and hillslope scales.

Chamizo, Sonia. Rodríguez-Caballero, Emilio. Cantón, Yolanda. Domingo, Francisco. Escudero, Adrián.

Estación Experimental de Zonas Áridas. Universidad de Almería. Universidad de Almería. Estación Experimental de Zonas Áridas. Universidad Rey Juan Carlos.

Runoff processes in arid and semiarid areas are characterized by a high temporal and spatial variability. While the first one depends on the variation of rainfall and antecedent moisture, the latter one is mainly determined by spatial patterns of ground covers (vegetation, rocks, crusts) and topography. Biological soil crusts (BSCs) are common soil covers in arid and semiarid areas and they play a key role on local hydrological processes as they affect many soil surface attributes associated with hydrologic properties. Despite their recognized role, little attention has been paid to examine the influence of BSCs on infiltration and runoff at different spatial scales under natural rainfall conditions. In this work, runoff in plots with varying cover of cyanobacterial and lichen BSCs is analysed at plot and hillslope scales, during two hydrological years in a badlands area of SE Spain. Structural equation modelling (SEM) was applied to test the relationship among rainfall characteristics, BSC cover, slope gradient and runoff. Our model demonstrates that rainfall characteristics were the main factors controlling runoff yield. In high intensity events, rainfall intensity was the characteristic with greater influence on runoff, whereas in low intensity events, the amount of rainfall exerted a greater influence. The slope gradient positively affected runoff at hillslope scale, but did not have influence at plot scale. At both scales, runoff decreased with increased lichen cover, but this effect was only significant in low intensity events. Under high intensities, the BSC cover did not have a causal effect on runoff. Therefore, our results suggest that the consideration of BSC-crusts should improve the runoff modelling in arid and semiarid areas for low intensity rainfall events but it would have less importance for high intensity ones.

S.35-04-O

Enhanced Vegetation Index from MODIS and rainfall as predictors of actual evapotranspiration in two dryland sites at SE Spain.

Contreras, Sergio. Serrano-Ortiz, Penélope. Morillas, Laura. Uclés, Olga. Sánchez-Cañete, Enrique P.

CSIC - Centro de Edafología y Biología Aplicada del Segura. CSIC - Estación Experimental de Zonas Áridas. CSIC - Estación Experimental de Zonas Áridas. CSIC - Estación Experimental de Zonas Áridas. CSIC - Estación Experimental de Zonas Áridas.

Relationships between spectral vegetation indexes and actual evapotranspiration (ET) have not been well established in Mediterranean drylands. We evaluate the temporal dynamics and correlations among 16-day composites of ET, rainfall and the Enhanced Vegetation Index -EVI- in two dryland FLUXNET experimental field sites located at SE Spain: Llano de los Juanes (S1), a montane subhumid open shrubland at 1600 m.a.s.l. (MAP = 526 mm/yr) and Balsa Blanca (S2), a lowland semiarid grassland at 200 m.a.s.l. (MAP = 220 mm/yr). Data series were previously filtered in order to remove noise effects and to extract consistent phenological profiles. Mean Annual ET was higher in S1 (266 ± 41 mm/yr) than in S2 (188 ± 9 mm/yr) (p

S.35-05-O

Fluxes of dissolved carbon on a riparian forest in the Western Amazonia, Brazil.

Leite, Nei. Krusche, Alex. Cabianchi, Giovana. Souza, Reginaldo. Xavier, Farley. Johnson, Mark S.. Ballester, Maria.

CENA/USP. CENA/USP. CENA/USP. UNIR. UNIR. UBC. CENA/USP.

Transfer of nutrients among hydrological flowpaths provides important information about biogeochemical processes occurring on a given ecosystem, from land to adjacent streams. Dissolved carbon concentrations and fluxes in bulk precipitation, throughfall, stemflow, overland flow, soil solution, groundwater and stream water were determined from November 2005 to April 2007 for a tropical riparian forest in the Urupá River basin, Rondônia, Northwestern Brazil. The general pattern of concentrations and fluxes indicate dissolved organic carbon (DOC) to be preferentially controlled by quick flowpaths (throughfall and overland flow) and inorganic carbon (DIC) by slow flowpaths (groundwater). Forest canopy exerts an important enrichment of organic carbon especially due to the wash-off of organic matter deposited in the dry season derived from intense biomass burning, as is common in the studied region. DOC concentration in overland flow seems to be largely supplied by throughfall, since 84% of the rainfall reaching the forest floor comes from this hydrological flowpath. Streamwater DOC presented a clockwise hysteresis in relation to discharge suggesting an important contribution from lateral flow. Streamwater DIC showed highest concentrations at the baseflow condition suggesting supply from rock weathering. These mechanisms controlling carbon dynamics between river and riparian forest evidences an important role of connectivity and the strong interaction between aquatic and terrestrial ecosystems.

S.35-06-P

Influence of increased air humidity on xylem flux of silver birch (*Betula pendula* Roth.) trees in free air experimental facility.

Lubenets, Kristina. Sellin, Arne. Kupper, Priit.

University of Tartu. University of Tartu. University of Tartu.

Several experimental systems have been developed to estimate the effect of global warming and increasing atmospheric carbon dioxide concentration on the functioning of trees and forest ecosystems. Although the impact of rising temperature and carbon dioxide concentration on woody plants is already well documented, the influence of co-occurring changes in atmospheric humidity (induced by rain, mist and fog events) on an ecosystem level is almost unknown. The Free Air Humidity Manipulation (FAHM) experimental facility was established on abandoned agricultural field in 2006-2007. We use integrated approach of two different technologies to increase air humidity in experimental plots: misting technique to atomize water and FACE-like technology to mix misted/humidified air inside the plots. This is the first time when free air misting treatment is used to study trees' and forest ecosystems functioning in light of climate change. The FAHM system enables to increase the air relative humidity up to 18% over the ambient level during humidification treatment, depending on the wind speed inside experimental stand. Our data suggest that the FAHM experimental facility enables water fluxes through a deciduous tree canopy to be reduced and this effect is attributable both to the increased air humidity and decreased leaf temperature. For example, the average diurnal stem sap flux density in silver birch (*B. pendula*) trees was about 1/3 higher in control plots compared to humidification plots during misting in 2009. Also, tree leaves in a humidified plot demonstrated lower leaf temperature compared to the control plot. Changes in these two basic factors may create considerable differences in the physiology, anatomy and nutrition of a whole tree, also affecting forest functioning in the light of global climate change.

S.35-07-P

Effect of the definition of rainfall event on runoff analysis.

Molina, Isabel. Lázaro, Roberto. Cayuela, Luís. Arnau, Eva. Calvo, Adolfo. Ladrón de Guevara, Monica.

Estación Experimental Zonas Áridas EEZA-CSIC. Estación Experimental Zonas Áridas EEZA-CSIC. Universidad Rey Juan Carlos. Estación Experimental Zonas Áridas EEZA-CSIC. Universidad de Valencia. Estación Experimental Zonas Áridas EEZA-CSIC.

The concept of rainfall event is imprecise because its delimitation depends on the purpose of the study. A minimum inter-event time (MIT) is often used to delimitate events. Changing the MIT alters the number of rainfall events, the mean rainfall and the mean event duration, and therefore, the relationship between rainfall and ecological processes. However, MIT is often selected arbitrarily. A promising way to avoid such arbitrariness is to select the MIT that maximizes the relationship between rainfall and key ecosystem processes. As those processes have different rainfall response times, there is more than one way to divide rainfall. However, a criterion or method can be established. We studied what the best rainfall division would be in events related to measured slope-scale runoff. Runoff is a key process because it modulates water redistribution, and therefore, available water and plant functioning, especially in semiarid areas. The data come from Balsa Blanca and El Cautivo, two instrumented areas in SE Spain. The method is based on Generalized Additive Mixed Models and maximization of the R². We considered MITs of 24 h, 18 h, 12 h, 11 h, 10 h, 9 h, 8 h, 7 h, 6 h, 5 h, 4 h, 3 h, 2 h, 1 h, 30 min and 10 min. The best MIT was 1 h for Balsa Blanca and 10 min for El Cautivo. This difference can be explained by the different slope angles, vegetation and soils at the two sites. In semiarid environments, slope-scale runoff is mainly related to rainfall in the previous hours or minutes rather than days. Soil and surface covers can be crucial in determining the best MIT.

S.35-08-P

Improving evapotranspiration estimates in semiarid ecosystems: the role of soil evaporation.

Morillas, Laura. Uclés, Olga. P. Sanchez-Cañete, Enrique. García, Monica. Villagarcía, Luis. Domingo, Francisco.

Estacion Experimental de Zonas Áridas, CSIC. Estacion Experimental de Zonas Áridas, CSIC. Estacion Experimental de Zonas Áridas, CSIC. University of Copenhagen. Universidad Pablo de Olavide. Estacion Experimental de Zonas Áridas, CSIC and Universidad de Almeria.

Since evapotranspiration (ET) is a key factor in dryland's hydrological balance, adaptation of a simple model for ET estimations based on MODIS LAI data and Penman-Monteith equation (PML model) (Leuning et al., 2008) is presented. We propose three methods for improving the consideration of soil evaporation influence in total evapotranspiration estimates for these ecosystems. The original PML model considered evaporation from the soil to be a constant over time, f , of the equilibrium soil evaporation. We propose an adaptation to the model for sparsely vegetated drylands that considers f to instead be a variable related primarily to Soil Water Content (SWC). In order to estimate daily f values, the first proposed method (f_{SWC}) uses rescaled SWC measurements, the second, based on Zhang et al. (2010) (f_{Zhang}), uses the ratio of 8 days antecedent precipitation and equilibrium soil evaporation, and the third one (f_{sec}), includes a soil drying simulation factor for periods after a rainfall event. ET estimates were validated using ET measurements from Eddy Covariance systems located in two functionally different sparse vegetated drylands sites: a littoral Mediterranean semiarid steppe and a dry-subhumid Mediterranean montane site. The method providing the best results for daily ET estimations in both areas was f_{sec} (MAE 0.35-0.40 mm day⁻¹) as it was capable to reproduce the pulse-behavior characteristic of soil evaporation in drylands that is strongly linked to water availability. These proposed model improvements made possible to apply the PML model for ET estimations in sparse vegetated drylands where a more accurate soil evaporation consideration is necessary for this model performance.

S.35-09-O

Can we predict groundwater discharge using ecological optimality?

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A major limitation to sustainable water resources planning is the lack of reliable estimates of the various components of the water balance. In Australia in particular, groundwater discharge is often ignored in water allocation plans despite emerging evidence of widespread groundwater use in terrestrial ecosystems. In this study, we have reviewed estimates of groundwater discharge from across Australia. Despite being recognised as an important component of the ecosystem water requirements there were only a handful of studies that quantified the contribution of groundwater to evapotranspiration. However, using this compilation of studies we demonstrate considerable convergence among these studies with existing ecohydrological frameworks (such as Eagleson's ecological optimality or the Budyko framework) and present techniques based on ecohydrological principals for estimating this important component of the ecosystem water balance. These approaches may be particularly relevant for estimating groundwater discharge spatially or for data poor areas.

S.35-10-P

Impact of hydro-energetic constructions and dyking upon specific ecosystems.

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Hydro-energetic constructions and dyking induce a major impact that determined radical transformations in the functioning of the fluvial ecosystem. On the Danube course, which is 2,857 km long, there were built more than 35 large hydro-energetic dams. This fact triggered the transformation of the fluvial character in a fluvial-lacustrine character for almost half of the river length. The ecological structure modified: planktonic and benthonic biocoenoses specific to the ecosystem transformed in fluvial-lacustrine ecosystems, process that led to fundamental transformations in the structure and functioning of the planktonic and benthonic plant and animal populations. There occurred an acute simplification and specialization of the population structures: from the fluvial to the fluvial-lacustrine type. The construction of the dykes along the river represented the second major impact upon fluvial life. Dyking, which is more fragmented along the upper and middle course, is highly used along the lower sector (Km 955). This sector overlaps the Romanian territory. Through the construction of the dyke, the river was separated from the widest flooding area (more than 300,000 ha). Thus, natural floodings interrupted. Consequently, the entire structure characteristic to the ecosystems from this area disappeared. Within the surface of the floodplain, 40% were permanent lakes, 40% temporary lakes (pools), and 20% rarely flooded terrains. The Danube Floodplain comprised the greatest ecosystemic and population diversity within the territory of Europe.

S.35-11-O

Plant community patterns and the strength of the plant-water infiltration feedback in semi-arid ecosystems.

Pueyo, Yolanda. Moret, David. Alados, Concepción L.. Sáiz, Hugo. Bueno, Guillermo.

Instituto Pirenaico de Ecología (CSIC). Estación Experimental de Aula Dei (CSIC). Instituto Pirenaico de Ecología (CSIC). Instituto Pirenaico de Ecología (CSIC). Instituto Pirenaico de Ecología (CSIC).

In semi-arid environments, the positive feedback between vegetation and water infiltration rate is considered an important mechanism for sustaining the diversity and productivity of plant communities. In this study, we investigate how the strength of the plant-water infiltration feedback is related to plant spatial patterns and other community traits, such plant community composition and cover. To do so, we measured infiltration properties of the bare soil and plant community patterns in two ecosystems with markedly different hydro-physical properties (gypseous environment and impermeable silty soils). We also investigated how plant and soil properties change with aridity and grazing, as we hypothesized that both stresses would influence the strength of the plant-water infiltration feedback. Our results showed that both ecosystem types presented low water infiltration into the bare soil. In gypseous environments, infiltration was controlled by the surface soil crust, while in silty soils, soil compaction was the limiting factor. Both soil compaction and soil crust hampered plant establishment as we observed highly clumped seedling patterns in those situations. Grazing affected the hydrological behaviour of the ecosystems, while plant spatial pattern was more affected by aridity. We also found a strong positive relationship between plant spatial aggregation and plant diversity across the ecosystems studied, suggesting a beneficial role of the resources concentration mechanism in these semi-arid ecosystems.

S.35-12-P

Runoff and Erosion in semiarid ecosystems depend on complex interactions among some features of Biological Soil Crusts and rainfall .

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Universidad de Almeria. Estación Experimental Zonas Áridas CSIC. Universidad de Almeria. Universidad de Almeria. Universidad de Almeria.

Biological soil crusts (BSCs) often cover non vegetated areas in arid and semiarid ecosystems and act as runoff sources for plants. These ecosystem engineers modify many soil surface properties, like surface stability, cohesiveness, cracking, porosity, infiltration, water retention and micro-topography controlling first runoff and consequently erosion. Although it is accepted that BSCs play a key role controlling those processes, little is known about the importance of BSCs features (cover, composition, roughness, water repellency, etc) on them or, more interestingly, how they interact with rainfall characteristics. BSCs increase fine porosity of soil surface, micro-topography and subsequent infiltration but at the same time BSCs enhance runoff by hydrophobic compounds secretion. Moreover, BSCs soil stability, reducing soil detachment, but also increase runoff as consequence of hydrophobicity and pore clogging and thus may enhance sediment yield. In this work, Structural Equation Models have been used to unveil direct and indirect relationships among the different BSCs features and rainfall characteristics to understand how they control runoff and erosion. Runoff and erosion response of BSCs under natural rainfall have been monitored for two hydrological years at plot scale. Our results show that BSCs effects on runoff and erosion vary depending on rainfall features and overland flow mechanism. During high intensity rains, runoff is generated by infiltration excess and runoff and erosion are controlled by rainfall intensity and BSCs cover through its effect on soil porosity, hydrophobicity and surface stability. Under low intensity and high magnitude rainfalls, a mixed mechanism (saturation-hortonian) generates the runoff and rainfall volume exerts a stronger effect than rainfall intensity. BSCs cover also has indirect effect on runoff and erosion enhancing surface micro-topography and stability.

S.35-13-O

Connectivity and degradation in semi-arid systems: patterns, thresholds and feedback effects.

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The University of Newcastle, Australia. The University of Newcastle, Australia. The University of Newcastle, Australia.

Hydrologic, geomorphic and vegetation processes in drylands are tightly coupled through feedback mechanisms. These feedbacks have implications for the equilibrium and resilience of the emerging vegetation and landform patterns, and are particularly important for potential degradation effects under climate and anthropogenic pressures. Here we analyze banded semi-arid systems at the hillslope scale. As increased surface runoff connectivity has been linked to degradation, we focus on evolving “connectivity patterns” resulting from these feedback effects. We analyze the connectivity patterns using a landform evolution model (LEM) that includes coupled dynamic vegetation, hydrology, and soil depth evolution modules. Surface connectivity resulting from different (initial) topographies and soil depths, as well as varying soil erodibilities and vegetation characteristics are analyzed and contrasted. Model results are compared with vegetation and connectivity patterns obtained from high-resolution satellite images from both well preserved and degraded semi-arid sites in the Northern Territory and New South Wales (Australia). The analysis from satellite images reveals a major role of surface connectivity on the spatial organization of patchy vegetation, suggesting that transitions on the distribution of vegetation leading to degradation are related to sharp variations on the landscape surface connectivity. More general model results further suggest that these sharp variations are related to thresholds on slope and soil erodibility, regulated by feedback effects dependent on vegetation response times and soil depths. These results have important implications for restoration efforts in degraded semi-arid areas.

S.35-14-P

Sudden formation of streams in a flat semiarid landscape in Central Argentina.

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The non-drainage condition (annual precipitation match annual evapotranspiration) observed in undisturbed dryland sedimentary plains can be disrupted by land cover changes. Conversion from dry forests (DF) to agriculture (A) can trigger the onset of deep recharge and, consequently, strong hydrological changes. Here we link the role of deforestation practices with the sudden formation of watercourses in a semiarid landscape (not dissected for the last ~10 kyr), and explore the possible complementary role of recent precipitation raises and seismic activity. Aerial photographs and satellite imagery from 1962 to 2010 were employed to delineate the basin stream network and the temporal shifts of DF coverage. Since 1976, DF area was reduced by ~260 km². Drainage density changed from 0.01 km/km² (1976) to 0.28 km/km² (2010). A strong power law negative correlation exists between DF coverage and drainage density ($R^2 = 0.96$). The most intense deforestation rates took place in the 1976-1985 period (18 km²/yr), coincident with the highest seismic activity period (~60 earthquakes with a magnitude $\geq 5^\circ$ -Ritcher- in a 300 km radio). It is hypothesized that earthquakes could generate terrain instability and soil liquefaction. Despite the positive trend observed in precipitation since 1976, the non-drainage condition has not been modified in DF stands. Water yield measured at catchment scale (10 mm/yr) agreed with recharge rates (16 ± 6.6 mm/yr) measured at plot scale in agricultural vadose zone profiles. The combination of changes in land use, climate and seismic activity has increased the vulnerability of the original landscape to the emergence of new watercourses.

S.35-15-O

Dewfall deposition on contrasted slope aspects in a badlands ecosystem in SE Spain.

Ucles Ramos, Olga Maria. Villagarcia Saiz, Luis. Canton Castilla, Yolanda. Lazaro Suau, Roberto. Domingo Poveda, Francisco.

Estacion Experimental de Zonas Aridas. Centro Superior de Investigaciones Cientificas. Departamento de Sistemas Fisicos, Quimicos y Naturales. Universidad Pablo de Olavide. Departamento de Edafologia y Quimica Agricola. Universidad de Almeria. Estacion Experimental de Zonas Aridas. Centro Superior de Investigaciones Cientificas Estacion Experimental de Zonas Aridas. Centro Superior de Investigaciones Cientificas .

Water is a limiting factor in arid/semiarid environments and dewfall can be an important source of moisture in these ecosystems. "El Cautivo" field site, (Tabernas, Almería, SE Spain) is in the most arid region of Europe (220 mm y⁻¹). It is a badlands area with patterned vegetation: NE facing slopes (shady) are covered by biological soil crusts (BSC), dwarf shrubs, grasses and annuals and SW facing slopes (sunny) are normally bare and eroded. BSCs improve soil stabilization, soil properties, hydrology and erosion (among others) and dew can develop an important role as water source for BSCs. However, research is needed to quantify dewfall and study its spatial distribution. The aim of this work is to study and compare dewfall deposition on a north and a south facing slopes in this site during a hydrological year (Sep'2009 - Aug'2010; 400 mm rainfall). The single-source Penman-Monteith equation simplified for potential water condensation together with micrometeorological variables and wetness sensors information were used to detect occurrence and frequency of dew events and to quantify dew amounts on both slopes. Our results enhance the importance of dewfall in this ecosystem as a water source and differences between north and south slopes were found. Dewfall contribution to the water balance during the study period was 2% and 10% of rainfall on south and north slopes respectively. But on summer period, it represented the 8% (south) and 77% (north) of rainfall. Dewfall can be considered a key factor for BSCs spacial distribution and development.

S.35-16-P

Effect on evapotranspiration of the change in precipitation patterns on a semiarid ecosystem from SE Spain.

Villagarcía, Luis. Ladrón de Guevara, Mónica. Morillas, Laura. Chamizo, Sonia. Were, Ana. Serrano, Penélope. Domingo, Francisco. Lázaro, Roberto.

Universidad Pablo de Olavide - Sevilla. EEZA - CSIC - Almería. EEZA - CSIC - Almería. EEZA - CSIC - Almería. Vrije Universiteit - Amsterdam. CEAMA - Granada. EEZA - CSIC - Almería. EEZA - CSIC - Almería.

A multi-source evapotranspiration (ET) model with parameterised soil and vegetation surface resistances was modified to take into account the presence of stones on the soil (10%), and the seasonality of the relation between stomatal conductance and vapour pressure deficit of the main plant species (*Macrochloa tenacissima* (Loefl. ex L.) Kunth). The model was implemented for the Balsa Blanca experimental site (Cabo de Gata, Almería), and the ET estimates were compared with Eddy covariance (EC) measurements from years 2007 to 2009. Daily average differences between measured and estimated ET were ca. 15%, which is considered a good agreement in arid and semiarid areas, where ET values are small. Therefore, the model was considered appropriate to estimate ET for this ecosystem. Subsequently, the model was used to estimate ET considering the stomatal conductances of *Macrochloa tenacissima* plants under different treatments of rainfall exclusion and controlled irrigation. Differences of 11% and 13% were found when comparing the daily ET estimates using the stomatal conductances of plants under the two most extreme treatments (100% and 50% respectively of amount of water and number of rain days in relation to natural rainfall), and ET estimates using the stomatal conductances of plants with no treatment. These results indicate that the different treatments of rainfall exclusion used had no significant effects on the ET of the site for the studied period.

S.35-17-O

Quantifying the relations between forest changes and water at a large spatial scale.

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University of British Columbia. University of British Columbia.

Climatic variability and forest disturbance are commonly recognized as two major drivers influencing streamflow change in large-scale forested watersheds. The greatest challenge in evaluating quantitative hydrological effects of forest disturbance is the removal of climatic effect on hydrology. In this presentation, we will describe an innovative methodology designed to quantify respective contributions of large-scale forest disturbance and climatic variability on streamflow using the Willow watershed (2860 km²) situated in the central part of British Columbia, Canada. Long-term (>50 years) data on hydrology, climate and timber harvesting history represented by equivalent clear-cutting area (ECA) were available for this study. Firstly, effective precipitation, an integrated climatic index, was generated by subtracting actual evapotranspiration from precipitation. Secondly, the modified double mass curves (DMCs) were developed by plotting accumulated annual streamflow against annual effective precipitation, which presented a much clearer picture of the cumulative effects of forest disturbance on streamflow following removal of climatic influence. The average annual streamflow changes that attributed to forest disturbances and climatic variability were then estimated to be +71.4 and -85.8 mm, respectively. The positive (increasing) and negative (decreasing) values in streamflow change indicated opposite change directions, which suggest offsetting effect between forest disturbance and climatic variability in the study watershed. Finally, a factored ARIMA model was generated to establish quantitative relationships between accumulated annual streamflow deviation and annual ECA. The model was then used to project streamflow change under various timber harvesting scenarios. The methodology can be effectively applied to any large-scale single watershed where long-term data are available.

S.36- Climate change, extreme events and alpine ecosystem responses

S.36-01-P

Nested alpine butterfly (Papilionidea) faunas of European mountains.

Báldi, András.

Hungarian Natural History Museum.

The key to understand large scale patterns of biodiversity is to identify the factors regulating the organisation of faunas. Nestedness is a common compositional feature; faunas are nested if the species present in species-poor sites are proper subsets of those present in species-rich sites. On large spatial scale species-specific extinction and colonisation are the key mechanisms resulting in nested pattern. Extinction is related to area, while colonisation to isolation (or connectedness). I studied these mechanisms on the alpine butterfly faunas of European mountain tops (non alpine species were excluded). I used occurrences of 74 butterfly species on 30 alpine areas in Europe (including Turkey) from Varga (2003. The geographical distribution of high mountain Macrolepidoptera in Europe). I calculated the Nestedness Temperature values, and ordered them according to: (i) isolation, (ii) area, (iii) longitude, and (iv) latitude of the alpine areas. Nestedness correlated negatively with area and positively with isolation, suggesting that both extinction and colonisation contributed to the organisation of alpine butterfly faunas. Longitude and latitude did not correlate with nestedness. I identified idiosyncratic species and areas, i.e. those which contributes most to the decrease in nestedness ('outliers'). These species had restricted distribution (e.g. *Coenonympha rhodopenis*, *Erebia hispania*), and these areas were at the edge of the continent (e.g. Northern Caucasus, Northern Scandinavia). I conclude that this important taxon will severely be threatened by global warming, as alpine areas and their connectedness is expected to decrease.

Factors driving survival and growth at treeline: A 30-year experiment of 92000 conifers.

Barbeito, Ignacio. Dawes, Melissa. Rixen, Christian. Bebi, Peter.

WSL Institute for Forest, Snow and Landscape Research - SLF, WSL Institute for Forest, Snow and Landscape Research - SLF, WSL Institute for Forest, Snow and Landscape Research - SLF, WSL Institute for Forest, Snow and Landscape Research - SLF, WSL Institute for Forest, Snow and Landscape Research - SLF.

Understanding the interplay between environmental factors contributing to treeline formation and how these factors influence different life stages remains a major research challenge because detailed long-term observations of treeline patterns are rare. We asked the following research questions: 1. Can trees survive above the current treeline in the European Alps? 2. Are environmental factors that drive survival the same that drive height growth? 3. Does the relative importance of environmental variables influencing survival and height growth change over the first thirty years after planting? We used an afforestation experiment including 92,000 trees to investigate the spatial and temporal dynamics of tree survival and growth at treeline in the Swiss Alps. Seedlings of three high-elevation conifer species (*Larix decidua*, *Pinus mugo* ssp. *uncinata* and *Pinus cembra*) were systematically planted along an altitudinal gradient at and above the current treeline (2075 to 2230 m a.s.l.) in 1975 and closely monitored during the following 30 years. We used general additive models to identify changes in survival and growth along gradients in elevation, snow duration, wind speed and microtopography and used decision-tree models to quantify interactions between the different variables. For all three species, snowmelt date and elevation were the most important environmental factors influencing survival and growth over the entire period studied. Individuals of all species survived at the highest point of the afforestation for more than 30 years, although survival declined strongly above 2160 m a.s.l., about 50 to 100 m above the current treeline position. Optimal conditions for height growth differed from those for survival in all three species: early snowmelt (ca. day 125-140) yielded highest survival rates but relatively later snowmelt (ca. day 145-150) yielded highest growth rates. Although snowmelt data and elevation were important throughout all life stages of the trees, variable importance of microtopography decreased over time and that of wind speed increased. Our findings provide experimental evidence that tree survival and height growth require different environmental conditions and that even small changes in the duration of snow cover, in addition to changes in temperature, can strongly impact tree survival and growth patterns at treeline. Furthermore, the relative importance of different environmental variables for tree seedlings changes during the juvenile phase as they grow taller.

S.36-03-O

Land-use vs. climate change: do they both represent a threat to subalpine grasslands? A test on the dominant *Festuca paniculata* (L.) Schinz & Thell.

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CNRS, France. CNRS, France. CNRS, France. CNRS, France. Université Caen - Basse Normandie, France. INRA, France. Université Joseph Fourier, France. CNRS, France.

Mowing abandonment in subalpine grasslands in the central French Alps decreases plant species diversity, mainly because mowing limits the development of the dominant *Festuca paniculata*, a tussock-forming Poaceae. Climate change predicted for the coming decades may represent an additional threat to diversity in subalpine grasslands. This study aimed at investigating the response of *F. paniculata* to changes in climate and mowing regime. A field experiment manipulated climate (control vs. climate change) and mowing regime (mown vs. unmown) for two summers (2009-2010). Climate change corresponded to a seasonal change (+1°C, precipitations reduced by 30%) and a 3-week extreme event in 2009 (+6°C, no precipitation). After only two years of treatment, summer mowing had increased leaf senescence, decreased tillering, summer growth, biomass of tiller basis and leaf nitrogen content. In contrast, none of these traits were affected by the climate manipulation at short term. However, the extreme event of 2009 transiently increased leaf senescence. Moreover, non-structural carbohydrate content in tiller basis at the beginning of the 2010 growing season was affected by former mowing, especially under control climate. This study confirms the sensitivity of *F. paniculata* to summer mowing and provides evidence for its resistance to short-term, moderate climate change. However, mowing effects on *F. paniculata* may be limited by extreme droughts and heat-waves. The first results of this ongoing study suggest that changing land-use may represent a greater short-term threat to subalpine grasslands than climate change.

S.36-04-P

Photoprotective strategies of high mountain endemic plants in Canary Islands.Brito, Patricia. Luis, Ana. Lorenzo, Roberto. Morales, Domingo. Jiménez, M^a Soledad.

University of La Laguna (ULL). University of La Laguna (ULL). University of La Laguna (ULL). University of La Laguna. University of La Laguna.

Plant Ecophysiology Group, Dpt. Plant Biology, University of La Laguna (ULL), Tenerife, Spain The high-mountain environments are characterized by adverse climatic conditions for plant development, as low temperatures, high radiation and water deficit. However, there are plants that withstand climate constraints in these altitudes, presenting strategies for dealing with these conditions. In Canary Islands (Spain), the high mountain plants are present only on the highest islands of the archipelago, La Palma and Tenerife, extending roughly from 2000 m. to 2425 - 3100 m a.s.l. respectively. The best representation in extension, richness and diversity of this ecosystem is present in Teide National Park (Tenerife). In this study we evaluate morphological and physiological photoprotective strategies that present some species of this alpine ecosystem, *Pterocarpus lasiospermus* (Dipsacaceae), *Erysimum scoparium* (Brassicaceae), *Scrophularia glabrata* (Scrophulariaceae) and *Descaurainia bourgeana* (Brassicaceae) both in the open area and in the timberline ecotone where they coexist with the endemic *Pinus canariensis*. This transition area is highly sensitive to environmental changes and its study is very important for the assessment of climate change. We measure morphological attributes (size individuals, leaf area, leaf shape, leaf angles, etc...) and photosynthetic pigment concentrations (HPLC analysis), with emphasis on xanthophylls cycle pigments, and chlorophyll fluorescence. The latter two parameters are good indicators of energy excitation excess. The results will be evaluated by statistical analysis to compare physiological and morphological strategies among different species. Thanks to the project "CGL2010-21366-C04-04" (Spanish Government) and Teide National Park for facilities and permissions. PB has a fellowship from CajaCanarias.

S.36-05-O

Probable effect of warming on nitrogen mineralization in the drakensberg alpine centre, southern africa.

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Ezemvelo KZN Wildlife. La Trobe University. University of KwaZulu-Natal. University of Botswana.

The Drakensberg Alpine Centre (DAC) is one of southern Africa's 18 centres of plant diversity and endemism, and southern Africa's only true alpine region. The DAC's alpine and sub-alpine soils are derived from outpourings of nutrient-rich basaltic lava. Total nitrogen (N) levels are particularly high (values of 4% are not unusual). However, most of this N is either locked up in organic forms, or is in short supply inorganically because low temperatures appear to arrest microbial action and hence N mineralization. Certain plant communities bear testament to its nutrient-poor N economy; the dominant floristic element is affiliated to the nutrient-poor Cape Floristic Region. We hypothesize that global warming may result in higher rates of N mineralization which may affect native plant communities accustomed to low N availability. The hypothesis is based on preliminary data generated by pot experiments and N incubation (simulation) experiments. N incubation experiments showed that Drakensberg soil mineralized less than 0.17% of its total N budget at 12°C because the microbes responsible for the conversion of organic N to inorganic N were severely inhibited at this spring temperature (when pulses of N mineralization follow early season wet-up). The pot experiments were also informative. The few remaining individuals grown in warmer environments (using soil derived from the DAC) were stunted with small leaves and had abnormally high shoot N concentrations. We believe that the high levels of N mineralization under these conditions were deleterious. We thereby predict that the plant communities thriving in the DAC's (currently temperature-mediated) nutrient-poor soils may be extirpated by future episodes of significant warming because of their inability to cope with N concentrations far beyond their natural tolerance range. Such communities may therefore be replaced by common nitrophilous ruderals that are neither conservation-worthy nor native to the DAC.

S.36-06-O

Freezing resistance in high and low elevation plants in the central Chilean Andes: possible consequences of climate change.

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Alpine habitats have been proposed as particularly sensitive to climate change. Shorter snow cover could expose high-elevation plants to very low temperatures, increasing their risk to suffer damage by freezing, hence decreasing their population viability. In addition, longer and warmer the growing season could affect the hardening process on these species. Thus, understanding the ability of these species to withstand freezing events under warmer conditions is essential for predicting how alpine species may respond to future climate changes. In addition, the ability of lowland species to colonize alpine habitats require that they can tolerate the freezing temperatures. Here we assessed the freezing resistance of eleven species from the central Chilean Andes by determining their low temperature damage (LT50) after experimental warming in the field. Plants were exposed during two growing seasons to a passive increase of the air temperature using open top chambers (OTCs). In addition we determined the LT50 of 35 species from the treeline ecotone. Overall, high-Andean species growing inside OTCs increased their LT50 indicating that warming decreased their ability to survive severe freezing events. Most of the species from the treeline have the potential to withstand the freezing temperatures of the alpine sites, although non-native were more resistant than native ones. Our results suggest that current climate warming trends will seriously threaten the survival of high-elevation plants by decreasing their ability to withstand severe freezing events and that the migration from lower elevations could be restricted for native species but not for non-natives.

S.36-07-P

Responses in plant communities to variation in precipitation patterns.

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Patterns of precipitation are likely to change significantly over the next 100 years, e.g. more heavy summer-rainfall events and longer periods of drought are predicted for Northern Europe, which is likely to alter plant ecosystems. In this study plant community responses to variation in precipitation patterns are described by modelling vegetation data recovered from grassland sites with experimentally altered hydrology. Vegetation data are obtained from two grassland sites both comprised of a flooded area, a drained area and an non-manipulated area to obtain a broad scope of soil-water availability. Pin point analyses, which measure plant species cover and plant compactness (occupation in 3D-space of the species) recorded in May and August describe the dynamics of the communities during the growing season. A state-space model (Bayesian network) quantifies the competition effect of species (or groupings of species) on each other on the hydrological gradient. Groups are defined by life span and traits such as specific leaf area, seed size and height, which are all likely to reflect adaptation to the hydrological regime. Eventually results from the above can be applied to other sites around Denmark that have similar vegetation, topography and flooding regimes. The vegetation data from these sites can be obtained from the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environments (NOVANA). This will enable us to assess the effects of variation in precipitation in a larger part of Denmark.

S.36-08-P

Ozone levels and potential risk of injury on the sub-alpine grasslands of the Guadarrama Mountains.

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Ecotoxicology of Air Pollution. CIEMAT. Plant Biology Department II. (UCM). Ecotoxicology of Air Pollution. CIEMAT. Plant Biology Department II. (UCM). Ecotoxicology of Air Pollution. CIEMAT. Ecotoxicology of Air Pollution. CIEMAT. -HOME-. -HOME-.

The Guadarrama Mountain range, located in the centre of the Iberian Peninsula, comprises high valuable ecosystems, from open evergreen woodlands to high mountain grassland communities. The environmental conditions with strong solar radiation, high temperatures and low winds, favour photochemical production of ozone (O₃) from the precursors emitted by Madrid City. However, very little information is available about the concentrations of air pollutants present in this area and the risk of possible effects on these mountain ecosystems. Ozone concentrations were monitored at two high elevation sites, located at 1850 and 2265 m.a.s.l., during the period 2007-2010. Additionally, NO_x and SO₂ levels were measured at 2265 m.a.s.l. The ozone levels at the top of the mountains were every year over the thresholds for plant protection according to the European Air Quality Directive (2008/50/EC). The highest O₃ values were recorded at the highest elevation where the *Festuca curvifolia* grassland community grows. This community is especially rich in endemic species protected at national and European level, representing the southern limit of the distribution of some alpine species. Shifts in species composition have recently been reported for this community. The aim of this research was to study whether atmospheric pollutants, could be contributing to induce the observed changes. Four representative species were selected to study the physiological behavior under field conditions: *Festuca curvifolia*, the dominant grass of the community, *Hieracium vahlii* and *Jurinea humilis*, the most abundant forbs, and *Senecio pyrenaica* representing the annual species. The four species showed a short growing season with the most active physiological period lasting only two months, between snowmelt and summer drought. Stomatal O₃ fluxes absorbed by the different species were estimated. Ozone levels at the beginning of the growing season (end of spring) were potentially the most harmful for all the studied species since they occurred while plants were having maximum stomatal conductance and thus maximum ozone fluxes were absorbed inside the plant. High O₃ concentrations recorded in summer were only potentially important for *Jurinea* and *Senecio*, as *Festuca* and *Hieracium* presented at this time very low stomatal conductance. Different strategies of plants growing in the same community should be taken into account in order to understand the response to air pollution at a community level.

S.36-09-P

Quantitative analysis of xylem anatomy in *Silene ciliata* along an altitudinal gradient in Mediterranean mountains.

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Mediterranean high-mountain environments differ from other alpine environments in that summer drought stress occurs also at high elevations, thus further constraining the cold-limited plant growing season. Consequently, increasing water stress associated with climatic warming may lead to more complex outcomes than altitudinal shifts only. Assessing climate effect on growth and hydraulic transport systems in plant species inhabiting Mediterranean mountains is critical to understand their potential response to future environments. We studied *Silene ciliata*, a caespitous perennial of alpine grasslands, to ascertain (i) radial growth responses to climatic variables, and (ii) how the species adapts its hydraulic architecture to varying environmental conditions. Survey was conducted at four sites located along an altitudinal gradient from 1,800 to 2,400 m a.s.l at Peñalara (Guadarrama, central Spain). At each site, 12 individuals of *S. ciliata* were randomly selected to be harvested. At the laboratory, root collars were carefully cut and permanent histological preparations were obtained and photographed. On the pictures, annual rings were visually defined, measured, and cross-dated. Climate-growth correlations were conducted. Vessels were semi automatically analyzed (size, number) by means of the tool ROXAS. *S. ciliata* shows distinct and indistinct rings, diffuse porous and semi-ring porous wood and solitary vessels. Preliminary results indicate a mean age of the species of 17 yr, growth responses to rainfall conditions, and changes in vessels size distribution along the considered altitudinal gradient.

S.36-10-P

Effect of the extreme summer heat-waves on isolated populations of two orophytic plants in the N-Apennines (Italy).

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One of the effects of global climate change is the occurrence of heat-waves: climatic models predict that they will become more intense, longer lasting and/or more frequent, as a consequence of the increased inter-annual variability and average values of summer temperatures. Plants are heavily damaged by heat-waves, both directly through the effect of extreme temperature, and indirectly through effects of drought and exposure to high ozone concentration. In this study we analysed the effect of extreme summer temperatures on reproductive performance in term of flowering abundance and biomass production of two orophytic species, *Alopecurus alpinus* Vill. and *Vicia cusnae* Foggi & Ricceri, during period 1999-2004 and, in particular, their response to heat-waves occurred in 2003 (HWs2003). In correspondence of HWs2003, especially in relation to mean temperature of June, we observed a significant decrease in the number of flowering stems and flowers per flowering stem for both species; their flower production in fact reached the lowest value. Furthermore *A. alpinus* showed a declining trend of flower production during the examined period, while its canopy cover was not influenced. Hence we found out that extreme weather negatively affect species survival, in particular flower production which is more sensitive than vegetative growth, usually maintained. This may induce changes in reproductive strategies of species and consequently genetic diversity of isolated populations may vary in the medium term. Finally, although plants respond to gradual warming in different ways, extreme temperatures have generally a negative effect, especially during summer, due to frequent drought and temperature stress.

S.36-11-P

Coexisting arboreal and shrubby conifers differ in their growth responses to climate at Mediterranean high mountains.

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Mediterranean mountains differ from other mountain systems in the presence of summer drought, which constrains even more the potential plant growing season. At tree line, different arboreal and shrubby conifers coexist. While the climatic responses of trees have been assessed, the response of shrubs is still unknown; it is to be expected that they are less sensitive to air temperatures than trees by being more coupled to the soil microclimate. We constructed chronologies of tree-ring width for the period 1950-2006 for two conifer species, a shrub, *Juniperus sabina*, and a tree, *Pinus sylvestris*, coexisting at three localities of the Iberian System (Moncayo, Alto Tajo and Javalambre), and we analyzed their climate-growth relationships. Growth in both species responded to climatic variability, but the climatic signal was stronger in pines. Spring temperatures affected positively radial growth in both species, but the effect occurred one month later in pines (May vs. April). Summer drought constrained growth in both cases, although the response to summer (July) rainfall was greater in junipers. The shrubby juniper species can overcome thermal limitations due to its morphology, which allows their meristems to be warmer and more coupled to the soil microclimatic conditions. Juniper is more dependent on summer rainfall than co-occurring Scots pine because it shows shallower root systems and uses more superficial water. The climatic potential of *Juniperus sabina* and its differential response with respect to co-occurring pines will allow using this species to monitor the response of woody species to ongoing climate warming.

S.36-12-O

Buffer capacity of alpine plants against extremely warm summers.

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Summer temperatures in European mountain regions increased remarkably during the last decades, by about 0.8 K from the 1990ties to recent years. We demonstrate that high mountain vegetation reacted significantly by shifting towards more thermophilic species compositions. The outstanding 2003-heatwave had less influence on this process than anticipated. Obviously, alpine plants as long-lived organisms have considerable capacity to buffer such extreme events.

S.36-13-P

FLUXPYR: cross-border network for the study of climate and land-use changes in the Pyrenees - early achievements, challenges and prospects.

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Mountain ecosystems are particularly sensitive and amongst the first to be impacted by climate and land-use changes, which suggests that they are valuable experimental sites, observatories and early-detection systems. Understanding global change impacts on ecosystems and the provision of goods and services, and developing adequate mitigation and adaptation strategies, requires international, integrated, and trans-disciplinary approaches and efforts. FLUXPYR (2009-2012, www.fluxpyr.eu) is a European cross-border network cofinanced by the EU-ERDF, Catalan Government and Midi-Pyrénées Region, which aims at the study of climate and land-use change impacts on Pyrenean agroecosystems. It focuses mainly on carbon, water and energy fluxes and stocks, snow and land cover dynamics, ecosystem productivity and socio-economic changes. FLUXPYR combines ecosystem, atmospheric and satellite studies and relies on a combination of techniques, including micrometeorology (eddy covariance), soil chambers measurements (e.g. CO₂ and N₂O emissions), vegetation and soil sampling, hydrological gauging, aircraft measurements, remote sensing (satellite and aerial images) and social surveys. Data are used for the calibration of empirical and process-based models (e.g. snow dynamics, atmospheric CO₂ transportation), the calculation of greenhouse gas balances and the creation of maps (e.g. snow and land cover, soil humidity). FLUXPYR fosters the exchange of knowledge and experience and raises awareness amongst the stakeholders and the society about the causes and consequences of climate change and ways to face it. Its outcomes will inform sustainable climate change adaptation and mitigation strategies. We will present FLUXPYR's early achievements, main challenges and prospects, and will underline the relevance of regional networks for global change studies.

S.36-14-P

Butterfly elevational distributions are constrained by host plant distributions in a mountain area: implications in the context of climate change.

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Climate change is expected to force species distributions towards higher elevations and latitudes. However, this expectation assumes that all other conditions and resources are suitable and available, respectively, in the potentially colonisable areas under future warmer climate conditions. Based on detailed distributional data for 40 locations over a 560-2250 m elevation range in a mountain area in central Spain, we tested to what extent prevalence (proportion of occupied sites), and upper and lower elevation limits of 45 butterfly species were associated with those of their respective host plants. Butterfly prevalence was positively correlated with host plant prevalence. 33% of species occurred above 2000 m in elevation, suggesting that they were topographically limited by the maximum mountain altitude. For the remaining species, we found a positive correlation between butterfly and host plant upper elevation limits. The ranges of 44% of species stretched below 750 m in elevation, indicating that they have no apparent lower elevation limits in the area. For the remaining species, there was no significant correlation between butterfly and host plant lower elevation limits. Our research revealed that, apart from the obvious topographic limitation of maximum mountain altitude, future range shifts at upper elevation range limits could be limited by host plant availability for many species. This limitation imposed by the availability of biotic resources could exacerbate expected losses in range area due to climatically-driven uphill range shifts for species with lower elevation range limits in mountain regions

S.36-15-P

Monitoring Mediterranean high mountain vegetation in Sistema Central: GLORIA project and collateral ecological studies.

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High-mountain ecosystems are considered to be among the most vulnerable to climate change. In these habitats, plant communities are subjected to low temperatures that condition short growing seasons. In the Mediterranean climate, summer drought can shorten this period even further, and the annual variability of precipitation may generate more extreme conditions in drier years. In addition, temperatures and precipitation are predicted to suffer more drastic variation in Mediterranean mountains; hence important biodiversity changes can be expected in Mediterranean high-mountain ecosystems. Nevertheless Mediterranean high-mountain ecosystems are still relatively little known; their biodiversity patterns, structure and function have only been elucidated in last decade. High-mountain environments are also currently target ecosystems for monitoring the changes caused by global warming. Specifically the GLORIA project has developed a common long-term survey protocol of plant biodiversity changes in these habitats. Other short-term studies can be combined with long-term protocols and make use of the data already available in order to increase the understanding of these habitats and to predict the future responses of communities to global change. We summarized the most relevant results already achieved with short-term studies using the data recorded with GLORIA protocols in Sistema Central. These collateral studies provided information about main environmental gradients and habitat constraints, functional strategies and spatial patterns of plant species and plant species associations in a Mediterranean high-mountain.

S.36-16-O

Climatic change, extreme events and alpine ecosystems response in western Canada during the last 15ka.

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The biota in the Cordilleras of western Canada have had to adapt quickly to enormous changes in climate, ranging from widespread glaciation at 15ka, to the Altithermal/Hypsithermal warm event at 6ka. Revegetation of the glaciated areas in the mountains was primarily from the Beringian refugium with some additions from the areas to the south and the Queen Charlotte Island and Plateau Mountain refugia. Much higher precipitation in the mountains and development of extensive areas of sand dunes on the Prairies occurred during the Neoglacial events. Since 1900, the precipitation in the mountains has decreased markedly while that on the Prairies has increased. Now there are only three small dune areas on the Prairies that have not been revegetated, but the mountain glaciers are receding and much of the former diverse flora that developed during the Neoglacial is limited to the areas of high winter precipitation. Frequent fires and anthropogenic activities have greatly altered the forests in the mountains and may have helped in the reduction of precipitation on the Eastern Cordillera. Elimination of fires and irrigation farming have reduced the numbers of many of former abundant species of plants on the prairies, and the species formerly occupying the sand dunes are limited to the few remaining sand dunes areas in the badlands. The vegetation is far less diverse than south of the glaciation limit, and only those species that can adapt to rapidly changing environments survive. Landslides, mudflows, rockfalls and snow-avalanches continuously provide new microenvironments.

S.36-17-P

Characterization of dispersive altitudinal movements of birds mountain.

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In order to study dispersive altitudinal behavior of birds as an adaptation to the mountain, there were conducted biweekly census by the "Points Method", between October 2009 and September 2010, in 33 fixed points in "Serra da Estrela", Portugal, since 400 to 1993 meters of altitude. The birds community presents a high specific diversity (n=133 species). The resident species present a major representativeness (n=58; 48%), while the remaining are migratory. From the variation of population numbers of resident passerines, it appears that "time" and "altitude" presents a significant influence in their relative abundance, evidence of pronounced seasonal altitudinal movements. Of these, 35% perform altitudinal movements (n=14), being possible to distinguish four variation patterns of altitudinal distribution: (1) species distributed mainly by higher areas during reproduction and by the basal areas in winter (n=6 species); (2) species distributed mainly by higher areas during reproduction and uniformly throughout the altitudinal gradient in winter (n=1 species); (3) species distributed uniformly across the altitudinal gradient during reproduction and mainly in the basal areas in winter (n=5 species); (4) species in spite of distributing themselves preferentially by basal areas throughout the hole year, during reproduction they suffer a decrease of the effective in basal floors in detriment of an increase in higher areas (n=2 species). Only 31, 5% of the variation of abundances is related with biophysical factors, while the variables related to habitat and time of the year, present major significance than climatic factors. It is concluded that the altitudinal movements aren't a direct response to climatic factors but to the changes that they induce in the biotypes. The largest proportion of the variation is justified by biological factors such as availability of resources and competition.

S.36-18-O

Effect of the 2003 heatwave on *Eryngium alpinum* under different management regimes

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In the summer of 2003, Europe was impacted by a heatwave that altered ecosystem productivity and increased plant mortality in natural areas. We analyse the effect of this extreme climatic event on the demography of the protected alpine plant *Eryngium alpinum*. We also consider how population dynamics varies in relation to local ecological conditions and management regimes (mowing, grazing and absence of management). Vital rates of different life-stages (fecundity, survival and flowering rates of seedlings, juvenile, vegetative adult and reproductive adult plants) of *E. alpinum* were estimated in seven field sites in the French Alps between 2001-2010. Spatiotemporal variation of vital rates and its impact on population dynamics (deterministic and stochastic population growth rate, λ and r) were studied using matrix population models and life table response experiments. Fecundity rates did not show significant temporal variation. Reduction in survival rates was observed following the extreme 2003 summer. Flowering rates exhibited great variation between years but no sign of the 2003 heatwave. λ was smaller during the heatwave and simulations showed that increasing the occurrence probability of a 2003-like event resulted in smaller r . Fecundity rates were reduced in sites subject to grazing. Between site variation in seedling and juvenile survival rates contributed considerably to variation of λ . There were few differences in vital rates and population dynamics between sites subject to mowing and in absence of management. Spatiotemporal variation in vital rates was consistent across juvenile and adult plants and for flowering and survival rates, i.e. good years for flowering in one life-stage were also good for flowering in the other stages and for survival. Conversely, fecundity and seedling survival rates exhibited contrasting pattern among them and with juvenile and adult vital rates, sometimes compensating the spatiotemporal variation in λ . Synthesis. This study demonstrates that plant vital rates can exhibit differential response to changing environmental conditions and illustrates which vital rates make the largest contribution to difference in population dynamics of an alpine protected plant between years (survival rates only) and between sites (fecundity and survival rates).

S.36-19-P

Global warming will influence the quality and quantity of food available for tundra herbivores.

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Regardless of numerous studies on global warming affecting tundra vegetation, only very recently herbivores have been acknowledged as important factors interacting with or even counteracting warming. The Arctic is encountering remarkable temperature increase, and knowledge on the combined effects of warming and grazing on vegetation is needed for better management plans. Shrubs - the dominant growth form and key food source on tundra - are rapidly responding to warming. This study analyzes the effects of long-term warming (open-top chambers) on abundance and nutritional quality of four dominant shrub species, aiming at better understanding how food resources available for tundra herbivores respond to warming climate. We used a multisite experiment in forest-tundra ecotone along 900 km gradient from central to northern Norway. Warming increased shrub abundance in all locations, only *Vaccinium myrtillus* decreased in the southernmost location due to heavy competition with *Empetrum hermaphroditum*. Nitrogen and phosphorus concentrations of *Betula nana* decreased, but remained unchanged in the other shrub species. Total soluble phenolics did not respond to warming. Tannins varied greatly among species, locations and habitats and showed idiosyncratic responses to warming. Our findings suggest that abundance of palatable shrubs will increase especially in northern tundra habitats, whereas less-palatable *Empetrum* is highly increasing in nutrient-rich alpine forests. The large changes in shrub abundance will probably be more important for herbivores than the minor, and partly idiosyncratic, effects of warming on plant quality. Future warming is thus expected to be favorable to tundra herbivores, at least if only food availability is considered.

S.36-20-O

Global Change and high elevation biota.

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In this presentation I will first address the various facets of global change in alpine ecosystems. I will then present evidence on likely treeline responses and effects of climatic warming in alpine landscapes. High elevation treelines are clearly temperature related, hence we would expect them to track warming. However delays will be substantial, although obvious responses started in the middle of the last century. The alpine is often treated as a cold limited, harsh environment with plants cold stressed. Now it became popular to treat the alpine as a warming endangered system. Only either one can be true. This debate goes to the core of misconceptions with regard to the most prominent terms in ecology 'stress and limitation'. It will be shown by remote infrared-thermometry that alpine landscapes are full of microclimatic stepping stones and refugia that make this terrain particularly safe for surviving climatic excursions. References: Paulsen J, Weber UM, Körner Ch (2000) Tree growth near treeline: abrupt or gradual reduction with altitude? *Arct Antarct Alp Res* 32:14-20 -- Körner Ch (2006) Significance of temperature in plant life. In: Morison JIL, Morecroft MD (eds): *Plant growth and climate change*. Blackwell Publishing Ltd, Oxford p. 48-69 -- Scherrer D, Körner Ch, (2009) Infra-red thermometry of alpine landscapes challenges climatic warming projections. *Global Change Biology* 16:2602-2613 -- Scherrer D, Körner C (2011) Topographically controlled thermal-habitat differentiation buffers alpine plant diversity against climate warming. *J Biogeography* 38:406-416

S.36-21-P

Low temperature limits cambial activity and determines secondary growth at the alpine treeline.

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Temperature is the driving factor behind the formation of natural high elevation treelines, directly affecting xylogenesis. The low temperature limitation of meristematic processes is thus key to understand treeline formation. Here, we studied xylogenesis in *Pinus uncinata* during the growing season by sequential microcoring at the Swiss treeline. To assess temperature sensitivity of xylogenesis in situ, we applied controlled Peltier-mediated cooling and warming (± 3 K relative to ambient temperatures) to branch segments in *P. uncinata*, commencing 12 days after snowmelt. Surprisingly, xylogenesis in aboveground tissues started one week before snowmelt, and the cambial zone was fully developed by the time the cooling and warming treatment started. Although not significantly, experimental cooling of branches reduced the number of cells produced per season, likely due to the slower rate of cell production in the cambial zone during the short remaining period of cambial activity, whereas warming extended the production of earlywood into the late season. We conclude that temperatures early in the season determine the width of the cambial zone and thereby strongly control the number of tracheids produced during the forthcoming season. Temperatures later in the season largely determine the earlywood-latewood ratio, rather than affecting the number of tracheids produced per season. These data provide an empirical basis for the mechanistic understanding of tree growth at treeline in response to temperature.

S.36-22-P

Impact of climate change on outbreak dynamics of forest insects along Alpine altitudinal gradients.

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Global climate is currently changing at an unprecedented rate. Despite many uncertainties, there is consensus that climate change has already and will have impacts on the spatio-temporal dynamics of forest insect herbivores. Our aim is to quantify the relative importance of density-dependent regulation vs. abiotic climatic factors in driving the spatio-temporal outbreak dynamics of two important forest herbivores (*Ips typographus* and *Thaumetopoea pityocampa*) occurring along Alpine altitudinal gradients. Analyses of *I. typographus* suggest that both endogenous density-dependent regulation and exogenous abiotic factors such as drought and temperature are important factors driving inter-annual changes in population density. Extreme drought events appeared as the main abiotic triggers of *I. typographus* outbreaks but with different effects depending on the altitude. For *T. pityocampa* the outbreak dynamics was more complex. We found relatively strong direct density dependence probably related to both the reduction of food quality and the activity of natural enemies, while the direct effect of climate was less evident. One clear signal was, however, an upward shift of the outbreaks at the upper part of the elevational range due to recent temperature warming. Although the outbreak dynamics of the two species can be characterized by a relatively high degree of complexity and uncertainty, climate change emerged as one factor driving some of the current outbreaks of *I. typographus* and *T. pityocampa* in the Alps, leading to severe ecological and economic consequences on both artificial and natural forests.

S.36-23-P

Development rhythm (phenology) of subnival/nival plants of the Caucasus.

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One of the important plant strategies in extreme conditions of high mountain areas is a very short growing season coinciding with the most favourable period of a year. The adaptation includes development of special rhythmological features including characteristic bud structure and development pattern, leaf and flower acquisition, short flowering and fruit-bearing phases, etc. The research was done at bases of ice-capped mountains of the Greater Caucasus: Mts. Kazbegi, Elbrus, Chanchakhi. Regular phenological observations were conducted mainly in surroundings of Mt. Kazbegi and Mamisoni pass, on various exposures at 3150-3350 m a.s.l., in 1970-1982. Plant distribution in subnival/nival zones largely depends on snow cover depth, which enabled us to distinguish 4 habitats with different snow cover. The habitat with close to average snow cover exhibits the highest species richness. The majority of plants have open proleptic buds, and only few species have closed buds. Flowers and inflorescences in most cases start formation in wintering buds in autumn. Growing season start mainly depends on snow thawing time and it mostly begins in the end of June. The flowering phase lasts until the second half of September in subnival zone (the second third of August in subalpine zone). The majority of species start flowering almost simultaneously. Phenorhythmotypes are diverse in subnival/nival zones. Evergreen and summer-wintergreen (facultative) as well as widespread summergreen and short growing season plants occur there. After 25-30 years since collection of the baseline data phenological observations are started on the same plots to study effects of global climate change.

S.36-24-P

Studying climate change impacts on insect communities using a transplant experiment.

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Global climate change will have profound effects on the distribution, abundance and ecology of virtually all species. Our knowledge about these effects in Australia is extremely limited. In particular, there is little information as to how plant-insect interactions will respond to a warmer climate. As plants and their insect herbivores together comprise the single largest component of global biodiversity, understanding how such interactions will change in the future is critical to understanding community and ecosystem impacts. This project investigates how climate change may affect interactions between Australian native plant species and their insect herbivores, focusing on how these changes will affect the structure and composition of insect communities. We conducted a large-scale field transplant experiment using a latitudinal gradient as a surrogate for a warmer climate. Host plant species were chosen to represent three of Australia's major plant families, the Myrtaceae, Fabaceae and Proteaceae. Each host species has a narrow geographic range in the Sydney region. The field transplant sites were 600 km north where annual mean temperatures are approximately 3°C higher than those within the native range of the hosts. The transplants were thus exposed to a climate expected for their native ranges 30-50 years in the future. Insect colonization on the transplants and on control plants within the native range was monitored for one year. We will present data comparing the insect communities at the transplant sites to those within the native range in terms of species abundance, species richness, and community structure.

S.36-25-P

Phytosociological and ecological studies of high alpine to subnival scree vegetations of N and NW of Iran (Alborz and Azarbayjan Mts.).

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University of Vienna. Institute of Mountain Research (IGF). VINCA, Vienna Institute for Nature Conservation. University of Vienna.

Iran is a mountainous country with a fragmented high alpine and subnival-nival zone across the Iranian mountains. In this work a syntaxonomic and synecological survey is presented on the flora and vegetation of high alpine and subnival-nival scree vegetation of Alborz and Azarbayjan mountains in N and NW of Iran. 145 phytosociological relevés have been collected from scree vegetation types which are altitudinally concentrated between 3400-4500 m of the study area. By means of phytosociological classification and ordination, the plant communities and environmental factors are analyzed. All high alpine and subnival scree plant communities are initially arranged in one class, two orders, four alliances and 17 associations. The altitude, slope and edaphic qualities are more important for species composition and vegetation mosaic. The high rate of endemism with a narrow geographical distribution makes the flora and vegetation of these areas vulnerable to climate warming. The narrow altitudinal and geographical distribution of most of species of these vegetation types and the low potential of alternative cold habitats render them highly vulnerable to climate change.

S.36-26-O

Disease-Mediated Vegetation Shifts Influence the Effect of Climate Change on Carbon Fluxes.

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Umeå University. Umeå University. SLU. Metla. Durham University.

Ongoing global warming is expected to cause direct changes in plant community composition in high latitude ecosystems. The effect of global warming on plant communities may also be indirect, via effects on predators and herbivores that propagate through food-webs, although the importance of such processes are poorly known. Here we present evidence for opposing effects of increased snow cover on vegetation change and carbon balance in a tundra ecosystem, before and after the outbreak of a host-specific plant parasitic fungus, *Arwidssonia empetri*, that killed a majority of the shoots of the dominant plant species, *Empetrum hermaphroditum*, after 6 years of increased snow cover. After the outbreak of the disease, plant biomass, leaf area index and gross photosynthesis were all significantly lowered in plots with increased snow cover compared to control plots. Since soil respiration remained similar in both treatments, net ecosystem carbon exchange shifted to negative in plots with increased snow cover, but remained positive in control plots. Our findings show that altered snow conditions can markedly affect species composition and carbon balance of arctic ecosystems, although the direction of the change will depend on food-web interactions. Although the growth of *E. hermaphroditum* increased by the snow treatment, its abundance decreased due to the high disease incidence. This study is the first to confirm that plant diseases can alter species composition and carbon balance of the tundra. This indicates that disease incidence has to be considered in order to predict more accurately ecosystem responses to climate change.

S.36-27-P

Species-specific biomass responses during 5 years of N and P fertilization within a late snowbed at Gavia Pass (Rhaetian Alps, Italy).

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University of Parma. University of Parma. University of Parma.

The increase of anthropogenic nitrogen deposition and the climate warming-linked increase in soil nitrogen mineralisation, raise the question of how alpine tundra species, usually limited by N and P, will react to these nutrient increase. While for graminoids, shrubs and mosses literature data show a somewhat consistent reaction model, for many herbs there is a strong species-specific behaviour. This is the reason that lead us to study late-melting alpine snowbeds, an habitat colonised by a number of very poorly studied herbs and dominated by a moss, *Polytrichastrum sexangulare*. The study was carried out since 2003 at an alpine site on southern Alps, where we set up a nutrient amendment experiment with 5 different concentration of N and P. The abundance of all species was estimated based on the intercept points method. The dominant moss showed a significant biomass decrease in all the treatments. Vascular plants biomass showed a significant increase in the treatments with combined N and P, while not significant results were obtained with N or P only. All vascular species showed a significant biomass increase in the treatments with combined N and P since the beginning. Chionophilous species like *Veronica alpina*, *Cardamine alpina* and *Gnaphalium supinum* showed a biomass increase restricted to only the first half of the experiment, whereas *Leucanthemopsis alpina* and *Poa alpina* showed a strong increase during all the years of fertilization. We can conclude that an increasing input of nutrients should change dominance relationships between species within this community advantaging those with a wider and plastic ecology seriously menacing the conservation of this community.

S.36-28-O

Modelling alpine biodiversity response to climate: are all dimensions equally well predicted from species distribution models?

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University of Lausanne. University of Lausanne.

Predicting the impacts of forecast 21st century climate change on alpine ecosystems and biodiversity is pertinent to a wide range of ecological, social, cultural and economic issues. Species Distribution Models (SDMs) have allowed substantial progress by assessing the response of the alpine flora under different scenarios of climate warming. Such assessments have mainly dealt with the taxonomic dimension of biodiversity as they focused on targeted species, species richness or species composition. However, little is known on how predicted changes by SDMs translate into changes in other dimensions of biodiversity such as functional diversity and phylogenetic diversity. In this frame, the aim of this study is to assess how a common modelling framework (i.e. climate-based SDMs) equally represents the three dimensions (i.e. taxonomic, functional and phylogenetic) of plant diversity in a mountain environment. We used 'state-of the art' techniques for building fine-scale topoclimatic SDMs of the commonest species within a study area located in the Western Swiss Alps. We stacked model predictions to reconstruct species assemblages and subsequently to calculate taxonomic, functional and phylogenetic diversity. We showed that SDMs might not equally represent the three dimensions of plant diversity and that respective prediction accuracy of these dimensions is not constant over space but rather change along elevation. We discuss the implications of these findings in regard to the conservation of species, evolutionary history and ecosystem properties under climate change.

S.36-29-P

Elevated CO₂, warming and extreme events at treeline.

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Warmer temperatures, changes in extreme events and elevated atmospheric CO₂ concentrations will probably affect plants and ecosystems at treeline. In a unique treeline experiment, we enhanced CO₂ concentrations and temperatures at plots with 35-year-old larch and pine trees. We studied growth, freezing sensitivity and carbon balance. We found that enhanced atmospheric CO₂ and warmer temperatures enhanced growth of some species at treeline. Better growing conditions, on the other hand, led to higher sensitivity to extreme events such as freezing. Warming enhanced loss of recalcitrant carbon. Our results indicate that future plant growth at treeline will probably be enhanced, but extreme events may offset some effects of climate change. However, due to carbon losses from the soil, no considerable carbon sink may be expected in the short term.

S.36-30-O

Impact of experimentally induced summer drought on ecosystem processes in alpine grassland.

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The future summer climate in the European Alps is predicted to be drier and warmer, with an increased probability of extreme events such as severe droughts. However, how alpine grassland ecosystems will respond to changing precipitation regimes is unclear. We simulated summer drought with rainout shelters at three alpine grassland sites with contrasting macroclimate and geology in the Swiss Central Alps at about 2500 m a.s.l. to study the impact of prolonged summer drought on several key ecosystem processes. Here, we focus on responses in above- and belowground biomass production at community, functional group and species level, and on modifications in litter decomposition. After two years of summer drought, community standing aboveground biomass of the alpine swards has decreased significantly. In contrast, due to an increased formation of fine roots and storage organs, standing belowground biomass has increased substantially. This clearly shows that alpine grassland communities change their resource allocation in response to summer drought. While most of the plant species show a trend towards reduced aboveground biomass production under drought conditions, some species seem to profit from a drier climate and tend to produce more aboveground biomass when exposed to drought. In addition, under drought conditions, litter decomposition rates are significantly reduced, thus drought also has a clear influence on temporal decomposition patterns. Our results show that two years of summer drought considerably affect essential ecosystem processes in alpine grassland. We conclude that alpine grassland ecosystems could be particularly susceptible to prolonged summer drought in the future.

S.36-31-P

Short term effects of nutrient amendments on phenology of four snow-bed species at Gavia Pass (Rhaetian Alps-Italy).

Tomaselli, Marcello. Petraglia, Alessandro. Carbognani, Michele.

University of Parma. University of Parma. University of Parma.

The increase of anthropogenic nitrogen deposition and the climate warming-linked increase in soil nitrogen mineralisation, raise the question of how alpine tundra species, usually limited by N and P, will react to these nutrient increase. Focussing on this nutrient limitation, we examined changes in flowering phenology of four typical snow-bed herbs after an experimental design focused on nutrient amendments at an alpine site on southern Alps. Fertilisation with N and P at four different concentration started in 2003, while measures and counts, started in 2005, went on for two seasons (2005 and 2006). Phenological observation were taken every 6-7 days from 1-2 days after the snow-melting date to the end of the growing season. Flowering phenology showed differential responses for the four species. *Cardamine alpina* showed an increment of flowering ramets and a predated seed dispersion in highly fertilised plots. *Veronica alpina* showed an early flowering date and an increased number of fruits per ramet for highly fertilized plots. *Leucanthemopsis alpina* and *Poa alpina* showed an increased number of flowering ramets. Amendment experiment produced a positive effect on the vegetative growth and on the potential reproduction of these species, with an increasing number of fruiting or potentially fruiting ramets. An increase of nutrients amounts for many year should lead to a change in species density of all vascular species, with a strong effect for larger and ecologically wider species, as *Leucanthemopsis alpina* or *Poa alpina*, and a weaker impact for very little and more strictly chionophilous species such as *Cardamine alpina* and *Veronica alpina*.

S.36-32-P

Seven years of experimentally increased N- and O₃-deposition affect soil air $\delta^{13}\text{C}$ of a subalpine grassland in the Swiss Alps.

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Agroscope Reckenholz-Tänikon Research Station ART. University of Basel. Agroscope Reckenholz-Tänikon Research Station ART.

To investigate the effects of ozone (O₃) and nitrogen (N) deposition on a subalpine pasture, 180 turf monoliths were exposed to a combination of three [O₃] and 5 N deposition levels during 7 years at Alp Flix (2000 m a.s.l.) in a free air fumigation system. Affecting assimilation and respiration of plants and heterotrophes, both N and O₃ deposition may alter C pool sizes and turnover rates throughout the ecosystem. Plant derived soil organic matter has a characteristic $\delta^{13}\text{C}$ signature that depends on environmental conditions during assimilation of the C and on the stability/age of the respective pools. The $\delta^{13}\text{C}$ of soil air CO₂ reflects the $\delta^{13}\text{C}$ signature of the substrate primarily respired in microbial metabolism. $\delta^{13}\text{C}$ analysis revealed a strong seasonality of $\delta^{13}\text{C}$ and large absolute differences between N, but not O₃ treatments. Seasonality is characterised by resupply of labile substrates very early in the growing season and changing fractionation mechanisms while plants approach maturity. The N effect in $\delta^{13}\text{C}$ within seasonality is a consequence of increased productivity under N fertilisation. The database also allows to speculate that mitigating the N limitation of microbial growth accelerates the consumption of favoured C substrates. Consequently, increased N supply may have led to a depletion of labile SOM pools and reduced the C sink properties of the subalpine grassland, ultimately enhancing global warming.

S.36-33-P

Increasing plant diversity on alpine summits in Switzerland.

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To study and describe the frontiers of plant life in the nival zone, botanists with mountaineering skills have centuries ago climbed many high summits in the Alps. These researchers have collected a wealth of data on the flora of more than 250 summits in Switzerland, which are ideally suited to study long-term vegetation changes in high altitudes and their driving factors. Meanwhile, not only the climate has warmed considerably, but also land-use, the population sizes of wild animals and hikers have changed. In our study, we re-visited and botanized 150 summits in the Swiss Alps. Species richness has increased considerably during the past 100 years. Factors that promoted this increase were a relatively low altitude of summit, mixed geology and a high number of herbivores, while human disturbance tends to have had a negative effect. The increase in species numbers has been accelerating since the first summit studies in the 1980ies, parallel to a stronger temperature increase. Many summit colonizers are species typical of lower areas, but some characteristic high-alpine species became even more frequent as well. Our results confirm that climate warming shifts plant species distribution limits upwards and thus, drives the overall pattern of floristic enrichment on alpine summits. However, whether a species can reach a summit and persist there also depends on other factors, such as local environmental conditions, seed vectors, and human disturbance.

S.36-34-O

Lessons to learn from impacts of 2003-heatwave on vegetation in a central Alpine valley.

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The European heatwave of 2003 impacted the Alpine forests both in terms of aggravated growth conditions at low elevations and by increased fire frequency from valley bottoms to towards the timberline. How resilient are these forests to fire disturbance and how plastic do they respond to extreme drought events? To answer, we investigated (1) the re-colonisation with plants after a stand-replacing fire along a 1300 m elevational gradient; (2) the ability of autochthonous and Mediterranean provenances of pine seedlings and saplings (*Pinus sylvestris*, *Pinus nigra*) to withstand extreme drought events; and (3) recorded effects of the heatwave on mature Scots pines during an irrigation experiment in the same area. Results of the three projects show the following: Post-fire plant species richness peaked three to four years after severe forest fire, with increased numbers towards the timberline. The occurrence of alpine plant species during the 4-year-monitoring-period was surprisingly stable, with transient downward shifts of individual species. Autochthonous Scots pine seedlings showed higher phenotypic plasticity in response to extreme drought and are thus expected to better cope with the high inter-annual variability of the central Alpine climate in the long run than Mediterranean pines. In contrast, growth rates of drought-resistant Mediterranean pines were smaller if climatic conditions represented average valley climate. Finally, mature Scots pines were able to recover from growth limiting drought periods. In conclusion, impacts of extreme events only transiently impact vegetation in central Alpine valleys, an insight that contrasts with outcomes of dynamic vegetation modelling.

Identifying adaptive genetic diversity in relation to environmental variation: association genetics in Brassicaceae.

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Local adaptation plays an important role in the extension of species' ecological niche to new habitats as a consequence of the change in environmental conditions, such as climate change. Still, the genetic basis of local adaptation is not well understood, especially not in non-model species. To investigate the genomic patterns of local adaptation and their transferability between non-model species, we studied the association of genetic markers to environmental variables in five alpine plant species of the family Brassicaceae, which are related to the fully sequenced model species *Arabidopsis thaliana*. In this study, we sampled populations of each species in the Swiss Alps and the Jura Mountains and produced amplified fragment length polymorphism (AFLP) markers. After performing outlier analyses, we associated identified outliers to the seven most uncorrelated environmental variables from a set of topo-climatic GIS layers using multiple linear regressions. The analyses detected few loci of putative environmental relevance, of which one, found in *Cardamine resedifolia*, was selected for sequencing. We sequenced-characterized the genomic environment of this locus and searched for single nucleotide polymorphisms (SNPs) within each of the five species. Identified SNPs were genotyped and tested again for environmental association to infer recurrent patterns of local adaptation in related species. Results suggested that in at least one other species, i.e., *Arabis alpina*, this locus is environmentally relevant or is linked to a gene under selection. Such findings are useful for modeling future vegetation dynamics and help to identify trends in plant adaptation in alpine ecosystems.

S.06 - Cause-effect relationships in food webs-aquatic ecosystems as study systems

S.06-12-0

Evaluating alternative models of wetland interaction-web structure at the landscape-scale from the Everglades, USA.

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The interaction of nutrient and hydrological gradients in aquatic ecosystems may have profound impacts on patterns of species interactions and community structure and function. We used path analytical modeling to evaluate the fit of seven interaction-web structures to data on aquatic communities of the Everglades, Florida, USA. Our interaction web consists of data on hydrological and nutrient drivers, primary producer (periphyton) biomass and species composition, primary consumer biomass (macroinvertebrate infauna of periphyton mats and two species of fish), and secondary consumer biomass (large macroinvertebrates and fish). We hypothesized a linkage of the relative role of top-down effects on primary consumers to the time passed since a local site was last re-flooded following a drought and that this effect would interact with the amount of anthropogenic phosphorus enrichment. We tested these effects on data from 28 sites in 2005 and found only modest support for any role of top-down effects; a model with only bottom-up effects fit our data only slightly less well than one with top-down effects on periphyton infauna. One explanation is that bottom-up and top-down effects changed along nutrient gradients in a way that approximately balanced, yielding very little spatial variation in primary consumers. This result is supported by independent experimental studies. We will conclude by discussing the benefits and limits of path analysis and related modeling methods in elucidating cause-effect relations, and in contrast to experimental study.

S.13 - Evolutionary Ecology

S.13-30-P

Latitudinal change to Ozone sensitivity in *Quercus ilex*.

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Studies carried out in animal and plant species suggest that, owing to the high stress undergone by populations native to the boundaries of their biogeographic range, evolution appears to select for more abundant tissue defensive biochemical endowments, with the result of individuals more resistant to the predominant stress factor there (i.e., either low temperature in the northern border or water stress in the southern border). However, the high complexity of biotic and abiotic interactions in the border of the range, together with the universality of defensive biochemical mechanisms, should drive the selective forces to an higher generic resistance to stress, irrespective of the stress factor considered (as, for example, ozone). In this line, we tested the hypothesis that individuals of *Q. ilex* native to the borders of its range are more resistant to ozone fumigation than those native to the core of its range. Here, we present the first results relative to physiological traits. We collected acorns from 5 populations of *Q. ilex* located from the northern border of the range of this species (Montpellier area, France) to its southern limit in the Iberian Peninsula (Almería area, Spain). Potted seedlings from the 5 populations were grown in controlled growth chambers in 80 ppb ozone atmosphere and in free ozone air conditions. The experiment lasted for 90 days. We analysed the photosynthetic response of the seedlings to the ozone treatment by considering gas exchange (net photosynthesis, conductance, internal CO₂) and fluorescence variables (Fv/Fm, ΦPSII, ETR, etc.). Results show that populations differ in both gas exchange and fluorescence variables, and also in their response to ozone treatment. Thus, there exists a general pattern of response to treatment associated to latitude; with populations native to the northern part of the range being less sensitive (more resistant) to ozone. In addition, results also show that the population located in the southern border of the range (Almería) is less sensitive to ozone than should be expected as regards of its latitude. We conclude that populations of *Q. ilex* native to either the northern or the southern borders of the range of the species are more resistant to stress than those native to the core of its range.

S.19 - Ecological Models and their applications in forest management

S.19-23-P

Runoff Redistribution Among Woodland Vegetation Patches: Assessing the Optimal Source-Sink Area Ratio

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A central tenant of ecohydrology in drylands is that runoff redistribution concentrates the key limiting resource of water, which can then enhance vegetation growth and biomass. Conversely, a reduction in vegetation patches can lead to a threshold-like response: bare patches become highly interconnected, triggering an increase in hillslope runoff and erosion. However, assessing how maximization of runoff to vegetation patches relates to minimization of hillslope runoff, and applying these principles to improve the woodland management requires additional research. To illustrate how runoff redistribution potentially changes in response to conversion of vegetation patches to bare ones, we used a spatially distributed model, SPLASH (Simulator for Processes at the Landscape-Surface-Subsurface Hydrology), with an example of a semiarid piñon-juniper woodland hillslope with seven combinations of bare and vegetation patch cover, culminating in complete loss of herbaceous patches, for a 1-year design storm. The amount of hillslope runoff increased curvilinearly with reductions in herbaceous cover as runoff per cell increased from bare patches and runoff per cell increased for herbaceous patches. Notably, total amount of runoff to herbaceous patches was greatest when amount of bare cover was intermediate, highlighting a tradeoff between source and sink area. Our results certainly depends on several site-specific conditions, but the general nature of the response may be indicative of a general type of response applicable to many woodland. We suggest that the assessing of the optimal source:sink area ratio could be valuable for managing woodland, preventing hillslope-scale degradation and, potentially, maximizing productivity.

S.22 - Ecological indicators of environmental change

S.22-32-P

Edge effect on forest composition in an Atlantic Forest fragment, Brazil

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The emergence of an edge effect extent and magnitude is important in landscape planning, especially in strongly fragmented regions, which demand integrated handling among the several forest fragments with specific actions. The aim of this study was to evaluate and measure responses of edge effect in forest composition. The edge evaluations were performed in an altitudinal forest in Southeast Brazil, with collection of woodland species in 36 plots of 100 m² alternately arranged in three transects of 110 m. The variables used were: richness, indices of similarity, diversity and equability and successional stage. The statistical results (ANOVA and t-test) suggest an edge effect between 40 and 60 m. The values of distribution of richness, Shannon's diversity, Pielou's equitability and density of pioneer species had a decreasing linear behavior from the edge to the inside, with 60 m of edge effect. In the order hand, the similarity dendrogram suggest an effect of 40 m. The data were also interpreted under the point of view of vertical phytosociological structural analysis, which could identify two species as good indicators of edge effect extension: *Cupania vernalis* and *Trema micrantha*. *C. vernalis* showed an increment in the edge-inside direction, indicating 60 m of edge, while *T. micrantha* showed an opposite relation, being presenting in an edge of 40 m. Results this work presented some evidences about the measuring of edge effect with the use of biological indicators and further the influence of the structural characteristics of the forest edge over the response effects in composition.

S.29 - Sharing and harmonizing long-term ecosystem research and monitoring across Europe: contributions and experiences from the EnvEurope Life + project and the LTER-Europe network in 21 countries.

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A guest in an Information System: delegate functions in a model repository

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In this presentation, we will show the synergies between an information system and a model repository. Information Systems are designed to manage the information. The internal structure of the raw data and the procedures used to obtain useful knowledge are internal processes that are outside the scope of the end user. However, some users are expected to be able to use advanced tools in the context of a Global Change information system. These users require to know how data are structured, what are the relationships among data, etc. In order to meet these needs we have developed a tool called ModeleR, which allows you to extract most of the internal processes in the information system. ModeleR is a repository of models accessible from the web, which enables the user to design, document, manage, and execute Environmental Models. It feeds on the raw data the information system and provides feedback to the system through a set of Web Services. By integrating the information system with the model repository can display the metadata about environmental model that has processed the data.

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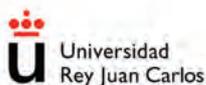
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