



# Iberian Meeting on Agroecological Research

Establishing the ecological  
basis for sustainable  
agriculture

**22/23**

November **2018**

**Évora** / Portugal



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agreco

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BOOK OF ABSTRACTS

# **I Iberian Meeting on Agroecological Research**

## Establishing the ecological basis for sustainable agriculture

22 / 23 November 2018 - Évora, Portugal

Agroecosystems as scenarios for biodiversity conservation

Linking biodiversity and ecosystem functions and services

Impact of farming practices on biodiversity and associated ecosystem functions

Agroecological restoration

Agroecosystems under global environmental change

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Évora, Portugal 2018

## **I Iberian Meeting on Agroecological Research**

Establishing the ecological basis for sustainable agriculture

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# **Iberian Meeting on Agroecological Research**

Establishing the  
ecological basis for  
sustainable agriculture

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**22/23** November **2018**  
**Évora** / Portugal

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## Programme

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## **1st Iberian Meeting on Agroecological Research**

Establishing the ecological basis for sustainable agriculture

Land conversion for agricultural purposes and the intensification of farming practices are major threats to ecosystems worldwide. Currently, nearly 50% of global land surface has been transformed by direct human action for agricultural purposes, with significant negative ecological and social consequences. In this unprecedented context, more environmentally sensitive farming practices are unquestionably required.

Agroecology is the study of the ecology of terrestrial agricultural systems. It provides a scientifically rigorous basis for sustainable croplands by taking into consideration all those ecological aspects that need to be addressed for the conservation management of production landscapes. Agroecology is thus aimed at guiding research and decision-making for food production and security, while committed with the conservation of biodiversity and its associated ecosystem functions and services, essential for sustainable agriculture.

In response to the burgeoning interest showed by researchers on agroecological studies in Spain and Portugal, the University of Évora, the Research Centre in Biodiversity and Genetic Resources (CIBIO – Évora) and the Institute of Mediterranean Agricultural and Environmental Sciences (ICAAM) organized the 1st Iberian Meeting on Agroecological Research (*ibagreco*).

The organization of *ibagreco* welcome you to Évora, and hope that you enjoy the visit, and find the programme of this first Iberian Meeting on Agroecology stimulating and thought-provoking.

Thursday **22** November 2018

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08:15 Registration

09:00 Opening Cerimony

### Session I

Chair: José M. Herrera

09:15 **Keynote speaker: José M. Rey Benayas.** Restoration in agricultural landscapes for enhancing biodiversity and its services without competition for land.

09:50 **Joana Santana.** Are farming systems useful indicators of biodiversity for high natural value grasslands?

10:05 **Adara Pardo.** Farmland biodiversity across diverse European agricultural systems: assessing the effect of Green and Blue Infrastructure.

10:20 **Ana Costa.** Seasonal variations in the effect of structural complexity of olive production systems on bat activity: implications for natural pest control services.

10:35 **Ana I. Leal.** Does grazing affect ground-foraging birds in Mediterranean agroforestry systems?

10:50 **Elena Velado-Alonso.** Exploring livestock biogeographical regions. A tool for agro-ecological planning and nature conservation.

11:05 Coffee Break

### Session II

Chair: Hugo Rebelo

11:30 **Nereida Melguizo Ruiz.** Soil communities under pressure: agricultural intensification impacts invertebrate abundance and diversity.



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- 11:45** **Evan A. N. Marks.** Management and evolution of rural green infrastructures for pollinator protection.
- 12:00** **Carmelo Gómez-Martínez.** Bumblebees' community composition and pollination specialization change in response to habitat fragmentation in an agricultural landscape in southern Norway.
- 12:15** **Pedro Costa.** Cattle-driven forest disturbances impact ensemble composition and activity levels of insectivorous bats in Mediterranean wood pasture.
- 12:30** **Alejandro Trillo.** Use of commercial bumble bees to pollinate strawberry crops and their spillover to natural habitats.
- 12:45** **Margarita Reverter.** Effects of crops on the space use and habitat quality of steppe birds: the Dupont's lark case.
- 
- 13:00** **Lunch** - Room 129

## Session III

**Chair:** Sónia Santos

- 14:15** **Keynote speaker: Pedro Beja.** Mainstreaming DNA metabarcoding in agroecology: a short review on challenges and opportunities.
- 14:50** **Sasha Vasconcelos.** Cascading effects of olive farm intensification on phytophagous insects and their natural enemies.
- 15:05** **Francisco M. Usero.** Influence of organic matter availability on plant-soil interactions.
- 15:20** **Aitana Ares.** Towards sustainable agriculture: Innovative solutions for Psa from the microbiome of *Actinidia deliciosa*.
- 15:35** **Alicia Tenza.** Supporting decision-making processes: evaluation of policy options to the sustainability of a small agro-system in the face of climate change.
- 
- 15:50** **Coffee Break**

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### Session IV

**Chair: Ignasi Bartomeus**

- 16:15 Unai Baroja.** Bats take advantage of numerous pest arthropods in vineyards systems: a metabarcoding approach.
- 16:30 Amparo Lázaro.** Disentangling direct and indirect effects of habitat fragmentation on pollination service: natural communities within agricultural landscapes.
- 16:45 Violeta Hevia.** Exploring the effect of a green infrastructure on wild bee abundance and pollination services in adjacent sunflower fields.
- 17:00 Rui Morgado.** The effects of olive farming intensification on Mediterranean breeding bird assemblages.
- 17:15 Ana Júlia Pereira.** Effects of human management on the diversity of plant communities associated to traditional Mediterranean olive groves.
- 17:30 Pedro Reis.** Traditional olives groves: the agroecology as the best path.
- 17:45 Poster session - Room 115**
- 18:35 Cocktail - Room 129**

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08:15 Registration

### Session V

Chair: Amparo Lázaro

- 09:00 **Keynote speaker: Montserrat Vilà.** Biological invasions and agroecosystems.
- 09:35 **Ignasi Bartomeus.** Species turnover promotes the importance of bee diversity for crop pollination at regional scales.
- 09:50 **Maria José Leiva.** Diversity at different organization levels. Importance for biological pest control in agroecology - A review.
- 10:05 **Jonatan Rodríguez.** Methods to control the invasion of *Acacia melanoxylon* for recovering native agroforestry systems.
- 10:20 **Alberto Jiménez-Gómez.** Málaga community gardens: review and future perspectives.
- 10:35 **José Muñoz-Rojas.** What drives land-use changes and their sustainability in Mediterranean agro-ecosystems?: a view from SW Iberia.
- 10:50 **Telmo Costa.** Impact of family farming practices in the environment.

11:05 Coffee Break

### Session VI

Chair: Javier Rodríguez-Pérez

- 11:30 **Sara Palomo-Campesino.** Exploring the connections between agroecological practices and ecosystem services supply: A systematic literature review.
- 11:45 **Luis Pablo Ureña Cámara.** Consumers' valuation of pasture-based livestock products through sustainability attributes.

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- 12:00 **Mariana Couto.** Bringing transhumance back to life as an option for the future: collection of nine years de experience.
- 12:15 **César Fernández-Quintanilla.** Using a middle-way strategy for weed management in dry-land cereal systems in Central Spain.
- 12:30 **María Almagro.** Plant residue quality mediate soil organic matter stabilization in an organic rainfed Mediterranean woody cropping system.
- 12:45 **Eva Hernández Plaza.** Functional characterization of weed communities help to explain their effects on crop performance.

13:00 **Lunch**

## Open Session

- 14:00 **Keynote speaker: Stéphane Bellon** (INRA). Agroecology in action - Institutionalization at the interface between science, practices, social movements and public policies.
- 14:20 **María Bastidas** (LIFEMONTADO-ADAPT Project). Climate adaptation at farm level: the experience of the LIFEMontado-Adapt project.
- 14:40 **Gonzalo Palomo Guijarro** (Mosaico Project). A participatory strategy for fire prevention in Alta Extremadura.
- 15:00 **José Eugenio Gutiérrez** (LIFEOLIVE-ALIVE project). Designing an olive cultivation model to recover biodiversity and profitability.

15:20 **Coffee Break**

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- 15:50** **Teresa Pinto Correia** (ICAAM). Sustainable agriculture: from science to practice.
- 16:05** **Nuno Oliveira** (Esporão S.A.). Fostering a Science-Based Cooperative Ecosystem in Organic Vineyard Management.
- 16:25** **Enrique Vega Rubio** (Finca Casablanca). Grazing management in pasture ecosystems.
- 16:45** **Open discussion**, moderated by Teresa Pinto Correia.
- 17:35** **Ibagreco 2018 Closing Ceremony**

## Invited talks

## **Restoration in agricultural landscapes for enhancing biodiversity and its services without competition for land**

José M. Rey Benayas

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Landscape transformation due to agriculture affects ca. 40% of the planet's land area and is the most important driver of losses of biodiversity and its services (ES) worldwide. There is a range of possibilities within two contrasting types of intervention to enhance biodiversity and ES in farmland, namely “land separation” and “land sharing”. Land sharing or wildlife-friendly farming may incorporate “farmland manicure” actions, which involve restoring or creating target elements to benefit wildlife and particular ES without competing for land – e.g. introduction of living fences, woodland islets, ponds and shelter for wildlife. These actions allow wildlife enhancement, provision of a range of ES such as connectivity, pest regulation, maintenance of farmland production, and conservation of values linked to cultural landscapes. In contrast, restoration by land separation, e.g. secondary succession following farmland abandonment and tree planting, would provide all these benefits only at the landscape or regional scales. Strategic revegetation including living fences, road sides, riparian systems and woodland islets are an alternative to designing ecological restoration in extensive agricultural landscapes, and their benefits are well documented in the scientific literature. However, guidance for large-scale restoration of such green infrastructure to provide multi-functional landscapes is often lacking. I explain a suite of guidelines that have been applied to planning projects in the Mar Menor south basin (SE Spain) and the Araucanía (South central Chile). I also provide a practitioner's perspective related to land-sharing restoration actions in central Spain, namely the Fields for Life project with the motto “We produce food and biodiversity”. Practical restoration projects are essential if we want to halt biodiversity loss and encourage the return of wildlife in agricultural landscapes.

## **Mainstreaming DNA metabarcoding in agroecology: a short review on challenges and opportunities**

Pedro Beja

*CIBIO – Universidade do Porto, Porto, Portugal.*

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The advent of ever more powerful DNA sequencing technology has opened up possibilities in the biological sciences that were unimaginable just a decade ago. The field of agroecology is no exception, with DNA barcoding in combination with high-throughput sequencing (metabarcoding) generating unprecedented capacity to describe complex ecological patterns and processes in agricultural systems. However, mainstreaming these new tools in agroecological research has remained relatively slow, mainly because they still involve a range of conceptual, methodological and technical challenges. Here I provide an ecologists' perspective on barcoding and metabarcoding, using the experience gained at my lab to illustrate the power and some limitations of these molecular tools. First, I show the importance of building comprehensive barcode reference collections to achieve ecologically meaningful taxonomic identifications. This is challenging, but by working closely with taxonomists we have been able to assemble a collection of >1500 arthropod species, which helped detecting new exotic species, solving some taxonomic problems, and highlighting many others that warrant further investigation. Second, I discuss the need to optimise field, lab and bioinformatics pipelines in relation to the specific research questions in agroecology. The considerable efforts required to meet this general goal are illustrated through case studies assessing impacts of biological and technical replication on metabarcoding results, testing multi-marker approaches to overcome primer biases, and developing procedures for non-destructive metabarcoding of invertebrate bulk samples. Third, I present some practical applications showing how the high taxonomic resolution achieved through metabarcoding can provide major insights on biotic interactions and on community assembly of nocturnal arthropods in agroecosystems. Finally, I take a look into oncoming technological developments that will provide further opportunities to agroecological research.



## **Biological invasions and agroecosystems**

Montserrat Vilà

*Spanish National Research Council, Estación Biológica de Doñana (EBD-CSIC), Sevilla, Spain.*

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The introduction and invasion of non-native species can affect the biodiversity and functioning of natural systems, many of which are embedded in cultural landscapes that form mosaics with agricultural systems. Many introduced non-native species are weeds, pests and pathogens affecting the services provided by productive systems such as agricultural land and forests. In this talk, I will expose some general patterns on the distribution, diversity, pathways of introduction, and impacts of invasions. By focusing mainly on plant invasions, I will also describe examples on how non-native species can be dispersed across natural and agricultural systems. Finally, I will synthesize how different components of global change influence invasions in agricultural systems.

## **Agroecology in action - Institutionalization at the interface between science, practices, social movements and public policies**

Stéphane Bellon

*French National Institute for Agricultural Research (INRA), Avignon, France.*

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Agroecology has come a long way, and currently faces new challenges. It has rapidly moved from the margins and taken a central role in research agendas, in the worlds of ecologically-based agricultures and social movements, as well as in public policies. Likewise, international environment and development institutions increasingly consider it can contribute to achieve sustainable development goals. This new dynamic questions both the identity and the scope of agroecology, as compared with its conceptual foundations and its potential to transform agriculture and food systems. Agroecology is scientifically rooted, and increasingly presented as a transdisciplinary, participatory and action-oriented approach. It departs from a classical linear transfer of knowledge and advocates alternative patterns to circulate knowledge, building on farmers' know-how and skills. It also provides another way of thinking of our relationship to nature, considered as a partner co-evolving with human societies. Whereas a dualism between nature and culture was a basis to design industrial agriculture, agroecology intends to technically act *with* nature, and no more *on* nature. Food production and reproduction of resources – as well as techniques and ecological processes – appear as two sides of the same coin. Agroecology also includes normative dimensions. Although it cannot be reduced to a specific technological regime, agroecological practices are manifold. They are based on a set of principles and various ecological processes (e.g. nutrient cycling, biological N fixation, natural regulation of pests, soil and water conservation, biodiversity conservation, carbon sequestration). Their combination in space and time contributes to the redesign of agricultural systems connected both with the environment and with those who eat food, i.e. all citizens... agroecological transitions also entail research questions (e.g. valuing biodiversity; supporting collective actions at landscape or territory level; defining assessment methods likely to account for an agroecological program...).

## **Sustainable agriculture: from science to practice**

Teresa Pinto Correia

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Long-lasting and productive linkages between science and practice require to step outside the classical linear approach of knowledge transfer, to engage into an interactive process based on cooperation and partnership. Within such renewed paradigm, in order to contribute to increased sustainability in the farming sector, research needs are defined and identified together by farmers and foresters, researchers, advisers and other actors, working side-by-side. Jointly the question is formulated and solutions are co-constructed. The collaboration between various actors makes it possible to make the best use of complementary knowledge types. Progressing into this type of approach for increasing innovation in the farming sector is a strong concern of the present European research funding within the agricultural sector and the reason behind the action of the EIP-Agri, acting at European level with close linkages to the national Rural Networks. In this presentation, we present the fundamentals of the co-construction of knowledge and its main goals, specifically addressing the sustainability of agriculture. Following, through the example of the Tertúlias do Montado, a series of regular and facilitated meetings gathering multiple actors with a stake in Montado silvo-pastoral system, and taking place in the region of Alentejo since 2016, we discuss the potentialities and constraints of such collaborative processes.

# Oral presentations

## Session I - Chair: José M. Herrera

### Are farming systems useful indicators of biodiversity for high natural value grasslands?

**Santana, Joana**<sup>1,2</sup>; Leitão, Pedro J.<sup>3,4</sup>; Ribeiro, Paulo Flores<sup>5</sup>; Lomba, Ângela<sup>1</sup>; Pedroso, R.<sup>6</sup>; Morgado, Rui<sup>2</sup>; Martins, Ricardo C.<sup>7,2</sup>; Catry, Inês<sup>1,2</sup>; Marques, Ana T.<sup>7,2,8</sup>; Reino, Luís<sup>1,2</sup>; Beja, Pedro<sup>9,2</sup>; Moreira, Francisco<sup>7,2</sup>

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**Keywords:** agricultural practices; biodiversity conservation; farmland management; habitat composition; steppe birds

The farming system approach has been recently pointed out as a comprehensive and useful tool to support the design of conservation actions targeting high natural value farmland. Although the effects of farming practices and land use patterns on biodiversity are well established, there is a knowledge gap on whether farming systems can be taken to indicate biodiversity patterns in agricultural landscapes. Here, we develop a case study to evaluate this, analysing the ability of models developed using information on either farming systems or habitat composition, or both, to explain grassland bird diversity patterns. Breeding birds were surveyed in the Special Protection Area of Castro Verde, southern Portugal, through 385 5-min point counts in the spring of 2017. Spatial variation in the richness and occurrence of bird assemblages and in the occurrence of individual species was then modelled in relation to variables describing farming system typology and habitat composition descriptors. We found that species richness models based on habitat composition variables had more explanatory power than those using only farming systems. However, combining farming system and habitat composition variables improved the performance of richness models and the occurrence models for some species. Overall, we conclude that farming system information does not explain bird species occurrence as well as traditional habitat models, but it can contribute to increase model explanatory power by incorporating information related to management practices that may have an impact on birds.

Acknowledgements: this research was funded by FARSYD project – ‘FARming SYstems as tool to support policies for effective conservation and management of high nature value farmlanDs’ (POCI-01-0145-FEDER-016664- PTDC/AAG-EC/5007/2014). R.M., I.C., A.T.M., L.R. and F.M. were supported by Fundação para a Ciência e a Tecnologia (FCT) grants SFRH/BD/99746/2014, SFRH/BPD/102637/2014, SFRH/BD/100147/2014, SFRH/BPD/93079/2013 and IF/01053/2015, respectively. R.C.M. work was carried out in the framework of REN Biodiversity Chair, funded by REN - Redes Energéticas Nacionais and FCT.

## Farmland biodiversity across diverse European agricultural systems: assessing the effect of Green and Blue Infrastructure

**Pardo, Adara**<sup>1</sup>; Rolo, Víctor<sup>1</sup>; Concepción, Elena D.<sup>2</sup>; Díaz, Mario<sup>2</sup>; Aneva, Ina<sup>3</sup>; Lukanov, Simeon<sup>3</sup>; Oppermann, Rainer<sup>4</sup>; Schraml, Antonia<sup>4</sup>; Ullrich, Benjamin<sup>4</sup>; Moreno, Gerardo<sup>1</sup>

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**Keywords:** Agricultural intensification, CAP greening, Farmland biodiversity, Green and Blue Infrastructure

The ongoing decline in biodiversity and related ecosystem functions and services in agricultural landscapes is a source of major concern. This biodiversity loss is primarily driven by agricultural intensification, which has led to the disappearance of seminatural habitats and landscape elements which are essential for ensuring ecological connectivity and biodiversity conservation. These include habitats and elements such as field margins, ponds, streams, hedges or grassland, currently referred as Green and Blue Infrastructure (GBI). A key instrument at the EU level that could help to mitigate this loss is the greening scheme of the Common Agricultural Policy (CAP), which has introduced compulsory agri-environment requirements in order to support the conservation of GBI. However, requirements and their level of implementation differ substantially across Member States, which contributes, together with the type of agricultural system, to the variation in GBI characteristics. We study how differences in GBI types and abundance affect biodiversity indicators, namely bird and plant richness. We count with six case study areas in three European countries that cover a variety of agricultural systems (i.e., grasslands in Bulgaria, mixed farming systems in Germany, and dehesas and dry cereal croplands in Spain). In each case study area, we carried out habitat (GBI) and biodiversity (bird and plant) monitoring surveys in 20-25 plots (25 ha each) in spring 2018. Results will help to identify most favourable GBI elements and habitats for farmland biodiversity conservation and to better understand the ecological effectiveness of CAP greening measures.

## Seasonal variations in the effect of structural complexity of olive production systems on bat activity: implications for natural pest control services [S]

**Costa, Ana<sup>1</sup>**; Silva, Bruno<sup>1</sup>; Barreiro, Sílvia<sup>1</sup>; Jiménez-Navarro, Gerardo<sup>1</sup>; Herrera, José M.<sup>1</sup>

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**Keywords:** biocontrol services; foraging; landscape structure; olive farming; *Prays oleae*

Management intensification has led to an increase in the homogenization of agricultural landscapes, specially in Mediterranean olive farms. Latter pattern represents one of the major causes of decline in the activity of many species over this habitat, including bats which are an important component of agricultural ecosystems by controlling insect populations. To understand how seasonal variations affects bat occurrence in olive production systems, we sampled olive groves with different structural complexities in spring, summer and autumn in Alentejo, southern Portugal. These seasons coincide with the peak activity of *Prays oleae*, one of the major pests of olive production systems. To better understand if it's possible for bats to control populations of latter pest, we surveyed bats by acoustic methods during three consecutive nights per season at each olive grove and the olive fruit moth with Delta traps that stayed in the field for 15 days, overlapping the period in which bat monitoring was carried out. Of all recorded species, *Pipistrellus kuhlii* was, by far, the most abundant, followed by *P. pygmaeus* and *P. pipistrellus*. Our results indicate strong differences in the activity of pipistrelle bats to the structural complexity of olive production systems. Moreover, we found that these differences were strongly season-dependent. Both *P. kuhlii* and *P. pygmaeus* were more active in more structurally complex olive groves, specially during summer when the avoidance of lower structural olive groves is very strong. During autumn however, *P. pygmaeus* activity is quite similar regardless the structural complexity. For *P. pipistrellus*, no significant differences were found across structural complexity in any of the seasons. Our results suggest that habitat heterogeneity is of high importance for bat activity, specially during spring and summer, implying that structurally-complex agricultural landscapes could promote higher natural pest control services provided by bats.



## Does grazing affect ground-foraging birds in Mediterranean agroforestry systems?

**Leal, Ana I.<sup>1,2</sup>; Acácio, Marta<sup>3</sup>; Meyer, Christoph F. J.<sup>4</sup>; Rainho, Ana<sup>1</sup>; Palmeirim, Jorge M.<sup>1</sup>**

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**Keywords:** Wooded pastures; Grazing impact; Ground-foraging birds; Conservation; Agroecosystems

The main objective of this study was to investigate how grazing affects wintering ground-foraging birds in Mediterranean agroforestry systems, thus contributing to the knowledge required for a science-based management of these valuable ecosystems. During winter 2012, we carried out an experiment in a wooded grassland in Portugal, whereby grazing was controlled in 12 purposely fenced two-hectare plots submitted to three grazing regimes: no grazing, 3 sheep/ha and 15 sheep/ha. In every plot we quantified ground habitat features, food abundance and intensity of use by ground-foraging birds. We found that, independently of grazing level, virtually all birds preferred to forage in patches with short ground vegetation and high food abundance. Measurements of latter parameters in the experimental plots showed that while grazing shortens vegetation, it decreases food availability, and thus had opposing effects on important determinants of habitat suitability for birds. Bird responses to grazing regimes were mediated by their foraging strategies: species whose foraging strategy involves longer displacements on the ground were benefited from grazing, presumably because they gain most from the reduction in vegetation clutter. Species with other strategies, as short feeding forays to the ground, did not respond to grazing or, in a few cases, were negatively affected by it. Most bird species that forage on the ground benefited from grazing, and although they could forage under a broad range of grazing levels, some showed clear preferences along the gradient of grazing intensity. In general, grazing should be maintained at a level sufficient to open up ground vegetation, increasing the area occupied by patches of short vegetation, in which almost all bird species prefer to forage. Thus, at moderate levels, grazing can be an important management tool to promote winter bird habitat quality in Mediterranean agroforestry systems, while increasing the economic value of these threatened landscapes.

## Exploring livestock biogeographical regions. A tool for agro-ecological planning and nature conservation [S]

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**Keywords:** Local Breed; Livestock; Agroecology; Biogeography; Conservation

Extensive livestock breeding systems have had a relevant role on the economy and shaping landscapes in Spain. In fact, Spain has a significant number of local breeds linked to traditional agroecosystems, which have high natural and biodiversity values. Nevertheless, the transformation of rural life and the production systems in the last decades has led to simultaneous processes of intensification and abandonment, resulting in the lack of use of this kind of animals. The relationship between local breeds and environmental conditions remains poorly known, in particular, local breed conservation actions are not considering these aspects. Therefore, we propose an analytically derived regionalization of peninsular Spain based on the interaction of the local breeds with a selection of ecological factors. The original area, of each of the 129 bovine, ovine, caprine and equine breeds, has been jointly analysed with environmental variables: static and dynamic climate, topography, lithology, potential net primary production and vegetation type. A preference index and null models have been used to assess the relationships between breeds and environmental variables. Also, Nonmetric Multidimensional Analysis has been performed to analyze the main ecological and biogeographical patterns. Our results have shown 6 differentiated bioregions for bovine, 5 for ovine and equine and 4 for caprine, reflecting the general importance of climate and topography on the breeds' distribution. We can deduce that, despite the relevant human influence on the breeds' distribution, the different species have a specific response to the land's biogeographical structure. These results set a basis to underpin the design for sustainable livestock systems adapted to natural conditions and able to promote biodiversity conservation.

## Session II - Chair: Hugo Rebelo

### Soil communities under pressure: agricultural intensification impacts invertebrate abundance and diversity

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**Keywords:** Soil food-webs; agricultural intensification; Mediterranean olive groves; functional groups; conservation

A major issue in applied ecology and conservation is to assess the impact that agricultural intensification can have on animal communities and biological diversity. Agriculture negatively affects biodiversity through the conversion of complex natural ecosystems into simplified, cultivated crops, and the intensification of management practices on such converted areas. While many studies focus on intensification impacts on predatory vertebrates or arthropods considered as natural enemies, research on the effects of the different management practices on entire communities, and specially on soil communities as a whole, is scarce. Here we investigated the effect of agricultural intensification on soil food webs of Mediterranean olive groves from the Alentejo region. Soil invertebrates were sampled in 45 sites that were under different management systems, conforming a gradient of agricultural intensification -from organic to super-intensive olive groves. All the animals were counted, measured and identified to the lowest taxonomic level needed to classify them into functional groups. There were significant differences in the total abundance of soil animals among management systems, although specific practices such as the use of agrochemicals appear to have stronger effects beyond conventional classifications. Moreover, we found a major decline in soil fauna diversity with management intensification, with lower numbers of taxonomic groups in intensive and super-intensive groves. Some functional groups, such as microbivores and fungivores (including the most abundant taxa, i.e. oribatid mites and springtails) were negatively affected by herbicides, likely due to the absence of herbs and shrubs. These preliminary results thus suggest that the use of agrochemicals, along with other management practices, may severely impact soil food web structure, potentially altering associated ecosystem functions in Mediterranean olive groves.

## Management and evolution of rural green infrastructures for pollinator protection

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**Keywords:** Green infrastructure; pollination; floral resources

Agro-environment schemes promoting pollinator resources are likely to play an increasingly important role in European Common Agricultural Policy. The Poll-Ole-GI SUODE project is currently testing the implementation of floral patches for enhancement of the pollination ecosystem service in sunflower – a crop dependent on entomophilous pollination – which could result in win-win benefits for biodiversity protection and crop productivity.

The Iberian context for the establishment of such “rural green infrastructures” is discussed, and the rationale for the implemented design is explained. In this study, we compare sunflower fields without any natural refuge for pollinators (NON), fields with natural green infrastructure (NGI) and the implemented flower patches (EGI). A model of field implementation of ¼ ha EGIs, along with associated economic costs, is presented. We describe the temporal evolution of the flower patches and discuss aspects related to management and effectiveness. We present preliminary entomological results from the Burgos region 2017 campaign, where insect abundance and diversity were assessed both before and during the sunflower flowering period. Sunflower plots adjacent to flower patches seem to have served as refuges for bees (abundance) before the sunflower bloom, and also fostered bee diversity (species number) during the bloom. We argue that the implementation of this kind of rural green infrastructure is an economical and effective greening measure. The implementation of small pollination islands resulted in the enhancement of both insect abundance and diversity in the short-term (5 months). To date, in the Iberian Peninsula there has been very little guidance on the temporal and spatial planning of pollinator-promoting agro-environment schemes, and these results are the first demonstrating measureable ecological benefits in extensive cereal-sunflower cropping systems.

## Bumblebees' community composition and pollination specialization change in response to habitat fragmentation in an agricultural landscape in southern Norway

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**Keywords:** *Bombus*; flower abundance; isolation; percentage of forest; pollination network

Land-use changes, as farming intensification or loss and fragmentation of semi-natural grasslands, have been suggested as the triggers of global bumblebee decline. However, the effects of landscape alteration on bumblebee communities and their pollination interactions are not yet well understood. Here, we aim to understand the role that landscape (patch isolation and complexity, percentage of forest in the 500 m buffer zone) and local variables (flower abundance and richness) have on the abundance, richness and pollination specialization (network metrics: H2', linkage level, d') of bumblebee communities in agricultural landscapes. For that, we used data on bumblebee visits to 24 semi-natural grasslands located on a fragmentation gradient in southern Norway. The percentage of forest surrounding the fragments and the local flower abundance were the variables affecting the most bumblebee abundance and diversity, although the strength of their effect varied along the season and among the bumblebee species. In general, bumblebee responded positively to flower abundance, being *B. pascuorum* and *B. terrestris* those that increased visitation the most in response to flower number. However, the percentage of forest in the landscape was positively related to the visitation of some species (*B. pascuorum*, *B. lapidarius*, *B. hypnorum*), whereas negatively influenced other species' visitation (*B. terrestris*, *B. nigrifrons*). Overall bumblebee abundance was reduced as the isolation of patches augmented, and species richness was positively related to flower abundance. Regarding pollination interactions, specialization measured both at network (H2') and species level (linkage level, d') decreased as floral abundance and the percentage of forest increased. Network specialization (H2') also varied along the season and increased with plant richness. Overall, our study shows that habitat fragmentation in agricultural landscapes modifies the composition of bumblebee communities and affects niche breadth of particular species.

## Cattle-driven forest disturbances impact ensemble composition and activity levels of insectivorous bats in Mediterranean wood pastures

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**Keywords:** Cattle grazing; Conservation management; Forest loss and fragmentation; Insectivorous bats; Vegetation regeneration

Forests can be modified by fine-scale disturbances such as those prompted by cattle grazing, but their impacts on biodiversity are far from being understood. Here, we investigate the response of insectivorous bats to cattle-driven forest disturbances, using a savanna-like Mediterranean agroforestry system, the Portuguese montado, as study system. In doing so, we compared bat ensemble composition and activity levels of bats across sites that differed in how frequently they were used by free-ranging cattle. Specifically, we selected sites regularly used by cattle (central places) and sites seldom used (grazing sites). We found strong between-site differences in both bat species composition and activity levels, with lower diversity and activity in central places compared to grazing sites. These response patterns, corresponded to marked between-site differences in tree cover, seemingly driven by cattle use given the lower levels of tree regeneration and vegetation productivity in central places compared to grazing sites. Our work therefore demonstrates that it is not only severe forest loss and fragmentation that has an impact on insectivorous bats, but also when these processes operate at fine spatial scales. We thus suggest that fine-scale forest disturbances, particularly those driven by recurrent cattle use, cannot be neglected in the conservation management of agroforestry systems. In this context, we propose some management strategies aimed at counteracting the impact of cattle-driven disturbances on biodiversity in general, and on insectivorous bats in particular.

## Use of commercial bumble bees to pollinate strawberry crops and their spillover to natural habitats [S]

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**Keywords:** *Bombus terrestris*; cross-habitat spillover; pollen diet; *Fragaria × ananassa*; fruit weight

The area devoted to pollinator-dependent crops and the use of commercial pollinators are increasing across agroecosystems globally. However, the role of commercial pollinators in the pollination function may depend on the presence of other flower visitors. Moreover, commercial pollinators have ample diet and thus, they may forage beyond crops where they can interact with native pollinators. I will present some results from my thesis on the use of commercial bumble bees to pollinate strawberry crops in Huelva. We found no effect of adding commercial bumble bees to strawberry fruit weight because of the pollination services provided by the community of pollinators present in the area. Further, we found that bumble bees spillover from crops to adjacent natural habitats where they showed large overlap in exploited floral resources with native bumble bees. These results suggest the need to assess the efficiency of the use of commercial pollinators in pollinator-dependent crops to prevent detrimental effects on the wild pollinator community.

## Effects of crops on the space use and habitat quality of steppe birds: the Dupont's lark case

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**Keywords:** Crops; food availability; hypogeous arthropods; microhabitat; steppe birds

Practices related to agricultural intensification can produce negative effects on vegetation structure and/or food availability not only on crops, but also in their surroundings. Such practices, in turn, may negatively affect the use of space by farmland birds. In this study we evaluated the effect of crops on the space use and the habitat quality of the Dupont's lark (*Chersophilus duponti*) in one of the most important areas for the species in the Iberian Peninsula. During spring (2016 and 2017) and autumn and winter (2016), we carried out bird censuses and sampling of vegetation structure and food availability within and around 7 crops in one locality in the study area. The intensity of space use by the Dupont's lark was calculated using a Kernel density function on the locations of species territories. Habitat quality was determined by sampling vegetation structure and food availability within, and at increasing distances to crops (i.e. 1, 10 and 50m). Variables of vegetation structure were summarized by Principal Components Analysis (PCA). Linear Mixed Models (LMM) and model averaging were used to estimate differences in the intensity of space use by the species depending on crop distance, vegetation structure and food availability, controlling for sampling date. Crop distance affected both vegetation structure and the intensity of space use by Dupont's lark. Biomass of hypogeous arthropods significantly decreased when distance from the crop was lower than 50m. The intensity of space use by Dupont's lark was positively related to the hypogeous arthropod biomass and it varied according to the sampling date. Our results suggest negative effects of crops on the species, which might be shaped both by the crop itself and by its effect on hypogeous arthropods abundance. These results also highlight the existence of a negative buffer of 10-50m around cultivated areas, which may have consequences on the effective area of optimal habitat available for the species.



### Session III - Chair: Sónia Santos

#### Cascading effects of olive farm intensification on phytophagous insects and their natural enemies [S]

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**Keywords:** Conservation; agricultural intensification; Mediterranean olive farms

Olive farms are progressively expanding in the Mediterranean region, and have undergone a process of management intensification over the last two decades. Organic farm management that relies mostly on natural pest control, and traditional low-intensity farming involving low agrochemical input, are rapidly giving way to high-intensity regimes with very high agrochemical application. However, in spite of this widespread intensification process, little is known of its consequences for biodiversity and associated ecosystem services, such as natural pest control. To address this issue, we examined the abundance of phytophagous insects and their natural enemies (predatory arthropods and parasitoid wasps) across farms under different levels of management intensity, ranging from largely unmanaged to superintensive farms. Sampling was carried out in southern Portugal. Sixty sampling points within 38 olive farms were visited in Spring, Summer and Autumn, and canopy arthropods were vacuum-sampled. Preliminary results revealed significant declines in the abundance of some focal *taxa* in the most intensive regimes, suggesting that the growing application of chemical pesticides and fertilizers may be influencing the dynamics of plant-feeders and their controllers in Mediterranean olive farms.

## Influence of organic matter availability on plant-soil interactions [S]

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**Keywords:** Soil microbial communities; greenhouse; organic matter; organic agriculture

Intensive greenhouse vegetable production is one of the most important economic sectors in south-east Spain. Intensification has greatly limited the application of organic matter, leading to soil problems and production loss. Organic matter is managed in different ways, ranging from conventional crop management without organic matter addition, to organic approaches with regular additions. We studied the effects of different greenhouse soil managements on microbial communities and the effect of these soil communities on crop productivity. We selected greenhouses with a conventional management, without organic matter application in the preceding 10 years, a conventional management with organic matter application within the preceding 5 years, and an organic management, with yearly applications of organic matter. Soil samples from 5 greenhouses per management type were used to extract inocula of each soil microbial community, adding 150 mL of each to 3 L pots with a common substrate of peat:sand (2:1 v/v). Tomato seeds of a commercial variety were sown with one established plant per pot that were kept in an experimental greenhouse for 2 months. Two additional inoculations were applied every 30 days. We measured photosynthesis, plant biomass and specific leaf area (SLA), and analysed soil nutrients as well as fungi and bacterial abundance in original soils and pots substrates after the first inoculation and at the end of the experiment. Original soils had no differences in bacterial or fungi abundance between managements. Pot substrates showed higher bacterial abundance and plants grew more and had greater photosynthetic rate when soils were inoculated with microbial communities from organic greenhouses compared to those from greenhouses under conventional management, i.e., without organic matter application. There were no differences in SLA between treatments. Our data suggest that soil microbial communities associated to greenhouse organic management had an overall positive effect on crop productivity.

## Towards sustainable agriculture: Innovative solutions for Psa from the microbiome of *Actinidia deliciosa*

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**Keywords:** *Actinidia deliciosa*; *Pseudomonas syringae* pv. *actinidiae* (Psa); microbiota; antagonist

One way to foster sustainable agriculture is through the integration of beneficial microorganism. Research focused in the role of endophytic bacteria is an innovative approach that allows the identification of naturally occurring bacteria, of specific taxonomic groups, and test them for their potential use as antagonist or as enhancers of plants' defense mechanisms against pathogens. Structural characterization of *Actinidia* sp. microbiota and the prediction of the bacterial community's functional potential will serve as a baseline to identify microorganisms bacteria and/or groups of bacteria with potential antagonist capacity or with potential role on the modulation of kiwifruit bacterial canker. The present study aimed to determine the structural bacterial diversity from leaves of healthy female and male plants of *A. deliciosa* and compare it with the structural bacterial diversity determined from leaves of Psa infected plants of *A. deliciosa*, in two orchards of Portugal. Five female and five male plants were selected from the healthy and infected orchards. From each plant, 10 leaves were handpicked in two occasions: June (spring) and October (autumn) of 2016 and combined as composite samples. Composite samples were used for isolation of microorganisms and for total genomic DNA extraction. The 16S rRNA gene sequence Illumina tags structural bacterial diversities determined, shown that: phylum *Proteobacteria* encompassed 84% of the sequences, and that genus *Pseudomonas* was dominant, followed by genera *Sphingomonas*, *Methylobacterium* and *Hymenobacter*. In infected female plants Psa, alone or coupled with other species of *Pseudomonas*, practically eliminated other three major genera identified in healthy orchard during spring. However, in autumn there is a shift with species of *Pseudomonas* being detected as minor populations while an increase of bacterial communities of genera *Methylobacterium* is observed. So, our results show that in spring there is a clear gender distinction in the structural bacterial diversity between diseased female and male plants. In the future, the isolated strains will be screened according with the 16S rRNA gene tags results, so that specific phylogenetic groups can be tested and integrated into strategies for prevention and/or mitigation of Psa infection.

## Supporting decision-making processes: evaluation of policy options to the sustainability of a small agro-system in the face of climate change

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**Keywords:** rural development; dynamic model; social-ecological system; vulnerability; resilience

Small-scale agro-systems in arid environments are relevant for global sustainability and food security. The sustainability of these systems is challenged by rapid socio-economic and environmental changes on larger scales. Here we present the advances of long-term, place-based research of a small-scale agro-system, the oasis of Comondú, in Baja California Sur Mexico, which has witnessed sharp depopulation in recent decades. Our study builds on a dynamic simulation model that simulates the historical behaviour of the main variables related to the depopulation process of this agro-system. Global drivers of change (i.e. rainfall, hurricanes and market prices) have strongly influenced this agro-system's dynamics, especially the climatic ones. Through a participatory workshop, in-depth interviews and literature review about the oasis, we identified the management options proposed by the local stakeholders for the future of the oasis. We used the dynamic simulation model to assess the efficiency of each management option and the combination of them to accomplish the sustainability goals of recovering the population and improving the socio-economic indicators. We evaluated this under different regional climate change scenarios. The management options were focused on local traditional activities of agriculture and livestock (e.g. improved production yields and increased added value of products), and on tourism development. The management options centred on the traditional activities had best results, especially those aimed to increase the added value of agriculture and livestock products, under the climatic scenarios where the average rainfall is expected to increase. However, under the unfavourable climatic scenarios, the traditional activities were seriously affected, because they strongly depend on rainfall. In these scenarios, the resilience of the system is strengthened by complementing the traditional activities with the endogenous tourism development, a non-land-based activity. We hope to support decision-making processes that aim to foster the sustainability of this system in a desirable state.

## Session IV - Chair: Ignasi Bartomeus

### Bats take advantage of numerous pest arthropods in vineyard systems: a metabarcoding approach [S]

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**Keywords:** sustainability; vineyards; bats; pest suppressors; *Rhinolophus hipposideros*

There is an increasing demand for a sustainable crop production as well as protection against damage caused by pests, that is fuelled by the human population growth and the concerns about future food availability. Insectivorous bats are major predators of herbivorous arthropods and act as suppressors of several pests. In this study, we 1) aimed to study the seasonal diet of bats foraging in vineyards and identify the pest consumption through metabarcoding of faecal pellets collected in vineyards at The Basque Country and 2) compare the bat consumption patterns of the two major grapeberry pests in the region, i.e. the European grapevine moth *Lobesia botrana* (LOB) and vine leaf-roller moth *Sparganothis pilleriana* (SPA) with the seasonal fluctuations in LOB and SPA populations. We used two primers sets to perform a Next Generation Sequencing approach of the COI gene. Altogether, 55 pest species (93% lepidopterans) were detected in the diet of different bat species from May to September, of which 22 are considered major pests and 7 are known to cause damage to vineyards. Among bat species, the lesser horseshoe bat *Rhinolophus hipposideros*, consumed the greatest number of pests with 46 species (93% lepidopterans). Our results imply an association between bats consumption and the two grapeberry moths abundance, considering that LOB and SPA were consumed during their outbreaks. Generally, the results suggest, by one hand that bats track and consume grapeberry moths according to their seasonal variation and that *R. hipposideros* may play a valuable role as pest suppressor in vineyard systems.

## Disentangling direct and indirect effects of habitat fragmentation on pollination service: natural communities within agricultural landscapes

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**Keywords:** Piecewise analyses; pollinator evenness; pollinator richness; seed set; visitation rates

The expansion of agriculture leads to the loss and fragmentation of natural habitats, affecting the diversity and abundance of plants and the pollination service provided. However, these effects are not well-understood yet, because in fragmented landscapes there are many correlated features difficult to disentangle. We used piecewise analyses to assess the direct and indirect effects of landscape fragmentation (patch size, isolation and complexity, percentage of forest surrounding the fragments) on the frequency and composition of pollinators of 60 wild plant species occurring in 24 forest fragments within an agricultural landscape in Southern Norway. In addition, we evaluated how landscape fragmentation and visitation patterns influenced seed production in the four most abundant plant species. Landscape had only direct effects on local floral communities; however, pollinator assemblages were directly affected by these floral communities and therefore, indirectly affected by the landscape. Flower abundance and richness increased with patch size and complexity, and flower abundance decreased with the percentage of forest in the surrounding landscape. Pollinator evenness was negatively related to flower richness whereas pollinator-group richness increased with focal species abundance. Plant species with unspecialized flowers received a higher number of pollinator-groups, and their visitation rates increased with total flower abundance and richness. However, overall visitation patterns did not relate directly to plant fitness, as only in one species pollinator-group richness significantly affected its reproduction. Instead, several landscape variables directly affected plant fitness. The percentage of forest in the landscape had direct and opposite effects on the fitness of different species, whereas patch size and complexity directly influenced seed set in other species. Altogether these results indicate that the increasing fragmentation of agricultural landscapes decreases pollinator visitation, richness and evenness through effects on the floral community, but that the final effects on plant fitness are highly species-specific and pretty independent of visitation patterns.

## Exploring the effect of a green infrastructure on wild bee abundance and pollination services in adjacent sunflower fields

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**Keywords:** Honeybees; pollinators; semi-natural habitats; wild bees.

Agricultural intensification and its associated effects have been negatively affecting species richness and abundance of pollinators. Sunflower (*Helianthus annuus*) is one of the crops potentially affected by this pollinator crisis, as it is highly dependent on pollination by bees (Apoidea). Among other measures to mitigate this situation, the European Union has proposed the installation of green infrastructures (i.e. semi-natural areas designed and managed to improve ecosystem services). In this contribution, we analyze the effect of a green infrastructure (composed of a 12-species floral mixture and nest boxes) on the presence of bees and sunflower seed set in adjacent fields. Twenty two sunflower fields were sampled during the summer of 2017 in three municipalities of Cuenca (Spain): 11 fields with green infrastructures installed and 11 fields located close to semi-natural habitats (used as control). We used pan-traps to collect bees, and performed visual counts to estimate bee visitation rates at different distances from the green infrastructures and semi-natural habitats. Further, we estimated seed set in all sunflower crops. Our results show that the abundance of wild bees was higher in green infrastructures, while there were no significant differences in species richness and diversity of bees between green infrastructures and semi-natural habitats. Visitation rate to sunflower heads was higher in the fields adjacent to green infrastructures than in those adjacent to semi-natural habitats. Furthermore, seed set was higher in sunflower crops adjacent to green infrastructures. Our results suggest that the installation of green infrastructures might be an effective agri-environmental measure that promotes both pollinator conservation and agricultural production.

## The effects of olive farming intensification on Mediterranean breeding bird assemblages [S]

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**Keywords:** Agricultural intensification; Olive farming; Farmland birds; Community modelling; Pest control services

Olive groves are typical elements of Mediterranean landscapes usually holding significant biodiversity values. Over the past two decades, stimulated by both policy and market drivers, olive farming has greatly intensified, either replacing less intensive groves or expanding into areas formerly occupied by other crops. Here we use breeding birds as proxies to evaluate the impacts of these changes on biodiversity, taking a novel, hierarchical, joint species modelling approach to assess variation in assemblage richness and in species functional composition, across an intensification gradient. Birds were sampled in southern Portugal in the springs of 2014-2016, at 26 olive groves per each of three intensification levels: traditional, intensive and super-intensive. The number of species recorded declined markedly from traditional (29), through intensive (25), to super-intensive groves (19). In addition, the prevalence of many species declined significantly from traditional to intensive (7 species, 22% of species considered) or super-intensive (14 species, 44%) groves, but a few showed increased prevalences either in intensive (Serin) or super-intensive (Sardinian warbler, Goldfinch and Linnet) groves. This has resulted in a significant overall decline in predicted species richness along the intensification gradient, that mainly affected insectivores, cavity-nesters and large-bodied (>30gr) species, while shrub-nesters showed the opposite pattern. Overall, our results point out strong negative impacts of olive farming intensification on local breeding bird assemblages. We show that on-going changes, particularly the transition to super-intensive, is reshaping and simplifying local bird assemblages, which are increasingly dominated by generalist small granivores, while insectivores and their potential pest-control services are strongly reduced. These results should be taken as a warning signal regarding the serious negative impacts on biodiversity and ecosystem services that may be occurring in Mediterranean landscapes affected by the fast expansion of intensive and super-intensive olive groves, calling for the development of management strategies to minimize them.

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## Effects of human management on the diversity of plant communities associated to traditional Mediterranean olive groves [S]

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**Keywords:** Mediterranean agroecosystems; traditional human management; olive groves; arable plant communities; rare weeds

Traditional olive groves on basic soils are a typical agroecosystem of the Mediterranean region with a very rich and singular flora, which have been used, for long, for the production of olive oil and often cereal crops, simultaneously. Agricultural intensification and land-use simplification are threatening these traditional agroecosystems all over this biogeographic region. In Portugal, agricultural intensification is directly destroying these traditional agroecosystems, but other significant threats are the gradual substitution of the traditional management of the herbaceous layer (regular ploughing), by the introduction of cattle (mainly sheep), and, more recently, the abandonment of the land. The objective of this work was to identify the effects of these three types of management on the diversity of plant communities associated with traditional Mediterranean olive groves. We explored the hypothesis that traditional management (ploughing) enhances the diversity of local plant communities, in particular the diversity of arable weeds. The study system comprises the olive groves on basic non-calcareous soils of the region of Baixo Alentejo (Southern Portugal). Sampling plots were regularly laid out over a 600x600m grid in a checker-board pattern (one per "black cell"). In each plot, we sampled 15 units (1m<sup>2</sup>), in a regular 10-meter grid. In each sampling unit, every plant species was recorded. A total of 40 plots (600 sampling units) were sampled. Our results suggested that besides the different species composition between the three types of management, we found differences in terms of alpha and beta diversity between types of management, in particular related to the presence or rare arable weeds. These preliminary results highlight the importance of traditional landscapes in order to conserve rare plant communities, which possibly "co-evolved" with human agriculture long time ago in this biogeographic region.

## Traditional olives groves: the agroecology as the best path

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**Keywords:** Alentejo; multifunctionality; olive groves; olive oil varieties; participatory research action

The Portuguese olive oil production has been recovering from a long decline, via the plantation of new irrigated olive orchards, doubling the production in six years. In the same time, the external market grew from a deficit of 121 M€ to a surplus of 65 M€. But the traditional systems (80% of the olives groves), with a low productivity and a high risk of dropping out, still occupy a vast utilized agricultural area (circa 264,000 ha) and are important for the natural and cultural heritage (traditional varieties, natural biodiversity, landscape, others services of the ecosystem, old mills, POD olive oils) and for social and territorial cohesion in the less favoured regions with a low population density.

In the beginnings of this decade, was developed a participatory research action in Vila Verde Ficalho parish (in Alentejo region) with the olive growers, mills owners, and the local action group, in cooperation with Spanish partners. Was realized: a survey (242 inquiries); technical visits between Portugal and Spain (growers, researchers and four Leaders' associations); conferences and technical workshops; a focal group; informal training actions; and was edited a book and ten booklets. It was found: a multifunctionality of products (e.g. honey, hunt, wild asparagus); ecological infrastructures (stone walls, riparian vegetation, small areas without agricultural use); a great variety of olive groves varieties; a landscape with slopes, fig, almond and strawberry trees, and a great wild biodiversity; small farms and old farmers but also a few dynamic entrepreneurs willing to work with the others; farmers willing to keep these HNV farming systems. We concluded that the best way to turn these economic viable is to convert to biological production with the cooperation between farmers. This will also preserve the natural biodiversity, the traditional landscape, the regional olive varieties, and contributes to local development.

## Session V - Chair: Amparo Lázaro

### Species turnover promotes the importance of bee diversity for crop pollination at regional scales

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**Keywords:** Pollination; Ecosystem services; Biodiversity

Ecologists have shown through hundreds of experiments that ecological communities with more species produce higher levels of essential ecosystem functions such as biomass production, nutrient cycling, and pollination, but whether this finding holds in nature (that is, in large-scale and unmanipulated systems) is controversial. This knowledge gap is troubling because ecosystem services have been widely adopted as a justification for global biodiversity conservation. Here we show that, to provide crop pollination in large-scale and unmanipulated systems, the number of bee species must increase by at least one order of magnitude compared with that reported in previous field experiments. This increase is driven by species turnover and its interaction with functional dominance, mechanisms that emerge only at large scales. Our results show that maintaining ecosystem services in nature requires many species, including relatively rare ones.

## Diversity at different organization levels. Importance for biological pest control in agroecology - A review

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**Keywords:** environmental friendly practices; flower strips; hedgerows; interspecific interactions; pest predators

Agroecological management is considered to minimize environmental problems associated with intensive agriculture, enhancing biodiversity and associated ecosystem services while food provisioning is guaranteed. It typically includes habitat diversification by planting non-crop plants. These practices also generally increase biodiversity of different organisms in the food web that in the case of the natural enemies of pest (NE) is thought to benefit pest control. However, the relationship between natural enemy's diversity and pest control (Conservation Biological Control: CBC) is complex. We conducted a review on this topic to shed light on the knowledge of the mechanisms, processes and drivers across different levels of biological organization (NE community, agroecosystem and agro-landscape). Differential effects of NE biodiversity on pest regulation are related with interspecific interactions which in turn are driven by species functional traits. Thus, traits that lead to complementarity among NE (resources partitioning or facilitation) will improve pest regulation while those that lead to niche sharing would result either in disruption of pest suppression in the case of intraguild predation (two predators share the prey but one of them also preys on the other) or in neutral effect (but higher resilience) in the case of functional redundancy. At ecosystem level, the positive effect of diversification of plant community is mediated by provisioning of floral resources but also by generating coexistence among different predators. At the landscape level, heterogeneity has similar effects on CBC to those that plant diversification has in the agroecosystem. Yet, to improve CBC both landscape and agroecosystem levels should be considered together since whether the efforts are concentrated just in the field (agroecosystem) they could be useless.

## Methods to control the invasion of *Acacia melanoxylon* for recovering native agroforestry systems [S]

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**Keywords:** Biological invasions; cut-stump herbicide; debarking; mechanical control; litter removal

Invasive alien plants can modify ecosystem services, reducing biodiversity and impacting negatively at the social and economic level. The leguminous *Acacia melanoxylon* R. Br. is one of the most problematic Australian acacia tree species worldwide. This invasive species is currently invading native agroforestry systems, producing severe impacts on ecosystem services in northwestern Iberian Peninsula. To minimize their impacts and recover invaded agroecosystems, the implementation of management strategies such as to control/containment and eradication of widespread invaders is extremely necessary. In this study, we evaluated different control methods that consisted of (i) cutting the tree, (ii) cutting and applying herbicide (Triclopyr 1%, immediately after cutting) on the stump and (iii) debarking, combined all of them with or without removing the litter. Visual-spot checks were done to assess the sprouting and performance of acacia trees and the recovering of native vegetation during eight months after treatments. Our results showed that both cut-stump plus herbicide and debarking treatments were very effective. The debarking method even caused irreversible damages to the trees, producing chlorosis and defoliation. However, the cutting treatment stimulated the sprouting of tress, suggesting that this method should never be implemented. Litter removal neither affected acacia trees nor favoured the recovering of native species during the study. These results may help to define strategies to be implemented by the stakeholders to control *A. melanoxylon*. Due to the effectiveness of cutting with applying herbicide on the stump and debarking in a short period of time, we suggest the application of these treatments as methods of control to reduce *A. melanoxylon* spreading.

## Malaga community gardens: review and future perspectives [S]

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**Keywords:** Social gardens; citizen science; food deserts; climate change; social participation

In recent years, numerous initiatives of community gardens have proliferated as leisure spaces focused on the production of healthy foods. Despite appearing to be a phenomenon associated with urban areas as an attempt to reconnect nature, there is also a certain rural interest in this type of gardens. This study compares the results of a survey carried out in 2015 on urban gardens in the city of Malaga carried out by the University of Malaga with results of surveys conducted in 2018 from the study of social gardens in various municipalities of the province of Malaga. This analysis shows that there are characteristics of the province community gardens that remain predominant. These are gardens in which social interaction plays a very important role often linked to agroecology training. However, the sale of products is practically not a priority for the analyzed initiatives. There are recurrent challenges in these projects, such as the demand for greater institutional support and the scarce systematization of data (collection, crops, rotations ...). These spaces are also important niches of opportunity for the promotion of social innovation, citizen science, adaptation and mitigation facing climate change, fight against food deserts or promotion of social interaction towards racial and gender social challenges in provinces with high cultural diversity such as Malaga.

## What drives land-use changes and their sustainability in Mediterranean agro-ecosystems?: a view from SW Iberia

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**Keywords:** Complexity; Land-Use; Iberia; Sustainability; Cohesion

Recent trajectories of change in Mediterranean agro-ecosystems have resulted in an extremely complex land-use mosaic with diverging degrees of sustainability. This is the case for SW Iberia, where recent trends towards intensification and financialization of agricultural land-uses in many areas co-exist with traditional farming systems with High-Nature-Values and much higher sustainability levels. Traditionally, efforts to unravel the drivers behind such diversity focused alternatively on ecological, socio-cultural, economic or regulatory aspects following either deterministic or possibilistic approaches. This is problematic, as it provides with a fragmented and over-simplistic picture of the complexity that defines processes of agricultural land-use change in diverse and complex regions. In response, I analysed the recent trends for two different systems; olive-groves and silvo-pastoral systems (Montados/Dehesas), in the neighbouring regions of Alentejo (Portugal) and Andalucía (Spain). To do this, I compiled and comparatively examined official reports on spatial, agronomical, ecological and socio-economic trends over the past 15 years, and also the relevant regulations and planning in place in both regions and agricultural systems. To reflect on the social and cultural discourses underpinning change, I examined how changes are reflected in the media, both popular and specialized, over the same time-period. Results indicate that even in regional contexts with similar ecological and socio-economic conditions, other instrumental (regulations) and structural (culture) conditions can mutually interact to drive trends with different degrees of sustainability. Differences occur not only among different contexts (Andalucía vs Alentejo) or land-use types (Montado/Dehesa vs Olive Groves), but also within a single land-use type in different regions (Olive Groves in Andalucía vs Alentejo). To achieve progress and reach a greater degree of territorial cohesion regarding sustainability, further integration and cooperation in policy making and mutual learning processes are necessary but insufficient, and challenges related to shifts in local cultures and mind-sets may prove as important.



## Impact of family farming practices in the environment [S]

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**Keywords:** family farming; pesticides; technical itinerary

Traditionally, family farming has contributed to the preservation of biodiversity and the environment while also contributing to decrease poverty and social inequalities, especially in developing countries (FAO, 2014). Nonetheless, there has been a growing adoption of intensive agricultural practices like the widespread use of synthetic fertilizers and pesticide crop spraying by family farmers. Therefore, in this study we wanted to establish the technical itinerary of family farming, in the North and Center of Portugal, and to assess their potential impact on the environment and understand which practices should be promoted or abandoned to make family farming more sustainable and to reduce its negative impacts. To that end, we interviewed family farmers using a checklist questionnaire that included questions related to the socio-demographic characteristics of the farmer and his family, farm description, technical itinerary and perceptions towards sustainable farming practices and pesticide use risks to the environment and health. Based on the results, we were able to determine that several practices related with soil management, like liming, absence of soil/water/leaf analysis and the non-use of composting may result in inefficient use of soil nutrients and lead to inappropriate use of fertilizers. On a positive side, many farmers use crop rotation, green and animal manure, the latter originating mostly from their own farm and thereby reducing the need of non-organic fertilizer inputs. Regarding pest management, almost all farmers use pesticides on a regular basis, whilst only a minority use biological or biotechnological pest control methods, even though about two thirds of all farmers recognize pesticides to be harmful. In a significant number of cases, farmers use pesticides without respecting the legal limits and safety intervals, originating health risks to the farmers and consumers and, at the same time, contributing to endanger the biodiversity of their farms.

## Session VI - Chair: Javier Rodríguez-Pérez

### Exploring the connections between agroecological practices and ecosystem services supply: A systematic literature review [S]

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**Keywords:** Agricultural landscapes; agroecosystems; agroecological practices; ecosystem services; systematic review

Current patterns of global change, are threatening the future of the agroecosystems, food security and the supply of ecosystem services on which human well-being depends. Within this context, agroecology emerged within political and scientific arenas as a socially equitable and ecologically sustainable approach that considers the full dimension of the food system, from production, processing and marketing, to economic and political decisions. This work aims to explore how agroecology has merged with the ecosystem services framework in scientific literature. We performed a systematic literature review through the Web of Science to explore the connections between agroecological practices and the supply of ecosystem services, focusing on papers including empirical data. In our search we combined terms related with agricultural practices (e.g., agroecology, organic agriculture, alternative agriculture, permaculture, etc.) and terms related with the ecosystems services supplied by agroecosystems. A total of 634 scientific articles were found in the initial search, 179 of which were selected for the analysis after in-deep review. Most of the papers used a biophysical approach to evaluate ecosystem services (67% of the papers), with regulating (97%) and provisioning (31%) services being more frequently analyzed than cultural services (6%). Specifically, the ecosystem services most frequently analyzed were pest control (54%), soil fertility (31%) and food (29%). Regarding agricultural practices, the most frequently analyzed were the non-use of chemical fertilizers (49%), pesticides (46%) and herbicides (44%), the degree of surrounding landscape complexity (32%), and sustainable tillage practices (24%). Most of the analyzed agricultural practices had a positive effect on ecosystem services supply (54%), with only 17% negative linkages identified. Remarkably, our review showed that many of the 10 elements of agroecology defined by FAO have not been properly addressed in literature, with only 33% of the papers including more than three of these elements. Finally, we identified research gaps and provide insights on where future research and policies should focus in order to promote a transition towards sustainable agrarian social-ecological systems that respect human rights, support rural development and enhance human well-being.

## Consumers' valuation of pasture-based livestock products through sustainability attributes [S]

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**Keywords:** grazing; sustainability; consumers; preferences; joint analysis

The aim of the study has been to identify the main sustainability attributes from products of three Andalusian autochthonous breeds (Segureña sheep, Lojeña sheep and Pajuna cow), raised in pasture-based production systems, as far as to ascertain Andalusian consumer's preferences and willingness to buy these products precisely because of their sustainability attributes. First of all, a large bibliographic review has been done in order to preselect a 20 attributes list, through which 24 livestock experts could be able to select the top four among them: 1) Linked quality label, 2) Feed based on grazing, 3) Fire prevention and 4) Family-run farms. Instead of use a total design of 16 combinations (4 factors, 2 levels), an orthogonal plan was designed to provide 8 cards to 54 consumers, each one with a random combination of the four factors. Also an elementary socioeconomic survey was carried out. After the sample characterization, a conjoint analysis (SPSS included procedure) was done with the collected consumers' data to determine the partial utilities of each attribute and finally the global importance. The most preferred attribute, according to their global importance, was Feed based on grazing (28.69%), followed by Family-run farms (24.52%), Linked certification mark (23.67%) and Fire prevention as the last one (23.12%). It is remarkable that results are in line with other studies wherein consumers consider "grazing" as the most valuable attribute in other animal products, such as cheese. For that reason, this could be a tool to improve the marketing of this kind of pasture-based products, as well as a response to public concerns regarding sustainability.

## Bringing transhumance back to life as an option for the future: collection of nine years de experience

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**Keywords:** Transhumance; extensive livestock; sheep; rural areas

The extensive livestock system and transhumant herds is still a global practice that is maintained in many developed countries for benefits it offers: harmony with biological cycles, socioeconomic impact in rural areas, provisioning of ecosystem services and maintenance of open spaces with low biomass content in the landscape for reducing fire risk. Furthermore, the grazed areas have been shown to be the only landscape where abandonment causes a loss of biodiversity.

The purpose of this study is collecting all the information generated in the Fundación Monte Mediterráneo over the last 9 years of experience practicing transhumance in trucks from Huelva (Andalucia, Spain) to Leonese-Palentina mountain passes (Castilla and León, Spain). The proposed methodology consists in systematizing existing data to subsequently establish rates and guidelines for their extrapolation to other areas.

The results show a decrease on herd mortality, improvement in the overall health of the herd, veterinary costs reduction, optimal level profitability threshold for herd of 1500 sheep. Furthermore, the modernization of high mountains shepherd huts allows for an improvement in quality of life of the shepherds.

The sheep sector is aged and with a lack of generational replacement, the transhumance activity has enough potential to reactivate it, and in addition, to become a new backbone of the rural areas in the both socioeconomic and the cultural fields, the driver of economies and promotes wealth. Increasing the value of the products and the services offered, an activity as depressed as it is necessary in the Mediterranean context: extensive livestock.

## Using a middle-way strategy for weed management in dry-land cereal systems in Central Spain

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**Keywords:** weed management; cropping systems; environmental impacts; dry-land cereals

Two contrasting approaches have been proposed for redesigning agricultural systems: no-tillage and organic. Evidence indicates that neither of them can be the sole basis for sustainable weed management. Weed control in no-tillage systems, based on prophylactic use of herbicides, has led to the evolution of widespread herbicide resistance. Weed management in organic systems is difficult, time-consuming and expensive. In addition, the intensive use of tillage may promote high rates of soil erosion and organic matter loss. The “middle-way” approach intends to break through this polarization, promoting a judicious use of all available tools to achieve an agreed-upon set of outcomes for the agroecosystem. This approach may include the use of herbicides to tune –rather than to drive– weed management. A long-term study is underway in Central Spain to test these three approaches for dry-land cereal production. During three seasons (2015-2018) we have compared a no-till barley monoculture that received fertilizers and herbicides (NT), a 2-yr pea-barley rotation managed with reduced tillage, fertilizer and herbicide inputs (MID), and a 3-yr fallow-pea-barley rotation managed according organic practices (ORG). Barley and pea yields in the NT and MID systems were similar and greater than in the ORG system. Weeds were suppressed effectively in NT and MID, but weed control was unsatisfactory in the ORG system. Impacts on climate change and freshwater ecotoxicology were lowest in the ORG system and highest in NT system. Energy use was similar in the ORG and MID systems and greater than in NT. Results of our study indicate that the middle-way approach can reduce the use of tillage operations and agrochemicals, lowering economic costs, environmental impacts and energy use, without compromising crop yields and weed control.

## Plant residue quality mediate soil organic matter stabilization in an organic rainfed Mediterranean woody cropping system

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**Keywords:** organic agriculture; improved soil management practices; soil aggregation; carbon sequestration; climate change mitigation and adaptation

The incorporation of plant residues in rainfed Mediterranean agroecosystems can be a powerful strategy to mitigate the current atmospheric CO<sub>2</sub> increase through soil organic carbon (OC) sequestration and stabilization. Our aim is to assess how the type (green manure *vs* ground covers) and quality (leaves and stems *vs* roots) of plant residues affect soil aggregation and OC stabilization in an organic rainfed almond (*Prunus dulcis* Mill.) orchard under four soil management practices (reduced tillage, reduced tillage plus green manure, reduced tillage plus organic manure, no tillage) after nine years from implementation.

We set up a full-factorial experiment in the laboratory to evaluate the effect of soil-plant residue mixing after tillage operations on decomposition, soil aggregation and OC stabilization. Soil at 0-15 cm depth (plow layer) and inter-crop plant biomass were collected at each management practice in spring 2016. Soil was homogenized and sieved to remove stones and large plant residues, and plant biomass was cleaned, separated by above- and below-ground components and cut into 2-3 cm pieces. Three types of homogeneously plant residues (leaves and stems, roots, and the combination of both) from each management practice were mixed with soil at 1:40 litter to soil ratio and incubated under controlled conditions (28 °C, 60% water holding capacity), and CO<sub>2</sub> release was measured regularly over 243 days. One 'no-plant residue' microcosm per treatment x block x replicate combination was also incubated to correct for the soil contribution to CO<sub>2</sub> production. At the end of the incubation, water-stable macroaggregates (>250 µm), free micro-aggregates (53–250 µm), silt plus clay size fractions (<53 µm), and the micro-aggregates occluded within macro-aggregates, were isolated by sieving and associated OC content was measured. Preliminary results show that leaves and stems mineralised faster than roots, and that soil aggregation and OC stabilization increase with higher-quality plant residues.

## Functional characterization of weed communities help to explain their effects on crop performance

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**Keywords:** Community Weighted Mean; Functional Diversity; weeds; traits; wheat

Weed species are crop accompanying flora and they have been regarded as organisms that compete for resources negatively affecting crop performance. Nonetheless, in recent years, their role in maintaining agroecosystem diversity and function is starting to be uncovered. The structure of weed communities is the result of management practices, climate and biogeographic factors and biotic interactions. These factors sort weeds into communities and determine the species relative abundance according to their values for several response traits. In turn, it is expected that the resulting weed communities affect crop performance depending on their composition, diversity and functional structure. Here we analyze whether and in which manner weed community structure affects crop yields so we can select management practices leading to weed communities less detrimental for crop production. We also ask whether measures that take into account the relative abundance of species (community evenness), the species identity (community composition) or the weed trait values outperform weed richness in explaining the variability in crop productivity. Specifically, we argue that a functional characterization of weed communities could be very valuable to understand weeds effects on crops. During 2016-2017 and 2017-2018 field seasons, 39 rainfed wheat fields were sampled in Andalucía (Spain). We collected data on weed identity and abundance and we used grain weight as a proxy for wheat primary production. Fields were either organically or conventionally managed and they spanned a range of management practices and climatic conditions. The structure of weed communities was described by a measure of community composition, by taxonomic measures and by functional based indexes (CWM, the weighted average value of each trait and FDis, the variability of values). We used general linear mixed models to assess the ability of each weed community structure measures to explain variation in crop primary production. We found that weed community evenness and the CWM of some traits were important to explain the variability in crop grain weight.

## Open Session -

### **Adaptação climática ao nível da exploração agrícola: a experiência do projeto LIFE Montado Adapt** **Bastidas, Maria**

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The Montado / Dehesa system is currently in decline due to a number of factors, one of them the Climate Change. The concentration of the rainy periods and the increase of extreme events like the heat waves, will aggravate the state of these weakened system. In this context of change, the LIFE MontadoAdapt project arise, an adaptation initiative of the Montado / Dehesa, which brings together 17 partners from Portugal, Extremadura and Andalusia in Spain, that will operate in 12 pilot areas, in 1250 hectares in total, with public and private management. The partnership brings together farmers, technicians and researchers in the definition and implementation of cultural and management models, called Integrated Land Use (ILU). The project will also look for new strategies to connect local communities and other consumers with Montado / Dehesa products, ecosystem services and biodiversity. Under the ILU are defined a set of eco-products (cork, aromatic plants, fodder banks, apiculture etc.) and eco-services (hunting, birdwatching, sport fishing, mountain-biking trails etc.), with the farmer looking for increase the diversification and profitability of the farm. In this choice, the social factor, that is, the potential of ILU to fight against rural depopulation, is also taken into account. Likewise, in the ILU measures are defined with the aim to improve resilience in systemic terms, such as conservation and recovery of corridors for fauna, exclusion of use of synthetic chemicals, promotion of natural regeneration, installation of nests box mainly for species with benefit on the control of forest pests, among others. The environmental, social and economic impact of the implementation of ILU will be monitored in order to measure the adaptation promoted by the project at the end of the 5 years of the project.



## **Proyecto MOSAICO: Una estrategia participativa de prevención de incendios en la Alta Extremadura**

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El proyecto MOSAICO es una actuación convenida entre la Junta de Extremadura y la Universidad de Extremadura para diseñar una estrategia participativa de prevención de incendios, para Sierra de Gata y Las Hurdes, basada en actividades agrícolas, ganaderas y forestales que gradualmente recuperen un paisaje diverso, habitado y con menor riesgo: un paisaje en mosaico. El equipo Mosaico está formado por personal experto que debe servir de puente entre los agentes públicos y privados que conforman la red social del territorio.

## LIFE-project OLIVE-ALIVE: designing an olive cultivation to recover biodiversity and profitability

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### LIFE OLIVE-ALIVE

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**Keywords:** Ecosystem services; Restoration; Agricultural landscape; Biodiversity-friendly agricultural certification; Demonstrative farms

Olive cultivation is strategic for biodiversity in Europe due to its extension, geographic context and environmental value. However in the last decades agricultural intensification has caused a notable loss of biodiversity and compromised its ecological functionality. Predominantly yield-oriented policies have summed up to the environmental crisis provoking a loss of profitability, especially prominent in traditional olive groves, still majority in the Mediterranean Basin. To deal with these two problems, in 2015 started the demonstrative LIFE-project OLIVE-ALIVE, with the objective of enhancing the profitability of the olive cultivation, recovering its biodiversity and ecosystem services. To this end SEO/BirdLife, University of Jaén, Diputación de Jaén and the Estación Experimental de Zonas Áridas (CSIC) are working in (1) designing an olive cultivation model able to recover biodiversity, (2) a certification providing an added value to the olive oil produced under this model, and (3) developing a market strategy for the oil trade produced under the warranty label “OLIVE/ALIVE”. In an effort without precedent, we have evaluated the biodiversity in olive groves and its affection by agricultural intensification or landscape context, by considering 20 demonstrative farms from Andalusia (40 considering their respective controls). We further executed restoration plans in each demonstrative farm, aimed to enhance their pre-operational biodiversity. After analyzing more than 260,000 records, our results corroborate its importance for biodiversity in Europe as well as its potential for future recovery. However, there are considerable differences between olive farms in their ability to retain biodiversity, attending to agricultural practices or landscape context, with losses of up to 30-40 % in intensively managed olive groves and simple landscapes. Our results also highlight that restoration plans should be designed according to farm size, landscape and previous agricultural management. Needed actions may be different according to specific target groups of organisms or where multidiversity-oriented aim is priority.

## Fostering a science-based cooperative ecosystem in organic vineyard management

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The Herdade do Esporão is in the typical landscape of the Alentejo, near Reguengos de Monsaraz, the capital of a DOC wine region. The estate's limits were defined 750 years ago, in 1267, and remain much the same nowadays. In the 1830 hectares of territory, between plains and valleys, there are 617 hectares of vineyards and 100 of olive groves. The rest are oak woodlands, part of them managed as a 'montado', and streamlines and wetlands. This forest dimension provides a bounty of biodiversity and ecosystem services of crucial relevance for the management of the farmed area, taking into consideration that all the area is being managed as organic. But the need for ecosystem and biodiversity conservation good practices became part of the management model in the 2000's. In 2007 Esporão joined the Business & Biodiversity initiatives, becoming the first wine producer in the world to commit to the preservation of biodiversity. Biodiversity then became a relevant factor in the definition of the strategy. Since 2017, a few projects internalized, to some extent, both the role of functional and high conservation status of species and habitats onto the land use management models. The vineyards and olive groves now present different fits regarding soil management and cover vegetation adapted to the production models, ecologic corridors and remnant natural areas for refugia and that act as natural suppliers of biocontrol agents like predators and pollinators. Also, bat boxes have been installed and wetlands protected or restored. Most of these practices derive from a close cooperation with R&D / Academic institution and are the results of a facilitating cross-pollination environment that bridges the needs of a land managing business with the expectations of research teams in order to foster a science-based cooperative ecosystem that allows both scientific progress and a sustainability-oriented business strategy.

## Gestión de pastoreo en ecosistema de dehesa

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**Keywords:** Suelo; Biodiversidad; Regeneración; Pastoreo; Agrosilvopastoral

Es un proyecto sobre gestión del pastoreo el cual pretende realizar una gestión sostenible del suelo, considerado como gran factor de biodiversidad y estabilidad del sistema; de la regeneración del arbolado, del pastoreo, para asegurar así el mantenimiento del ecosistema. Se realiza la trashumancia, con una menor de carga ganadera generando así una menor presión en el medio (menor uso de antibióticos, fitosanitarios, menor aporte de nitrógeno al suelo, etc.) interviniendo en los distintos nichos ecológicos de la explotación, intentando mejorar la biodiversidad para hacer un sistema más estable y sostenible en el tiempo.

De forma paralela y en colaboración con la universidad se trabaja en regeneración del ecosistema tanto de forma natural como forzada, a través de la plantación de árboles y/o bellotas. Todo esto realizado con un fuerte componente social, ya que los productos derivados presentan un canal corto de comercialización a través de grupos de consumo para fomentar el consumo responsable, así como colaboraciones con colegios y universidades.

# Poster presentations

## Effects of vegetation management on plant diversity in traditional irrigation systems

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**Keywords:** Acequia; Clearing; Burning; Cultural practices; SE Spain

Acequias are historical community-operated water channels used for irrigating of traditional farming areas (vegas). They have been traditionally managed by local inhabitants, either by clearing weeds or by burning them in winter, in order to keep the channels clean of vegetation, thus avoiding their clogging. The impact of these cultural practices on vegetation has not still been studied. The aim of this work is to show how traditional management influences floristic biodiversity in a traditional acequia in the vega of Granada (SE Spain). The acequia was treated following the traditional methodology used by farmers, being divided into areas that were burned, cleared, or left unchanged as control (January 2016). Afterwards, we collected soil samples and analysed them in the lab to determine the treatment effects on soil properties. Vegetation was monitored in late spring 2016 in order to detect differences between treatments. Traditional management increased plant diversity, this effect being much more patent for the burning than for clearing treatment. Soil analyses revealed only slight differences in pH and CaCO<sub>3</sub> content, higher for the burning treatment. The increase in plant diversity found in areas treated by traditional management was due mainly to the reduction of competition, which promoted the emergence or increase of populations of non-dominant species. The results indicated that traditional management not only offers advantages to the farmers but also promotes plant diversity and ecosystem services.

## Trade-off among organic farming or abandonment vs. traditional management on plant diversity of sloping olive groves

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**Keywords:** tillage; biodiversity; ecosystem services; agricultural practices; olive; SE Spain

Sloping olive groves cover a wide area of Andalusia, but they also show a high risk of abandonment due to low economic profitability, at least when they are managed in a traditional way. Its viability might come through the benefit of the ecosystem services demanded by the society, for example those derived of an increasing biodiversity, for which to change the agricultural practices is crucial. The main objective of this work was to quantify how organic farming or the abandonment of these traditional sloping olive groves can affect the biodiversity. For that, adjacent traditional, organic, and abandoned olive groves were selected in 20 contrasted localities on slopes higher than 20%. Also, the agricultural practices or other uses within each land management were taken into account (tillaged organic (TO), non-tillaged organic (NTO), tillaged traditional (TT), non-tillaged traditional (NTT), abandoned groves with woody vegetation (WA), and abandoned groves with herbaceous vegetation (HA). Three lineal transects of 30 m long were set up in each 60 plots to estimate plant diversity every meter (90 contact point/plot). Plant species abundance and richness were significantly higher for the organic management and the abandoned plots than the traditional ones. The same was found for the analyzed biodiversity indexes (Margalef, Shannon, Simpson, and Chao). Species abundance and composition was clearly different for abandoned plots, especially those with woody vegetation (WA), while it was similar for organic and traditional plots. However, species abundance and composition was more similar among tillaged plots than non-tillaged independently of the organic and traditional management. Non-tillaged plots were more similar to abandoned plots than the tillaged ones. From a biodiversity point of view, non-tillage (cover crop) is recommended for sloping olive areas, especially under organic farming practices.

## Agrarian landscape, natural landscape: an agroecological territorial approach for the space "Sierra Grande de Hornachos" (Extremadura, Spain)

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**Keywords:** Agroecology; cultural landscape; Natura 2000 network; territorial approach; protected areas

The Sierra Grande de Hornachos, located SW of the Iberian Peninsula in Extremadura (Spain), is a space protected by multiple figures, from the regional -Zona de Regional Interest (ZIR) - up to international ones - Site of Community Importance (LIC), Special Protection Area for Birds (ZEPA, Special Zone) Conservation (ZEC) - being included in the Biodiversity Conservation Network of the European Union, Natura 2000. The territory where this natural space is integrated presents an enormous cultural, agrarian and environmental richness; However, this complexity has not been expressed in opportunities for the revitalization of the local economy, returning again even to the old approach that faces conservation of the natural environment and agrarian production.

In this context, agroecology can provide a new paradigm, focusing the topic as to recognize the complexity of the territory and to build up rural development from multiple dimensions: ecological, social, economic, political and technological, transcending the divisions of space that impede articulated and interdependent vision. This work is part of the Research project that we are currently carrying out at the University of Extremadura entitled: Valorization of the vegetable biodiversity of the protected area "ZIR Sierra Grande de Hornachos" as source of innovation for development.



## Cultivating Future: promotion of Multifunctional Plants (PlaM) in Malaga [S]

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**Keywords:** Citizen science; ethnobotany; agroecology; companion plants; edible plants

In the Mediterranean region we have a wide range of multifunctional plants (PlaM), plant resources adapted to local climatic conditions which are also edible, medicinal, useful as companion plants in the orchard or to restore degraded lands; some of these plants are nettle (*Urtica dioica* L.), common mallow (*Malva sylvestris* L.), fat hen (*Chenopodium album* L.), etc. Currently, many of them are considered weeds that must be eliminated with phytosanitary products which negatively affect the environment. A paradigm shift is necessary to consider them as a resource of easy access and maintenance, since they promote environmental sustainability, circular economy and food sovereignty due to their great capacity to adapt to the local climatic conditions. Cultivating Future is a project that promote social innovation through the research of species with this potential in the province of Malaga. We will achieve our goal through research and dissemination as trainings and online workshops, productivity trials, companion planting trials and citizen science activities to demonstrate the response capacity of these crops in face of the social and environmental challenges associated with Climate Change. We pretend with this project to show forgiven vegetable resources to the most needed rural areas of Malaga and encourage social entrepreneurship applying those resources. The use of PlaM will provide and added value to the local agriculture and gastronomy in rural areas promoting social innovation to different problems as climate change and rural depopulation.

## Does dry-farming systems induce beneficial adaptations to young plants after a heat episode?

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**Keywords:** Dry-farming; heat recovery; irrigated system; *Olea europaea* cv 'Arbequina'; photosynthesis

The traditional Mediterranean olive (*Olea europaea* L.) orchards under dry-farming are being replaced by high water demanding irrigated-systems, which use cultivars selected for high productivity in detriment to sustainability. However, the increasing challenges imposed by climate-change may aggravate the water management in these Mediterranean agroecosystems. Dry-farming represents nowadays a sustainable alternative to highly irrigated-systems, but it requires a deeper knowledge of how highly productive cultivars (e.g. Arbequina), under dry-farming, withstand with climate-change associated episodes, namely heat. Young 'Arbequina' plants were exposed to 'dry-farming' and 'irrigated' systems for one month, after which in each system, half of the plants were exposed to a heat peak (40°C for 2h). Ten days after the heat-episode, photosynthetic pigments, fluorescence and gas-exchange were evaluated in plants from each group. Heat increased chlorophyll a, b and carotenoids in the irrigated system, while only chlorophyll had an increased in the heat treated plants under dry-farming. Plants from the dry-farming system showed some photosynthetic parameters below (e.g. effective efficiency of photosystem II and photochemical quenching) those of well-irrigated plants, which were aggravated by heat. However, the non-photochemical quenching was maintained in all conditions. Interestingly, also the net CO<sub>2</sub> assimilation rate, the transpiration rate and the stomatal conductance showed no differences 10 days after heat exposure, indicating that the olives growing under dry-farming showed a similar performance to those well irrigated and a higher recovery capacity. These data contribute to understand how olives will cope with drought/heat conditions, and may support the reintroduction of dry-farming systems as complement to a better water management strategy in agroecosystems facing water scarcity.

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## Shepherd School of Andalusia: agroecological training linked to the extensive livestock [S]

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**Keywords:** training; generational relief; grazing; young; shepherd

Grazing as a basis for feeding flocks is declining in the European Union. Problems related to the access of the land, the hardness of the shepherd's work, the scarce profitability of the activity, an undifferentiated market for their products and the lack of payment for their environmental services, among others, have meant that the number of farms with this model have dropped. Andalusia (Spain) created its Shepherd School in 2010, an initiative based on collaboration between different entities in the field of livestock and environment. The training plan has a total duration of 540 theoretical-practical hours with three axes of work: i) management of reproduction, genetics, feeding, health and facilities; ii) economic management, marketing and associationism, and iii) role of the shepherd and his flock in the maintenance of environmental sustainability. The figure of the shepherd teacher is fundamental for the success of the school: during 6 weeks the students carry out practices with them in their farms. In total there are 82 active shepherd teacher, with different autochthonous breeds and flocks with different aptitude: meat, milk and cheese making. A total of 117 students, 90 boys and 27 girls, have already attended the School, with a percentage of incorporation into livestock activity of around 60-70%. Finally, the Andalusian Shepherd School offers the possibility of making this sector more visible to society and highlighting its fundamental role in the maintenance and improvement of the environment.

## I9kiwi - Development of strategies for the sustainability of the kiwifruit industry through the creation of a value-added product

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**Keywords:** Kiwifruit; *Pseudomonas syringae* pv. *actinidiae*; Pollen; Kiwifruit cultivars

I9kiwi aims to respond to the challenges of the kiwifruit industry sustained by a holistic network that develops and adopts innovative strategies and agricultural practices to generate greater productivity, enhancing the sector's competitiveness into new markets. In this context, the project focus on three areas previously identified by the sector as the main constraints: kiwifruit bacterial canker caused by *Pseudomonas syringae* pv. *actinidiae*; pollen quality and efficient pollination; kiwifruit cultivars. The development of mitigation and control methods for Psa, in the field and in pollen, through the use of antagonists along with the development of bio-based methods to boost the immune system of the plant is in course. In parallel, the varieties adapted to the climatic of the two main producing regions are being identified based on high productive capacity and resistance/tolerance to Psa. Finally, innovative pollen application methods adapted to the national context have been tested and the results in productivity will be collected during the harvest season.

This integrate vision of the kiwifruit production also encompasses the mapping of the main Portuguese producing regions based on abiotic and biotic factors. Additional information regarding cultural practices and its economic impact are also being collected. These layers of information are being gathered in a web-based platform developed in the scope on the project. The results of field surveys and productivity on the three pillars of action: presence and severity of disease, quantification and diversification of pollinic services and cultivar variability will also feed the platform. In sum, this tool will correlate several layers of information in order to determine the impact of each factor on the overall productivity allowing the producers to implement strategies to increase productivity. For more information see: [www.i9kiwi.pt](http://www.i9kiwi.pt).

## Mapping social and inclusive farming initiatives in Madrid region

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**Keywords:** Agroecology; inclusive social farming

In the last decades in Europe and more specifically in Spain, there has been a great growth in both agroecology, understood as science, practice and social movement, and social and inclusive farming as a discipline and practice, but little emphasis has been placed on possible synergies between them, placing the economy of care at the centre. Social farming is a process by which contact with nature (agroecosystems) and in particular through farming activity (horticulture, olive-growing, winemaking, gardening, animal farm care, forestry, etc.) are worked out. The objectives are to improve the quality of life of groups at risk of social exclusion. The purpose of this communication is to present some of the results of the research project entitled: Viability of social farming in Madrid region. The project focuses on mapping and characterising existing inclusive and social farming initiatives through semi-structured interviews and visits to experiences (27 interviews have been carried out so far). A quantitative and qualitative analysis of the data was carried out. The results indicate that the main activity carried out by the initiatives is horticulture (90%), followed by gardening (22%) and animal care (15%). All initiatives have plots of less than two hectares with uncertified organic management (85%), certified organic (11%) and integrated agriculture (4%). The main groups they work with are people with health problems due to physical, psychic or sensory disabilities (33%). The next most abundant groups are elderly people in involutive situation, isolation, loneliness, need for care (25.9%). Finally we find other groups such as minors at risk of social exclusion, immigrants or women victims of abuse. As a conclusion, all the groups highlight the benefits for users of contact with nature through the different activities they carry out, but they highlight the difficulty of using reliable indicators to measure or quantify the impact of their actions at a social, environmental and economic level.

## Ecological infrastructures within Mediterranean agroecosystems: Towards an effective tool for evaluating their ecological quality [S]

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**Keywords:** Ecological infrastructures; functional biodiversity; ecological quality; evaluation questionnaires

In the current context of biodiversity loss within agroecosystems, ecological infrastructures (non-cropped functioning areas that deliver valuable services to people) play a key role in the enhancement of biodiversity and the services that it provides. The contribution that ecological infrastructures have in the improvement of biodiversity depends heavily on their ecological quality, defined as their potential to support functional biodiversity. We used the questionnaire proposed by Boller et al. (2004) as a basis for the development of a tool to evaluate the ecological quality of woodland patches, hedges and grass strips infrastructures associated to Mediterranean agroecosystems. A total of 482 ecological infrastructures were evaluated, and their vegetation assessed by inventorying their floristic composition. We assessed the relationship between plant species richness, which has been considered as a principal predictor of overall biodiversity in agroecosystems, and the items included in the questionnaire. According to these results, a new and simplified questionnaire (SQ), in which only significant variables were included, was proposed. Our results showed that the quality groups established when considering the new simplified questionnaire were more consistent than those obtained when using the Boller's et al. (2004) questionnaire (BQ). Moreover, as an additional tool in ecological quality evaluation, a list of indicator plant species associated to each of the four levels of quality obtained from applying the SQ, and identified by using their IndVal values, was provided. The development of reliable evaluation schemes is essential to assess the status of biodiversity. Here we propose an assessment tool focused on aspects of functional biodiversity, capable of discriminating between infrastructures with different levels of quality, but simple and easily applicable by both experts and non-experts. We highlight the interest of the questionnaire adaptation, simplification and validation process as a basis for developing more evaluation tools, adapted to other ecological infrastructure types.

## Influence of weed cover on assimilation, transpiration, stomatal conductance and water use efficiency in an olive orchard [S]

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**Keywords:** Olive; Weed cover; CO<sub>2</sub> assimilation; stomatal conductance; photosynthesis

In order to prevent erosion and improve soil conditions, the maintenance of weed cover becomes an increasingly common practice among different crops, including olive groves. Although previous studies have quantified the effect of weed cover on ecosystem-scale balances of carbon and water, the role of this conservation practice at the physiological level of the individual crop plants has not yet been explored. The aim of this study is to quantify and compare CO<sub>2</sub> assimilation (A), transpiration (E), Water Use Efficiency (WUE) and stomatal conductance (g<sub>s</sub>) at the leaf level in the two treatments – weed-cover (wc) and weed-free (wf) – and determine which environmental variables influence these processes. To do this, two plots of olive trees with irrigation (*Olea europea* L. "Arbequina") from southeast Spain were sampled. The data were taken with a portable gas analyzer (LI-6800, Li-Cor) controlling the following environmental variables: 400 ppm of atmospheric CO<sub>2</sub>, 60% relative humidity and 1000 μmol m<sup>-2</sup> s<sup>-1</sup> of PAR. One campaign were carried out per month (from January-2018) in which 10 random trees were analysed at each treatment. Preliminary results, reveal significant differences for A and g<sub>s</sub> for the two treatments: A<sub>wc</sub> = 7.10 ± 4.01 μmol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup>; A<sub>wf</sub> = 9.40 ± 4.41 μmol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup> and g<sub>s,wc</sub> = 0.063 ± 0.040 mol m<sup>-2</sup>s<sup>-1</sup>; g<sub>s,wf</sub> = 0.084 ± 0.052 mol m<sup>-2</sup>s<sup>-1</sup>. Whereas no statistically significant differences were found for E and WUE: E<sub>wc</sub> = 0.0011 ± 0.0007 mmol H<sub>2</sub>O m<sup>-2</sup>s<sup>-1</sup>; E<sub>wf</sub> = 0.0013 ± 0.0010 mmol H<sub>2</sub>O m<sup>-2</sup>s<sup>-1</sup> and WUE<sub>wc</sub> = 9.1 ± 5.8 μmol CO<sub>2</sub>mmol H<sub>2</sub>O<sup>-1</sup>; WUE<sub>wf</sub> = 9.5 ± 4.8 μmol CO<sub>2</sub>mmol H<sub>2</sub>O<sup>-1</sup>. The results show that there is a more powerful photosynthetic machinery in olive trees free of weeds. Currently we are investigating the micro-climatic and ecophysiological factors to explain the causes of these differences.

## Innovative and sustainable solutions for agricultural problems could help controlling exotic plant invasions

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**Keywords:** Invasive plants; bioherbicide potential; biostimulation potential; fertilizing potential; new ecosystem services

Management actions to prevent/minimize the impact of aggressive invasive species require new and viable long-term strategies. A recent idea consists of finding potential uses for plant residues derived from management actions as a way to partially recover invested funds, while contributing to palliate other environmental problems, favoring a circular bio-economy. We focus our study on *Acacia dealbata* Link that is considered the third worst invasive acacia species worldwide and it is expanding in Mediterranean areas, mainly in agroecosystems and abandoned arable lands. This species is a nitrogen-fixing tree with phytotoxic molecules that interfere with normal functioning of surrounding plants and soil microbes. The leguminous and phytotoxic traits make *A. dealbata* a potential source of new products for agriculture. Therefore, we are currently conducting a project to evaluate potential uses for the residues of this invader, valuing it by focusing on solving problems related to conventional agriculture, e.g. reducing the excessive use of synthetic agrochemicals and, consequently, the environmental pollution. In particular, we are evaluating the effect of natural compounds extracted from leaves and bark as potential bioherbicides or bioestimulants, as well as the potential fertilizer of green manures, contributing to a more sustainable agriculture.



## **Therapeutic horticulture and mental health: an integrating experience of pupils with different capacities in pedagogical orchards**

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**Keywords:** Therapeutic horticulture; pedagogical orchard; human wellbeing; mental illness

It is widely known the benefits of therapeutic horticulture on human wellbeing, and recent studies have emphasized the positive effect of horticulture on the treatment of mental health. During autumn 2017 and spring 2018, we set up a garden at the School of Agriculture Engineering of the University of Extremadura (Spain) aimed to carry out teaching and learning activities in young students with mental disabilities (YSMD). Latter project was possible thanks to the agreement with the Sorapán de Riegos Foundation (Badajoz, Spain). From summer 2018, we found that therapeutic horticulture was highly positive for YSMDS due to they developed new skills: namely, designing new spaces through permaculture, land management and sowing and cultivation in orchards. Through the learning process and supervised by coaches of the foundation, YSMDS exchanged views, empathized and took decisions together. During the first month of lectures, YSMDS additionally shared experiences with volunteer students of the School of Agricultural Engineering, and that was extremely useful for integrating experiences in knowledge, skills and attitudes in YSMDS. For the foundation staff, latter project was also useful as they were able to adapt intervention protocols for training YSMDS in therapeutic horticulture.

## Effect of the fertigation dose on the ecological legumes cultivation under greenhouse: pea (*Pisum sativum*) and sugar snap pea (*Pisum sativum* L. *macrocarpon*) [S]

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**Keywords:** Legumes; Diversification; Irrigation; Fertilizers

According to the new organic farming regulation (EU) 2018/848, in greenhouse crops, the fertility and biological activity of the soil must be maintained or increased through short-term legume and green manure crops, as well as through the application of manure animal or material of organic production. For this reason, legumes are an essential component in crop rotations within ecological agriculture under greenhouse conditions. The objective of this work was to evaluate the effect of reducing the dose of fertigation on the production of several varieties of pea and sugar snap pea in an ecological greenhouse, since the fundamental principles of organic farming are the conservation of natural resources and increase biodiversity. For this, two different treatments were selected: usual fertigation supply (100% fertigation) and restricted supply (50% fertigation). Fertigation programming was carried based on the soil moisture level measured by tensiometers, fertigating when a tension of -20 kPa was reached in the 100% fertigation treatment. The volume of fertigation was established at 3 L m<sup>-2</sup> for the treatment 100% of fertigation and 1.5 L m<sup>-2</sup> for 50% of fertigation. The plant material tested consisted of 7 commercial pea cultivars, specifically the cultivars were Buddy, Ambassador, Altesse, Jumbo, Lincoln, Eddy and Zircon, and 4 cultivars of commercial sugar snap pea AR-24007, Tirabí, Tirabeque-IS, Capuchino and a traditional one. To study the effects of the fertigation dose, commercial production was quantified. No significant differences were found between the 50% and 100% fertigation treatment in any of the pea or sugar snap pea cultivars tested. The results suggest that in our growing conditions, the production of pea and sugar snap pea in organic production can be developed with savings in water and fertilizer without loss of production, thus improving the sustainability of the system.

## Physiological responses to climate change of traditional Portuguese olive cultivars

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**Keywords:** Drought; heat; *Olea europaea*

Climate change scenarios, such as increasing frequencies of heat waves accompanied by drought episodes, exert a dramatic challenge for agriculture, particularly for most crop-trees of the Mediterranean region. *Olea europaea* L. is one of the most important crops in the Mediterranean basin, with high ecological and economic value. Olive production has increased in the last decades and Portugal is currently the 4th European olive oil producer. Olive breeding programs have been focused on highly productive cultivars that are usually used in super-intensive cultures with a high demand of water consumption, while ancient cultivars may present higher tolerance to drought and heat resilience. Therefore, it is important to select traditional cultivars that may give reliable performances under the predicted climate change scenarios. In this work, the differential physiological responses of economically important traditional Portuguese olive cultivars, Cobrançosa, Cordovil de Castelo Branco, and Cordovil de Serpa, to drought combined with heat were evaluated. Drought+heat treatment induced lower impact on water status in Cobrançosa. In addition, this cultivar was less affected regarding photosynthetic pigments content, maximum and effective quantum yield of photosystem II (Fv/Fm and  $\Phi$ PSII) and exhibited higher ability to trigger an antioxidant response. In turn, the cultivar Cordovil de Castelo Branco was the most sensitive to drought+heat treatment reducing pigments (carotenoids), Fv/Fm and  $\Phi$ PSII, and cell membrane stability. Data suggest that the cultivar Cobrançosa present high potential to cope with climate change, particularly drought combined with heat episodes, followed by Cordovil de Serpa and Cordovil de Castelo Branco. In addition, our data suggest that Cobrançosa could be a more suited cultivar to be planted in regions that are prone to these stress conditions.

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## Preliminary assessment of the competitive ability of different bitter vetch landraces (*Vicia ervilia* L. (Willd.)) in integrated weed management strategies

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**Keywords:** Grain legume crop; weed integrated management; crop competitive ability; *Vicia ervilia* L. (Willd.); agrobiodiversity

In Mediterranean drylands, the re-introduction of legume crops may be a way of enhancing their benefits in environmental and socioeconomic terms. The use of landraces as components of a genetically diverse population could support part of the increased agrobiodiversity in farm systems. Thus, their agronomic assessment, to test the effects on weed community, could inform about the best crop phenotypes for weed management. The aim of this work is to make a preliminary screening of distinct phenotypes of bitter vetch (*Vicia ervilia*, L. (Willd.)), studying the effects on functional diversity of weed communities under different sowing densities. A small-scale experiment was conducted, using four bitter vetch landraces that were previously characterized in the National Plant Genetic Resources Centre (CRF). They were selected depending on their phenotypical traits, including plant height and tolerance to lodging. In order to evaluate the effects of sowing density on crop biomass, weed biomass and functional diversity of weed community, four plots for every landrace with 100, 120, 140 and 160 plants m<sup>-2</sup> were established. Weed communities were characterized considering five response traits: two regenerative traits (seed weight, emergence time) and three related to acquisition of resources (growth habit, plant height and specific leaf area). Effects on functional diversity of weed community were assessed using two the two different metrics: dominant attributes in the community, described by community weighted means (CWM) and the variability of traits values, by mean pair distance (MPD). As expected, crop biomass was affected by sowing density but, none of the landraces evaluated were consistently associated with a greater functional weed diversity. Therefore, weed biomass, CWM growth habit and CWM emergence time were affected by the interaction landrace-sowing density. These preliminary results suggest the need of further investigation to better understand the integration of several weed management strategies.

## Towards a zero inorganic waste production in greenhouses horticulture sector: Challenges for sustainable bioeconomy farming systems in the South of Spain

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**Keywords:** Inorganic waste; horticultural greenhouses; bioeconomy; zero waste; Almería (Spain)

Agrifood waste is a major economic, social and environmental concern, and strategies towards its reduction are being developed both at global and European levels. In the last ten years, bioeconomy strategies and policy-related bioeconomy initiatives have been developed all over the world. Some of them are currently in the process of translation into specific actions. In January 2016 Spain launched its own strategy aiming at boosting a bioeconomy based on the sustainable and efficient production and use of biological resources. In such framework the present work, after analysing the main economic and production structure of horticultural greenhouses of Almería (Andalusia, South of Spain), aims to provide an overview of the main challenges and criticalities in this sector. After that, we analysed data and statistics on amount/volume and type of inorganic waste produced, elaborating an inventory of components and materials used in the processing and actual procedure of use and disposal (waste flows analysis). Framed within the REINWASTE project, we finally designed the most innovative "zero waste" solutions to favour the adoption of new approach for implementing a bioeconomy strategies in greenhouses horticulture sector of Almería (Spain).

## Multicriteria land suitability and climate change impact analysis for woody crops in north-central Spain

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**Keywords:** Crop diversification; crop diversity; *Olea europaea*; *Prunus dulcis*; *Pistacia vera*

Crop diversification is considered an important tool to improve the resilience of agroecosystems. The diversity of agricultural patches in a landscape can, for instance, affect pest control, or ensure agricultural production under diverse conditions. However, the lack of knowledge and economic incentives, or simply inertia, lead our farmers to rely on just a few crop species. This work is part of a project aimed to provide decision support tools in the context of crop diversification promotion in the region of Valladolid (central Spain). We present the results of a land suitability analysis for three woody crops: olive (*Olea europaea*), almond (*Prunus dulcis*) and pistachio (*Pistacia vera*) with growing interest in the region. Further, we analyse the impact of different climate change scenarios on this land suitability. A multicriteria spatial assessment approach with GIS has been used based on geographical data on climate, soils and topography provided by the regional government. These base data have been later modified according to regional predictions for climate change scenarios for two decadal time slices: 2041-2050 and 2071-2080. The accordingly modified maps were used as the basis of new prediction land suitability maps. Projections of increased temperature would benefit all three species, especially the most thermophile ones. Thus, the suitable area for olive and pistachio would increase in the region. However, patterns of decreased precipitation expected in all scenarios would result in serious water limitations to the three crops, which would need irrigation. This constrain can eventually compromise the viability of the crops.

## Genetic diversity of *Pseudomonas syringae* pv. *actinidiae*: seasonal and spatial population dynamics

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**Keywords:** *Pseudomonas syringae* pv. *actinidiae*; population dynamics; population genetic structure; copper resistance; kiwifruit bacterial canker

*Pseudomonas syringae* pv. *actinidiae* (Psa) is a gram-negative bacterium responsible for the bacterial canker in *Actinidia deliciosa* and *A. chinensis*, a quarantine disease threatening the kiwifruit industry sustainability. The Psa population genetic structure was characterized from 600 isolates obtained from several Portuguese orchards with distinct abiotic conditions in consecutive seasons. Leaves were collected from the same kiwifruit plants and the endophytic and epiphytic Psa diversity was assessed independently. Based on BOX-PCR fingerprinting analysis we determined that Psa population was highly heterogeneous with several co-existing populations. Evident changes occurred in the population structure between seasons translated in a notable decrease in Psa diversity in autumn. Moreover, differences between the epiphytic and endophyte population were also observed in samples collected simultaneously. Psa strains were identified as biovar 3 but our phylogenetic analysis revealed an unreported and highly polymorphic lineage. In this context Psa populations seem to be selected overtime from a diverse genetic pool according to their fitness. This perspective is important for the understanding of kiwifruit bacterial canker disease occurrence and Psa evolution and it is also relevant when adopting strategies for epidemics management.

## Nutritional value of fresh organic legumes from protected crops

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**Keywords:** Pea varieties; tirabeque; nutrition; organic crops

Nowadays society is concerned about nutrition and, in consequence, the interest for health is increasing, including the groups of vegans and vegetarians. Legumes are a very interesting group of vegetables because they contribute to the diet with a big proportion of nutrients as carbohydrates, minerals, vitamins, nutritional fibre and also a high proteic value. In this work two types of legumes are analysed. Firstly, “Tirabeque”, which is consumed mainly fresh, the pod and grain together, and it is commercialised as a “delicatessen”. The second type, peas, only the grains are consumed as fresh food, potentiating increasingly its consumption. Our focus was to determinate the nutritional and organoleptic interest of both type of organic produced legumes. 7 varieties of commercial peas (Buddy, Ambassador, Altesse, Jumbo, Lincoln, Eddy and Zircon) and 7 of “tirabeque” (Bamby, Capuchino, Pea Delikata, Pea Zuccola, Tirabi, AR-24007, Tirabeque IS and a traditional cultivar) were analysed for colour, firmness, pH, soluble solids content, total acidity, ascorbic acid, total fenolic compounds, nutritional fiber and minerals, all of them traits of interest in alimentation quality. It is remarkable of these analysis the high content of soluble solids in peas, which it is between 12,84 °brix and 21,01 °brix, which correspond to high values for nutrition quality. It should be noted also, in our organic crop, the high content in C vitamin, between 30-60 mg/100 mg of fresh weighth. In tirabeque should be remarkable the high content of fenolic compounds, 250 to 650 mg GAE/100 g of fresh fruit.



## Quantifying pollination deficits in kiwi (*Actinidia deliciosa*) in Portugal

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**Keywords:** Pollination services; Food provision; Management; Pollination experiment; Pollen application

Pollination is an important biodiversity-dependent service supporting food provisioning and affecting directly the yield and quality of over 75% of crops worldwide. *Actinidia deliciosa* is a dioecious species and therefore efficient pollination, i.e., pollen transfer between male and female plants, is a key feature in fruit production. Moreover, kiwi fruit caliber and market value are largely influenced by the number of seeds formed, which in turn depends on the number pollen grains reaching the stigmas. Because of unpredictable pollination levels in kiwi orchards, producers frequently include management practices of pollen application. This practice has however two associated problems: the high costs of the pollen and the dissemination of the bacterial cancer (*Psa-Pseudomonas syringae* pv *actinidiae*) through pollen application. In this study we aimed at quantifying pollination services in kiwi orchards representing the entire production area of Portugal to provide real estimates on pollination deficits and guide management practices. We set up a classical pollination experiment involving the following pollination treatments: open pollination, quantifying services provided by current pollination vectors; supplemented pollination, quantifying yield under optimal pollination services; and emasculated open pollination, quantifying services provided by the wind. The controlled pollinations were applied to 30 female plants in each of 8 orchards across a North-South gradient in the North and Centre of Portugal. We hypothesize that: 1) if current pollination services are efficient, fruit set and fruit caliber from supplemented flowers will not differ from those from open pollinated flowers; and 2) wind will have a significant contribution for fruit set, but the resulting fruits are expected to have lower and highly variable calibers. Preliminary results show a reasonably high fruit set irrespective of the pollination treatment, but also a high variability in pollination deficits among orchards, particularly regarding the role of wind on fruit set. The results are discussed based on current and future management practices of kiwi orchards.

## Parental investment strategies of the solitary bee *Osmia caerulescens* (Linnaeus, 1758) in cherry agroecosystems [S]

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**Keywords:** parental investment; aspect; zone; diameter

A key fitness component in bees is body size, which is largely determined by the amount of food allocated to individual progeny. Numerous studies indicate that different ecological factors drive the resource allocation decisions by the females. Land-use changes and sunlight affect the distribution and availability of resources, which in turn influences the offspring body size. Additionally, nest site conditions, like the diameter of pre-existing holes, are also important. We evaluate the effects of different landscape factors and nest characteristics on parental investment, in terms of offspring body size, in the solitary bee *Osmia caerulescens* in the cherry agroecosystems of Jerte Valley (Cáceres, Spain). A non-intensive agricultural management with small crop fields and a high proportion of semi-natural elements is prevalent in the valley. Bees were obtained from standardized trap-nests established in 36 cherry orchards. We selected slope (sunny or shady), and zone openness (open, >40% of cropped area, or closed, <25%) as variables describing the landscape, and we analyzed the effects of these variables on the dry weight of the progeny emerged from stems with different diameters (small, 2.5-4 mm; medium, 4.5-5.5 mm; and large, 6-10 mm), separately for males and females. The sunny slope positively affects the dry weight of both the males and females emerged from medium and large diameter nests, probably due to factors usually associated with the sunny aspect (more sunlight hours or more floral resources). However, in small diameter nests, the differences in landscape composition between open and closed zones interact with the effect of the slope on the offspring body size. These results reflect that the parental investment strategies of *O. caerulescens* can be adapted to different scenarios in terms of the availability of nesting sites and resources, and that a multifactor approach (including abiotic and biotic factors, a landscape perspective and nest characteristics) is needed to analyze their populations.

## Effects of agricultural intensification on the community of bees in cereal landscapes

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**Keywords:** bees; agricultural intensification; size structure; community structure; families substitution

Many studies have demonstrated negative effects of agricultural intensification on diversity and abundance of pollinators, but there is scant literature on whether it affects their community structure. We focused on the size structure of the bee communities across landscape and local gradients of agricultural intensification during the peak-blooming period in rain-fed cereal-devoted landscapes. To this end, we analyzed whether taxonomic structure (family level) and size structure of bee community composition varied in relation to some indicators of agricultural intensification at landscape and field levels in cereal cropping agroecosystems. We tested the effects of the percentage of agricultural land (at landscape level), and the effect of conventional and organic management, the contrast between field edges and centers, and the contrast between cereal and legume crops (at field level). By means of ordination-based methods that combine the taxonomic and the size-structure information, we tested how intensification indicators modify the abundance of different families of bees, and whether the intensification at different levels induces changes in the size distribution of bee individuals. Bees are more abundant in field edges than field centers, but we found no differences between managements, and the effect of the extra flower resources of legumes is only marginally significant, increasing bee abundance in cereal-devoted landscapes. By combining taxonomic and size information, we were able to detect significant differences between localities (42 % of the variance) and between field centers and edges (4 %). However, only a small fraction (11 %) of the variance between localities relates to landscape level intensification. Furthermore, using taxonomic and size information provides similar results, which makes us to hypothesize that, if there is any filtering acting on the size of bees, it must operate through a substitution of bee families, which display strong differences in their size distribution.

## Management *Osmia bicornis* and study of other bee communities associated to rape crops [S]

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**Keywords:** Ecosystem services; *Osmia bicornis*; artificial nests; *Brassica napus*; ecological infrastructures

The motivation of the present work is to study the use of artificial nests in rapeseed crops (*Brassica napus* var. *oleifera* DC.) in the northeast of Salamanca (Spain) related to the pollinating capacity of a managed population of the megachilid bee *O. bicornis* (Linnaeus, 1758) (Hymenoptera: Megachilidae). In addition, its nesting biology as well as the diversity and abundance of solitary bees associated with the wild flora forming the ecological infrastructures located at the edges of the crop are also assessed. The parameters of the nests are obtained and the pollen samples mounted and determined by the usual techniques. Solitary bees are sampled from ecological infrastructures performing by transects with an entomological net. Data are statistically analyzed by SPSS and Primer 5 software. Pollen analysis reveal that *O. bicornis* predominantly use rapeseed pollen, favoring a high viability of his offspring. However, the production of the crop in which *O. bicornis* was tested results lower than expected due to the presence of a specific insect plague. The data reveal that occupation of the artificial nests by *O. bicornis* is significantly affected by the nest orientation. The size of the cells and the sex-ratio show significant differences according to the number of cells per nest and the position of the cell in the nest. Furthermore, this position significantly affects the fresh weight of the pollen masses. The results also show that the abundance of bees and the wealth of genera are significantly affected by the month, showing July the highest values. We highlight the importance of continue carrying out studies with a greater number of replicas using *O. bicornis*. In addition, we emphasize the need to maintain these ecological infrastructures and enhance the diversity of forage plants to ensure the persistence of a diverse and stable community of pollinators.

## Estimation of a sunflower pollination buffer

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**Keywords:** entomophilous pollination; ecosystem services; GIS; sunflower; green infrastructure

Sunflower is the most important oilseed crop in Castilla y León and other regions of Spain. This crop is highly dependent on insect pollination, having a direct impact on yields. In some areas of Spain, the highly fragmented landscape without natural green infrastructure (GI) poses a significant barrier to the pollination ecosystem service. Quantification of the efficacy of natural green infrastructure on pollination efficiency will help inform policy and land use decisions. In 2017, ten sunflower fields adjacent to two different landscape structures - with and without natural green infrastructure - were monitored in 5 different municipalities in the province of Burgos, Spain (one field of each type per municipality). In each field, the proportion of viable seed development was assessed on eight sunflower heads at four distances from field edge: 0, 15, 30, and 60 m. The effects of distance and landscape structure were evaluated and quantified in a statistical model. The effect of natural green infrastructure (NGI) on pollination was found to be significant, estimated to be 6% greater than in plots devoid of natural vegetation (NON). The effect of distance also significantly negatively affected pollination at an estimated rate of 0.085% per meter. Assuming a linear effect for distance from vegetation, and comparing the best and worst pollination rates between the two treatments using the estimations of the model, this information was used to construct a GIS-based projection of pollination buffer extending from existing natural GI in one study locality, using actual sunflower parcel locations from 2017. When assuming that all area within the projected buffer results in a 6% increase, it is estimated that economic gains in that particular locality 2017 could have been increased by 2,000 euros had the sunflower fields been planted near these natural GIs.

## Temporal and spatial niche partitioning in pollinator communities on sunflower fields [S]

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**Keywords:** Pollinators; Sunflower; Niche complementarity; Functional complementarity; Pollination services

Bee populations decline has become a major research focus during the last years. Global change drivers such as landscape transformation or temperature increase have adverse effects on pollinator diversity, raising the concerns about pollination services maintenance. Pollinator diversity is important to ensure pollination function via niche complementarity. Understanding niche complementarity in spatial and temporal terms is hence of paramount importance in leading crops. For that purpose, we tested niche complementarity across a gradient of landscape quality on sunflowers fields in Chizé, France, through an experimental design that disentangles the i) Temporal niche: activity patterns across the time of the day and across days. ii) Spatial niche: abundance difference between pollinators groups across and within fields. By using pollinators exclusion experiments we measured the effects of niche complementarity on yield. Our results show pollinator complementarity activity periods along the day and over a temperature range. We also found that the abundance of solitary bees and bumblebees at the edge of the fields is higher than at the center during the sunflower flowering, a pattern not observed for honeybees. In parallel, we report a decrease in the seed weight as the distance to the edge increases when honeybees and bumblebees were excluded experimentally, highlighting the reliance of solitary bees contribution on yield.

## Pollination services in Pomoideae and Prunoideae orchards: does pollinator deficit compromise fruit production?

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**Keywords:** Crop yield; Food provisioning; Orchard agroecosystems; Pollinators; Pollination ecosystem services

Pollination is a key ecosystem service in both managed and natural terrestrial ecosystems. This process is essential to support food provisioning, directly affecting the yield and quality of over 75% of the crops worldwide. However, pollination services are currently being compromised due to an accelerated decline of wild pollinator populations and because of the honeybee colony collapse. Pollinator's decline constitutes a major threat to sustainable crop production, bearing severe economic impacts. Pollination deficit may be minimized by crop-targeted technical solutions; still, ecological solutions are considered a better alternative, as they provide a multitude of ecosystem functions and services with increased quality. Still, current pollination deficits are largely unknown and rarely quantified, although being crucial to develop and implement management solutions. Within the scope of the PoliMax project, we focused in representative insect-pollinated fruit crops of the Centro and Centro-Oeste Region of Portugal, i.e., Pomoideae and Prunoideae orchards, and aimed to quantify the current pollination services to understand how this service could be limiting crop production to, subsequently, develop ecological solutions to ameliorate it. For that, during flowering of 2018 we performed controlled pollinations involving open pollination, pollinator exclusion and supplemented pollination, to quantify fruit production under different treatments, and undertake direct pollinator observations in the studied orchards to quantify pollinator diversity and abundance. The study was developed in orchards of three varieties of Pomoideae, var. Reineta and Fuji for apples, and var. Rocha for pears, and one variety of Prunoideae, the cherry var. Folfer Cov. Preliminary results show a reasonably high fruit set irrespective of the pollination treatment in some varieties, but also a high variability in pollination deficits and pollinator abundances within and among orchards. The results provide quantitative measurements of pollinator dependence and pollination services for the studied varieties and are discussed based on current and future management practices of the orchards.

## Poll-Ole-GI SUDOE: rural green infrastructures for the improvement of pollination services [S]

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**Keywords:** Ecological restoration; Green infrastructures; Oleaginous agroecosystems; Pollination services

The Southwest region of Europe has extensive areas of insect pollinated oilseed crops, with sunflower being the dominant crop with a high economic value. However, over the last decade, pollination services have been severely reduced by habitat destruction and global pollinator decline. Recent evidence has shown that such ecosystem service can be eventually mitigated by the implementation of natural and semi-natural green infrastructures in the landscape. Still, in areas dominated by sunflower crops such practice has not been properly demonstrated and implemented. Therefore, within the frame of the Poll-Ole-GI SUDOE project to increase pollinator's diversity and, ultimately, increase crop productivity, the main objectives of this work were (i) to analyse the current status of pollination services in sunflower crops, and (ii) to evaluate the contribution of green infrastructures as natural solutions to ameliorate pollination services in sunflower crops. For this, we delimited two different regions in Spain: Burgos and Cuenca. In Burgos, we defined five fields with natural green infrastructures and ten sites where green infrastructures were implemented. In Cuenca, we defined eleven fields with natural green infrastructures, and eleven sites where green infrastructures were implemented. During the sunflower flowering peak of 2017 and 2018, direct field observations (through pollinator censuses) were made at different distances from the green infrastructures, performing more than 130 hours of monitoring. We hypothesise that pollinator's abundance and diversity increases with the presence of the implemented green infrastructures. The data on visitation rates, frequency of interactions and pollinators abundance and diversity are analysed within these expectations and connected with the crop yield. The results will enable to design tools to improve pollination ecosystem service within sunflower fields.



## Lepidoptera as bioindicator of the conservation degree of olive groves in the Mediterranean [S]

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**Keywords:** Agrosystem; Agricultural practices; Biological diversity; Richness; Shannon index

In Spain olive groves have great socioeconomic and landscape relevance because of the wide area they occupy and the proportion of population that depends economically on this crop. However, these systems have been intensified or abandoned in recent years due to the rural exodus and the economic unsustainability of this crop without the Common Agricultural Policy (CAP). Estepa region (Seville, Spain) was taken as a case study, with mainly two differentiated olive management: 1) integrated (use of chemical fertilizers in a controlled manner by technical control agencies and deficit irrigation); and 2) ecological (rainfed regime and organic fertilizers). To analyze the influence of the agrarian management on the degree of quality of olives groves, the diversity of butterflies was studied as a bioindicator of the degree of conservation. Several transect samplings were carried out, identifying, at species level, the diurnal lepidoptera found according to the Butterfly Monitoring Scheme Protocol (BMS), on which several biodiversity indices were applied. The results showed a greater richness of generalist butterflies in the plots with integrated management, being relatively frequent species. On the other hand, butterflies characteristic of the ecological olive grove were more specialized, being rare species. Given that presence of lepidoptera in olive groves can be affected by several factors such as diffuse contamination (nitrogen, phosphorus and potassium among others), and farming practices, this group is consolidated as one good bioindicator of the olive grove quality. Considering that organic practices are more respectful with the environment, it is logical to expect a greater richness of lepidoptera under the plots with this management, however, the greatest richness of butterflies observed at integrated olive groves plots with agrochemicals may be due to the ecological plots of the Estepa region are in a conversion phase.

## Agroecological studies on soil biodiversity: changes and tendencies related with farm design in Mediterranean agroecosystems [S]

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**Keywords:** Soil biology; Biological indicators; Functional diversity; Agroecological transition

In processes of agroecological transition, the improvement of soil quality, through the increase of biota and habitat management (through crop diversification) constitute the two fundamental pillars to establish sustainable agroecosystems. This requires a conversion strategy based on designing of biodiverse farms that enhance the presence of functional groups - beyond the substitution of agri- cultural inputs. Is there a relationship between under and above soil diversity? Is faunistic biodiversity affected in agroecosystems with different farm designs? The aim of the present work is to establish the relationship between crop design and agroecosystem faunistic diversity. For it, soil samples obtained from agricultural systems with different designs (conventional, natural, organic transition, organic monoculture, agroecological) were submitted to the following protocol: 1) collection at 0-10cm depth; 2) 7 day mounting on a modified Berlese-Tullgren system for obtaining soil fauna; 3) conservation of soil fauna in 75% alcohol and 4) sample analysis under binocular stereo microscope for the identification of main faunistic groups. Richness, abundance, diversity ( $H'$ ) and homogeneity ( $J$ ) were determined. Results show a relative tendency with higher values of abundance, richness and diversity, but not in homogeneity, of soil fauna in agroecosystems that have a farm design with high crop diversity. It is concluded that there is a direct relation between diversity under and above soil surface thus reinforcing the importance of biodiverse farm design as a strategy for agroecological transition.

## Monitoring of biological pest control in tomato greenhouses [S]

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**Keywords:** *Nesidiocoris tenuis*; *Bemisia tabaci*; *Tuta absoluta*; Modelling

In Andalusia, Spain, most of the protected tomato crops are currently using biological control and integrated pest management. Biological control organisms are usually introduced in the greenhouse, and periodically inspected. In order to reduce the number of putative treatments using chemical pesticides, an evidence-based control strategy against one of the main pests in tomato, the whitefly *Bemisia tabaci*, is developed. Therefore we monitored the evolution of the pest and that of its principal predator, *Nesidiocoris tenuis*, in greenhouses in the province of Almería. Between September of 2017 and April of 2018, yellow sticky plates (1 every 250 m<sup>2</sup>) were introduced in about 5000 m<sup>2</sup> crop surface in greenhouses in five different locations. Every 2 weeks these plates were removed and replaced. Collected plates for each of every 16 sampling dates were taken to the lab and the numbers of *B. tabaci* and *N. tenuis* adults counted. Plots of the evolution of the whitefly and the predator suggested differences between greenhouses: *N. tenuis* efficiently controlled the whitefly in tomato greenhouses, only when no other pests, such as *Tuta absoluta*, were present. The invasion by this lepidopteran compromised the evolution of *N. tenuis* and subsequent pest control. It is concluded that the presence of *T. absoluta* should be included in predictive models.

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## Promoting sustainable cacao through bat ecosystem services [S]

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**Keywords:** Bats; Cacao plantations; Pest suppression; Sustainable Agriculture

About 70% of the world's chocolate is grown in Africa. Although insect pests can cause losses of hundreds of millions of euros annually, no studies from Africa have yet address the role of small vertebrates as pest suppressors in cacao farms. Bats are insect predators that play a major role in pest suppression worldwide, including the Neotropics and Africa. Our study aims to understand if bats contribute to the suppression of the cacao pests in Cameroon, thus sustainably increasing cacao productivity. We will use a multi-disciplinary approach by integrating diet metabarcoding results, based on faeces collect during mist-net session, and ecological modelling. By combining diet results with an innovative ecological network approach, we will be able to identify the species and the environmental factors (landscape and vegetation characteristics) that suppress pests while promoting environmental friendly cacao plantations. Results will consist of fine-scale and large-scale policy management recommendations to help farmers improve yields while contributing to bat conservation. Here we present the concept of our three year-long study and some preliminary results from our first field season.

## Distribution of *Dicyphus cerastii* Wagner (Heteroptera: Miridae) in Portugal [S]

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**Keywords:** Biological control; *Dicyphus umbertae*; Physalis; Predator; Tomato

Mirids are the biggest family in the Heteroptera suborder with many species occupying very different ecological niches. This family accounts for several important agricultural pests but also equally important natural enemies of pests. Within the Miridae, the subfamily Dicyphinae is widely recognized for having several important biological control agents. The most important species belong to genera *Macrolophus*, *Nesidiocoris* and *Dicyphus*. These species can be found in field crops but also, and very importantly, in protected crops where they prey on several pest species. *Dicyphus cerastii* found in Portugal previously reclassified as *D. umbertae* Sanchez and Cassis 2006, has recently been reclassified as *D. cerastii* (Sanchez & Cassis 2018) following a major revision of the genus. This species enters tomato greenhouses in spring where it feeds on important pests like whiteflies (Hemiptera: Aleyrodidae), *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), spider mites (Acari: Tetranychidae), and leafminers (Diptera: Agromyzidae), and so providing important ecosystem services as a natural enemy. The conservation of native mirid species, may be important to allow protected tomato crops without recurrent use of pesticides. For this matter, knowledge about the distribution of beneficial mirid species is critical to properly set strategies that allow and enhance their contribution to crop protection. *D. cerastii* has been collected in several locations in Portugal as part of an ongoing work developed by this team. We present a distribution map for this species and the host plants on which it has been found.

## Autochthonous parasitoid controls an invasive species in protected vegetable crops – preliminary evaluation

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**Keywords:** Conservation biological control; Ecological resilience; Functional biodiversity; *Necremnus tutae*; *Tuta absoluta*

The South American tomato moth, *Tuta absoluta* (Meyrick), was found in Europe for the first time in 2006, in Castellon, Valencia, and it was reported in Portugal in 2009. Since then, it has been considered as one of the tomato key-pests, both protected and open field processing crops. It has spread all over the Europe, Africa and Asia. *Necremnus tutae* is an Eulophidae detected for the first time parasitizing *Tuta absoluta* in the Mediterranean basin. It is an autochthonous parasitoid, native to the Mediterranean basin, described for the science in 2015 and whose primary host is yet unknown. Parasitism by this eulophid was firstly detected in 2008 in Spain but at that time it was identified as *N. near artynes*. Soon it was found around the Mediterranean Basin. In Portugal, it was detected in 2014, and it was formerly identified in 2015. It was found in the West region and also in the Southwest coast in protected tomato crops, being the most important species in the parasitoid complex of *T. absoluta*. This parasitoid decreases *T. absoluta* population by larval parasitism but also by adult female host feeding. This study aimed at evaluating the parasitism impact in different scenarios of cultural practices (e.g. pesticide use, sulphur application to repel oviposition). Parasitism has been followed in Integrated Pest Management and zero pesticide residue greenhouses in the West and in Southwest coast, collecting leaflets with mines with alive or recently dead larvae, walking randomly ca. at least half an hour (time was registered). In some cases, the parasitism was very high (almost 100% of the collected larvae found in a Southwest greenhouse, in May 2018). In other situations, parasitism was very low or even not observed. Parasitism rates were compared and differences among greenhouses are discussed taking into account the cultural practices adopted.

## Ecosystem services provided by soil arthropods across different crop production systems

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**Keywords:** Conservation; Functional biodiversity; Olive groves; Open field annual crops; Pitfall traps

The functional diversity of arthropods is central in agroecosystems as this would ensure the provisioning of different ecosystem services such as pest control, nutrients recycling, and pollination. These ecosystem services depend on cultural and phytosanitary practices. In the region of Ribatejo, open field annual crops and olive groves are among the more economically important crops, most of them in an intensive system regarding irrigation, fertilization, pesticide use and soil mobilization. Aiming at looking for the differences between the services that arthropod biodiversity can provide, a study was conducted to monitor soil arthropods in open field annual crops and in perennial crops, using pitfall traps. In a super-intensive olive grove, 72 pitfall traps were randomly set up and at open field crops 32 traps were used. Results revealed a huge difference between species richness and abundance. At olive groves samples revealed around 200 morphotypes and at open field crops only 90 were found.

Among the morphotypes the main functional groups were identified, especially those who are predators in a perspective of assessing the increase of the natural limitation of pests whose cycle is completed in the soil. This type of functional diversity is presented and discussed the reasons and practices responsible for the lack of this biodiversity.

## Spatial variability of the spider community in the olive grove agroecosystem in Trás-os-Montes (Portugal)

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**Keywords:** Shrubland; Predator; Canopy; Trunk; Ground

Agricultural practices can affect the species composition of natural enemies within agroecosystems and it is crucial to know how spatial variability of natural enemies within crops could affect their distribution. Here we aim to characterize the spatial structure of the spider community in the olive grove in Mirandela (Trás-os-Montes; Portugal). In may 2014 we sampled spiders in five olive groves and the corresponding adjacent shrubland areas. The horizontal variability of ground spiders was studied by sampling two plots (central and margin area) within the olive groves and one more plot within the shrubland area. To assess their vertical variability, we sampled the soil, trunk, and canopy strata within olive groves. Ground spiders were sampled using pitfall traps, whereas canopy spiders were sampled by shaking tree branches and individuals inhabiting the trunk were sampled using sticky traps. All the captured spiders were identified and grouped in functional groups, and we calculated the relative proportion of each functional group. We assessed the diversity of functional groups with accumulation curves and a NMDS was carried out for the horizontal gradient data. We captured a total of 1,191 spiders encompassing 28 families, 83 species and nine functional groups: ambushers, foliage runner hunters, ground hunters, orb-web builders, sheet web builders, space web builders, sensing web builders, stalkers, and wandering sheet/tangle weavers. Ground spiders were significantly more diverse than trunk and canopy spiders. The diversity of functional groups was increasingly higher from center of the olive grove to the shrubland area. The distribution of functional groups also followed a clear pattern vertically within the olive grove. For efficient pest management, it is necessary to consider the spatial variability of functional groups of spiders within the olive crop with the aim to enhance species communities of natural enemies.

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## EIFCP233.1, a new source of parthenocarpy for courgettes breeding

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**Keywords:** Reproductive development; New varieties; *Cucurbita pepo*

Organic crop of courgettes need varieties without dependency of bioestimulants sprays, which increase fruit set but far from 100%. Pollinators are only effective in summer, but its effectiveness is reduced dramatically in the cold months. This is the reason because production of fruits without external stimulus, parthenocarpic fruits, is a priority to reach for varieties of organic agriculture thorough production cycles by year. In the practice, to develop varieties with fruit set independent of external stimulus, it is important to consider the correct development of both sexual organs, checking at same time the fertility of male gametes, the pollen viability, to allow heredity of the trait to descendants.

A direct selection program of courgettes lines with high genetic variability, offered as a result one line, IFCP233.1, that show fruit developed with an immature flower not opened, and the production of male flower without any defects, including pollen viability percentage near 100%. The anthesis of the female flower was arrested, and the petals didn't reach maturity, even when the fruit reached the usual size in anthesis. The ovary diameter increased markedly. When petals were released of female flowers, it was observed the emergence of placental tissue and also the development of gametophytes with the morphology of seeds in the floral cavity. Then, to develop a commercial fruit, this line should be used as a source of parthenocarpic fruits, to be crossed with other lines without malformations. 75% approx. of viable plants show this phenotype, signalling a dominant gene behind the trait, although the heritability must be determined in the following generations of backcrossing or hybridisation.

This work focus the characterization of the reproductive development, both male and female development, of courgette line IFCP233.1, in order to confirm the fertility of male reproduction system, and the unusual disposition of tissues of female flowers, to consider this line as a potential source of parthenocarpy for courgettes breeding.

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