Book of Abstracts

UNIVERSIDADE DE ÉVORA MED IUFRO CHANGE

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IUFRO FOREST ENVIRONMENT DIV 8 CONFERENCE 2023

Tuesday, 24 October 2023 - Friday, 27 October 2023

Book of Abstracts

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Welcome

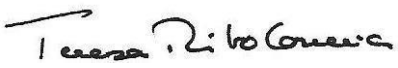
We are extremely pleased to welcome you all in University of Évora for the IUFRO Division 8 Forest Environment Conference 2023 The University building where we hold the conference in was created for an University already in the 16th century, and is now in the center of this historical UNESCO World Heritage town, Évora, and of a region with a specific Southern European character, Alentejo. Évora will be European Cultural Capital in 2027, and has adopted for this exceptional year the moto "vagar" – meaning slowness. By experiencing Évora and our region, you will perceive how this slowness creates and maintains a rich environment, including a unique forest.

In Alentejo, we are in a region dominated by a very particular type of forest, the holm and cork oak open forests corresponding to a silvo-pastoral system, the Montado. This open forest was mentioned in the very recent (September 2023) speech on the State of the European Union, by Ursula van der Leyen, President of the European Commission. She mentioned the cork oak forests of the South as one of the the three types of European forests we absolutely need to preserve, due to the incredible variety of ecosystem services they deliver to society. We hope you will get to visit and appreciate this forest. And we are sure you will help, with your rich scientific contributions and discussions, to new knowledge that can support decision and action for the preservation of such forests.

Overall, our conference focuses on the critical role of forested landscapes facing pressures driven by the Anthropocene. Many of the increasing challenges require approaches at different spatial and temporal scales so that we can understand the different ongoing processes and their consequences for ecological and socio-ecological systems and so that we can link to practice and to policy, through well-suited solutions towards increasing sustainability.

We need transformational and transitional thinking, knowledge and innovative approaches, new relationships between societal actors, new rules and management schemes, as well as supportive rather than controlling roles of governments. All these demands a holistic vision from society and decision-makers to ensure more resilient forested landscapes and better adapted to the most predictable scenarios of climate change and disturbance regimes.

Let's make together this Conference a relevant piece in the complex puzzle towards transformational and transitional thinking!



Chair of the IUFRO Div 8 Conference 2023, Évora

Organization

Scientific Committee

Alessandra De Marco (DIV.8 IUFRO), ENEA-SSPT, Italy

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Nuno Guiomar, MED-University of Évora, Portugal

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Sandra Luque, INRAE, France

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Organizing Committee

Teresa Pinto Correia, University of Évora, Portugal

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João Tiago Marques, University of Évora, Portugal

Patrícia Gazimba Bacalhau, University of Évora, Portugal

Sponsors

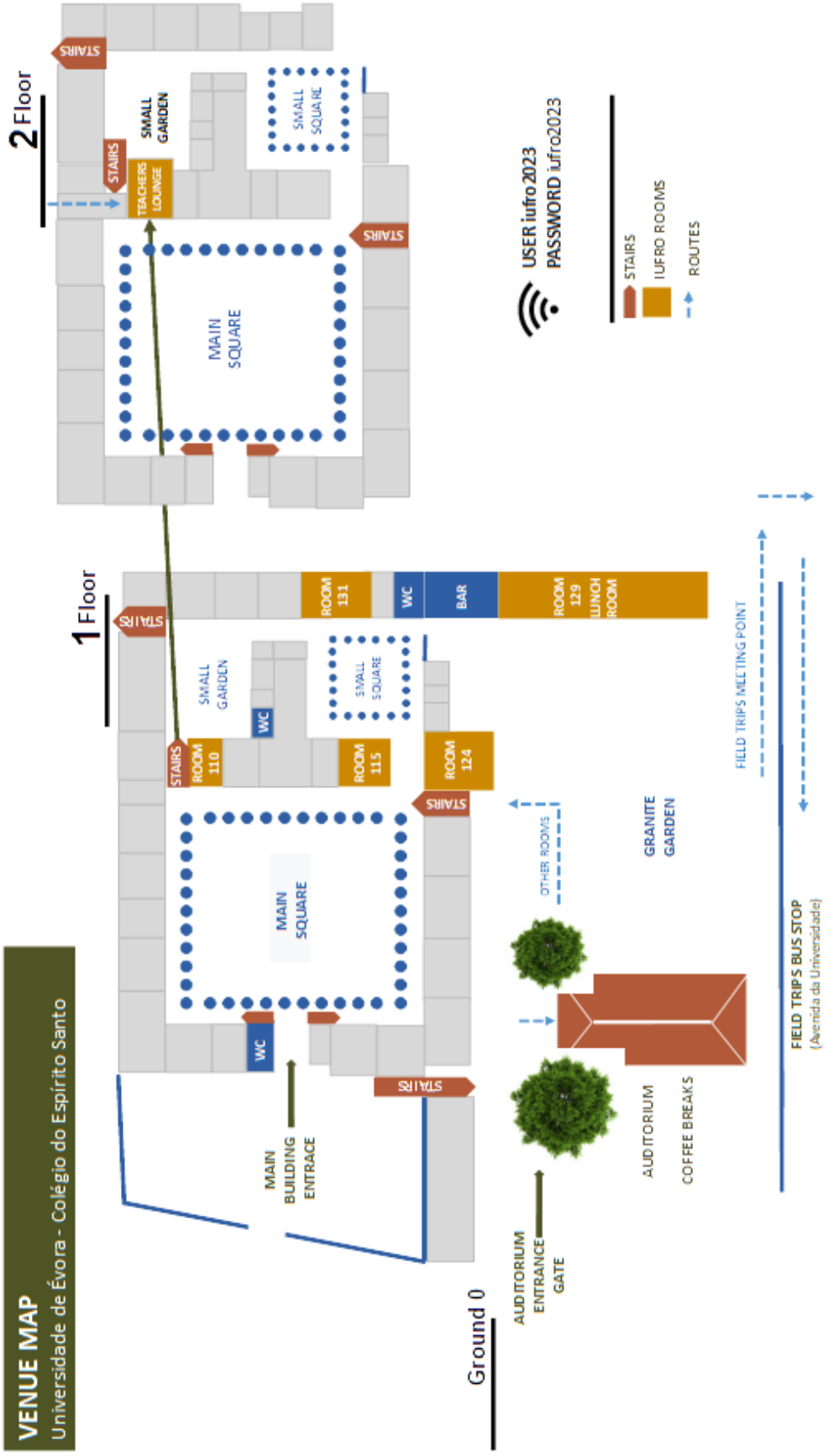
The Organizing Committee is grateful to the following companies and organizations for their kind sponsorship and support of IUFRO Forest Environment Div8 Conference 2023.

General Information

Meeting Venue

The meeting will take place at the auditorium of Colégio Espírito Santo (CES) located in University of Évora, R. do Cardeal Rei 6, 7000-645 Évora, Portugal.

Inside the CES building, the main conference room (the Auditorium), the parallel session rooms, the round table room, poster session venue exhibition and coffee break areas will be properly signposted, as illustrated in the map below.



Lunches

Lunches on Tuesday 24, Thursday 26 and Friday 27 of October will be served at room 129 of CES, and are included in the registration fee.

The lunch on Wednesday 25 will be distributed to all field trip participants as a brown bag previous buses departure.

Internet Access

A temporary login for the wireless Academic Network (eduroam) for the University of Évora has been created (valid from 21 to 28 of October). Please use the following credentials:

Guest User Name: iufro2023

Password: iufro2023

Scientific Information

Oral Communications

Speakers are kindly asked to contact the organizing committee to upload the presentation into the computer in the room where they will present, preferably on the previous day or at least 10 minutes before the session begins. If you prefer, you may send it to us in advance. For that, please use a cloud server and share the link with the IUFRO organizers (iufro2023@uevora.pt).

Posters Sessions

Posters will be displayed in the selected halls of CES. Authors are requested to display their posters on the post panels during the first coffee break on the 24th of October. Material to attach posters will be made available by the organizing committee at the front desk. Posters should be on display from Tuesday morning and left for the entire duration of the conference. Authors are requested to stay near their posters during both sessions so they will be available to answer any questions from the participants.

Language

English is the official language of IUFRO Forest Environment Div8 2023.

Useful Information

Timezone

The time zone in Portugal is GMT.

Water

Tap water in Portugal is drinking water.

Electricity

In Portugal, the line voltage is 220 V and the connection is made by a two pin plug. Travelers from the USA will require a voltage converter. Travelers from the UK will require a plug adapter.

Currency, Banks and Post Offices

The national currency in Portugal is Euro. Banks are open from Monday to Friday between 8:30 am and 3 pm. Post offices are usually open between 8:30 am and 6 pm.

Scientific Programme

Time	Tuesday 24/10	Wednesday 25/10	Thursday 26/10	Friday 27/10
08:00-09:00	Registration and Information desk	Registration and Information desk Field Trip: coming together at the meeting point and distribution in buses. Departure at 9:00	Registration and Information desk	Registration and Information desk
09:00-09:30	welcoming coffee	Field Trip	Keynote 3 - Camilla Sandström Keynote 4 - René Zamora Cristales Discussion	Paralel Sessions
09:30-10:00	Opening session			
10:00-10:30	Keynote1 - José M.Cardoso Pereira Keynote 2 - Pierre Paolo Roggero Discussion			
10:30-11:00			Coffee Break	
11:00-11:30			Paralel Sessions	Coffee Break
11:30-12:00	Coffee Break			Plennary Round Table + Launch of the Research Group on Silvo-pastoral systems
12:00-12:30	Poster Session			
12:30-13:00			Lunch	
13:00-13:30	Lunch			Lunch
13:30-14:00			Poster Session	
14:00-14:30	Paralel Sessions			
14:30-15:00			Paralel Sessions	
15:00-15:30				
15:30-16:00	Coffee Break			
16:00-16:30	Paralel Sessions		Coffee Break	
16:30-17:00			Paralel Sessions	
17:00-17:30				
17:30-18:00	Ad-hoc meetings			
18:00-18:30			IUFRO Div 8 General Meeting	
18:30-19:00	Sunset drink			
19:00-19:30				
19:30			Conference Dinner	

Detailed Scientific Programme

Tuesday, 24 October 2023

08:00	**Registration and Information desk**	
09:00	**Welcoming Coffee**- Atrium	
09:30	**Opening Session –** Auditorium	
	Which includes the Rector of the University of Évora, Hermínia Vasconcelos Vilar, the Research Director of INRAE and IUFRO Div8 Coordinator, Sandra Luque, the Director of the Research Unit MED, Fátima Batista and the Conference Chair, Teresa Pinto Correia.	

Chair: Teresa Pinto Correia

10:00	**PL 1**	**Fire regimes of Portugal: pastoral, periurban, wild, and agricultural** *José Miguel Cardoso Pereira*
10:30	**PL 2**	**Living labs for systemic innovations in silvopastoral systems: opportunities and challenges** *Pier Paolo Roggero*
11:30	**Coffee Break** - Atrium	
12:00	**Poster Session –** Small square	
13:00	**Lunch –** Room 129	

Parallel Sessions (14:00 – 17:30)

1. Human-nature relationships to support multifunctional forested landscapes, including socio-ecological approaches: Oral Presentations – Room 124

Chair: Helena Guimarães

14:00	**OC 1.1**	**Finding the path in the forest – An interdisciplinary approach towards multifunctionality in northern forests** *Cecilia Akselsson*
14:15	**OC 1.2**	**Effective Communication: Key to Advancing Multifunctional Forestry in the Climate Change Period** *Marcel Riedl*
14:30	**OC 1.3**	**Urban greenspace for Nature, Society and Culture across diverse landscapes and contexts in Eastern Europe** *Marine Elbakidze*

14:45	**OC 1.4**	**Where Forest Meets the Ocean: Operationalising an Integrated Landscape-Seascape Approach in Eastern Taiwan (2016-2023)** *Paulina Karimova*
15:00	**OC 1.5**	**Our Common Water** *Lars Högbom*

2. Innovative Tools, Methods and Approaches to improve decision-support and monitoring systems (e.g., coupling models, remote sensing, spatial tools, terrestrial sensors): Oral Presentations - Auditorium

Chair: Pierre Sicard

14:00	**OC 2.1**	**Canopy-based Classification of Urban Vegetation from Very High-Resolution Satellite Imagery** *Fatimatou Coulibaly*
14:15	**OC 2.2**	**The role of spaceborne LiDAR systems for forest monitoring** *Sérgio Godinho*
14:30	**OC 2.3**	**Close range remote sensing of relative humidity** *Alexandru Claudiu Dobre*

3. Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points: Oral Presentations – Room 131

Chair: Sergio Prats

14:00	**OC 3.1**	**Effect of mixture and management of a Southern European beech forest on carbon stocks and sinks** *Lorenzo MW Rossi*
14:15	**OC 3.2**	**Impact of five tree species conversion modalities on fauna and fungi soil biodiversity as monitored by DNA-metabarcoding in temperate forests** *Vicent Moulin*
14:30	**OC 3.3**	**Pyrenean oak forests under global change - integrating projected suitable areas in management plans** *Isabel Passos*

5. Silvopastoral systems and sustainable integrative solutions at the landscape level: Oral presentations – Room 115

Chair: Marina Castro

14:00	**OC 5.1**	**Developing soil early indicators on Montados' soil functions** *Oscar Gonzalez-Pelayo*
14:15	**OC 5.2**	**The positive effect of trees on pasture quality and soil carbon sequestration in holm oak savannas** *Alejandro Carrascosa Becerril*
14:30	**OC 5.3**	**The relationship between Canopy greenness and water availability in Cork and Holm Oak within the Portuguese Montado** *Danielle Rudley*
14:45	**OC 5.4**	**Towards satellite remote sensing of quality of Mediterranean grasslands to support management in agro-silvo-pastoral systems** *Jesús Fernández Habas*

Round Table: Forest Landscape Restoration initiatives: biodiversity, economy and people – Teachers' Lounge

Chairs: Anna Barbati; John Devaney; João Carlos Azevedo

14:00	**RT 1**	**Forest Landscape Restoration: resilient socioecological landscapes in the making** *René Zamora Cristales,Mónica Toro-Manriquez, Alejandro Huertas*
15:30		**Coffee Break**

2. Innovative Tools, Methods and Approaches to improve decision-support and monitoring systems (e.g., coupling models, remote sensing, spatial tools, terrestrial sensors): Oral Presentations – Auditorium

Chair: Nuno Guiomar

16:00	**OC 2.4**	**Improving conservation targets for forest biodiversity: toward operational solutions from space** *Sandra Luque*
16:15	**OC 2.5**	**Species distribution models using remote-sensed dynamic habitat index** *Maxime Lenormand*
16:30	**OC 2.6**	**Using remote sensing to model the breeding habitat of the Black Grouse, in open forest** *Alexandre Defossez*
16:45	**OC 2.7**	**Matching the effects of forest structure with management for predicting species occupancy at multiple spatial scales** *Adriano Mazziotta*

3. Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points: Oral Presentations – Room 131

Chair: Ana Cristina Gonçalves

16:00	**OC 3.4**	**How will climate change impact maritime pine forest distribution and productivity in Portugal?** *Cristina Alegria*
16:15	**OC 3.5**	**SWAT based responses on two contrasting eucalypt-dominated catchments under different climate scenarios** *João Rocha*
16:30	**OC 3.6**	**Soil organic carbon stock in managed, unmanaged, and disturbed Nothofagus forests in Chilean Patagonia** *Mónica Toro-Manriquez*

4. Forest management, public policies, governance models and decision making: Oral presentations – Room 124

Chair: Mª Helena Guimarães

16:00	**OC 4.1**	**Landscape transformation through collaborative approaches** *Sandra Valente*
16:15	**OC 4.2**	**Collaborative and strategic landscape planning for wildfire management – evidence from Portugal** *Teresa Pinto Correia*
16:30	**OC 4.3**	**Poor performance of community forests to sustainable livelihoods in Cameroon: long-term impact assessment and ways forward** *Guillaume Lescuyer*
16:45	**OC 4.4**	**Assessing Connectivity and Habitat Suitability of Green Infrastructure in the Boreal Forest of Sweden** *Ewa Orlikowska*

5. Silvopastoral systems and sustainable integrative solutions at the landscape level: Oral presentations – Room 115

Chair: Marina Castro

16:00	**OC 5.5**	**The transformation of the silvopastoral landscape of Montesinho Natural Park (1995 – 2021)** *Vitor Seripieri*
16:15	**OC 5.6**	**Stakeholder-informed assessment of grassland management for ecosystem services in dehesa/montado systems** *Verena Arndt*
16:30	**OC 5.7**	**Don't Put All your Eggs in One Basket: Montado silvo-pastoral system as a case study of resilience** *Isabel Ferraz de Oliveira*
16:45	**OC 5.8**	**Potential of Bituminaria bituminosa as a new forage perennial legume in Montados and Dehesas of the Iberian Peninsula** *Jesús Fernández Habas*

Round Table: Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points – Teachers' Lounge

Chairs: Pierre Sicard; Alessandra De Marco

16:00	**RT 2**	**Air Pollution and Climate Change Impacts** *Yasutomo Hoskhika;Ovidiu Badea*
17:30		**Ad-hoc meetings**
18:30		**Sunset drink**

Wednesday, 25 October 2023

08:00	**Registration and Information desk**
08:30	**Field Trip: Arrival to the meeting point**
09:00	**Field Trip: Bus departure**

Field Trip 1 (Green) – "Montado – a silvopastoral system with high biodiversity value"

Tiago Marques

The Montado is a multifunctional silvopastoral system that is known for its high levels of biodiversity and sustainable use of natural resources. However, in recent times, a general decline in the system has been observed in many areas due to various causes such as diseases, climate change, overgrazing, changes in land use and soil fertility. This decay is having negative impacts on biodiversity, ecosystem services, and the livelihoods of local communities. The Montado is a Mediterranean agro-sylvo-pastoral system, characterized by the presence of cork oak (*Quercus suber*) and holm oak (*Quercus rotundifolia*) trees, that are the main elements of the landscape. The scrub communities are diverse and typical of Mediterranean regions, and the landscape is also home to various freshwater habitats such as streams and temporary ponds, which enrich the biodiversity of the area. The cork oak is especially valuable for its bark that is harvested for cork production, which is an important economic activity. The acorns of the holm oak can feed the black pigs that graze in the undergrowth.

During this walk, we will explore a Montado landscape in the Mediterranean region, characterized by its well-preserved riparian areas. We will cover a distance of 10-12 kilometers and discuss the natural and social values of the landscape, as well as the management practices that are necessary to maintain them. This visit will provide an opportunity to learn about the biodiversity, ecosystem services, and cultural significance of the Montado, as well as the challenges and opportunities for its sustainable management.

Duration: 7.5 hours

Location: Serra de Monfurado, a Natura 2000 site near Évora

Field Trip 2 (Yellow) – "Sylvopastoral systems and sustainable integrative solutions at the landscape level"

Isabel Ferraz de Oliveira & Elvira Sales Baptista

Our visit will take us to different sustainable integrative approaches of sylvopastoral systems based on Montado. The Montado is a unique silvo-pastoral system based on native pastures under a canopy of evergreen oaks, where animals are raised free-ranging all year round. These systems have low labour and capital inputs and can provide a variety of ecosystem services. The oak trees are central to the multifunctional sylvopastoral Montado as, besides the cork and acorns' production, they also provide shade and shelter to livestock. Regarding feed resources, the Montado main constraints are related to low soil fertility and rainfall variation that have a huge impact on pasture biomass and animal productivity. Sustainable integrative solutions at the landscape level to cope with uncertainty within this system will be discussed. The farms are located within 50 Km from Évora, in the heart of the Montado.

Visit to two estates to see, in situ, the different activities, with special emphasis on forestry and grazing, which contribute to the integrated and sustainable management of the Montado.

Duration: 7.5 hours

Location: Farms near Évora

Field Trip 3 (Red) – "Cork and Forest Stands"

Ana Cristina Gonçalves

Visit to the Amorim cork factory and cork oak and umbrella pine forest stands. Corticeira Amorim is the world's biggest cork processing group and makes an unparalleled contribution to the business, market, economy, innovation and the sustainability of the entire cork industry. Founded in 1870, the company soon realized the infinite potential of this 100% natural raw material, transforming it into a widely-appreciated object in the context of an open, curious, alert, informed and prosperous society.

Cork oak and umbrella pine forest stands are multiple use systems characterized by its low density, heterogeneous spatial distribution, in which the main productions are bark (cork oak) and fruit, frequently associated to other productions such as grazing and non-woody products.

Duration: 7.5 hours

Location: Coruche

Thursday, 26 October 2023

08:00 **Registration and Information desk**

Chair: Sandra Luque

09:00 **PL 3** ***Forest governance in transition - caught between global agendas and local needs***
Camilla Sandström

09:30 **PL 4** ***Innovations to Enable, Invest and Monitor Landscape Restoration Implementation: Public and private finance to restore 350 million hectares of degraded landscapes globally***
René Zamora Cristales

10:30 **Coffee Break** – Atrium

Parallel Sessions (11:00-12:30)

3. Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points: Oral Presentations – Room 124

Chair: Sérgio Prats

11:00 **OC 3.7** **Even Cooler Insights: On the power of forests to (Water and Earth and) cool the Planet**
David Ellison

11:15 **OC 3.8** **Landscape fire severity: a multi-scale analysis of the drivers**
Nuno Guiomar

11:30 **OC 3.9** **Temporal and spatial patterns of extreme wildfire events at the European landscape scale**
Vanda Acácio

11:45 **OC 3.10** **Assessing the economic value of the Fire Protection Ecosystem Service in a mountainous landscape in northern Portugal**
Ângelo Sil

4. Forest management, public policies, governance models and decision making: Oral presentations – Auditorium

Chair: Mónica Toro-Manríquez

11:00	**OC 4.5**	**Moving to clear-cut free alternatives in Swedish forestry** *Renats Trubins*
11:15	**OC 4.6**	**Spatial decision support tools for assessing land-based climate mitigation actions** *Ekaterina Tarasova*
11:30	**OC 4.7**	**The Impact of Forest Management Plans on Forest Disturbances in Logging Concessions of the Congo Basin** *Marc Bouvier*
11:45	**OC 4.8**	**Characterization and Analysis of Rural Property Register as an Instrument for Land Management** *Maria de Belém Costa Freitas*

5. Silvopastoral systems and sustainable integrative solutions at the landscape level: Oral presentations – Room 115

Chair: Isabel Ferraz de Oliveira

11:00	**OC 5.09**	**How many trees to fall: how and where are we losing the Montado silvo-pastoral system?** *J. Tiago Marques*
11:15	**OC 5.10**	**Impact of cattle grazing spatiotemporal variation on cork oak seedling survival** *Abdullah Ibne Wadud*
11:30	**OC 5.11**	**Effects of conservation zones on the biodiversity and ecosystem services of Mediterranean evergreen oak woodlands** *Miguel Nuno Bugalho*
11:45	**OC 5.12**	**MIXED production at the landscape level: an emergy assessment on different agricultural systems under the same management** *Joana Marinheiro*

6. Forest Landscape Restoration initiatives: biodiversity, economy and people: Oral Presentations – Room 110

Chair: Patrícia Bacalhau

11:00	**OC 6.1**	**Learning from the past to face future challenges: gathering expert knowledge on the evolution of forest restoration in Europe** *Maitane Erdozain*
11:15	**OC 6.2**	**Trees4water- Tree based solutions for water quality improvement** *Cláudia Carvalho Santos*
11:30	**OC 6.3**	**Seedballs: Exploring its potential for an alternative planting strategies in elevating forest landscape restoration effort for Sarawak, Malaysia** *Annya Ambrose*

Round Table: Human-nature relationships to support multifunctional forested landscapes, including socio-ecological approaches - Teachers' Lounge

Chairs:Sandra Luque and Paulina G. Karimova

11:00	**RT 3**	**A Nexus approach to improving biodiversity and ecosystem services for sustainable landscapes on the road towards 2030 conservation targets** *Marine Elbakidze*
12:30	**Lunch –** Room 129	
13:30	**Poster Session –** Small Square	

Parallel Sessions (14:30-18:00)

2. Innovative Tools, Methods and Approaches to improve decision-support and monitoring systems (e.g., coupling models, remote sensing, spatial tools, terrestrial sensors): Oral Presentations – Room 131

Chair: Sandra Luque

14:30	**OC 2.8**	**Priority areas identification and management strategies for landscape forest restoration in Mozambique** *Frédérique Montfort*
14:45	**OC 2.9**	**Hurricane Activities in Gulf of Mexico Lead to Conversion of Forested Land: Implications for Water Quantity/Quality** *Latif Kalin*
15:00	**OC 2.10**	**Prioritizing Woodland Expansion with ECOFOREST: A Web-Based Tool for Ecosystem Service-Based Spatial Targeting** *Alessandro Gimona*

4. Forest management, public policies, governance models and decision making: Oral presentations – Auditorium

Chair: Francesca Giannetti

14:30	**OC 4.9**	**Forest certification and economic valorization in Europe: main drivers and limitations** *Sofia Corticeiro*
14:45	**OC 4.10**	**Matching policy and academic practices – the case of the Montado results-based payments** *Mª Helena Guimarães*
15:00	**OC 4.11**	**Riparian buffer zones in production forests create unequal costs among forest owners** *Tristan Bakx*
15:15	**OC 4.12**	**Institutional structures for protecting biodiversity and preventing illegal activities in forested landscapes in selected Western Balkan countries** *Maja Radosavljevic*
15:30	**OC 4.13**	**Private forest owners' organizations adherence to policy tools in Portugal** *Paula Simões*

5. Silvopastoral systems and sustainable integrative solutions at the landscape level: Oral presentations – Room 115

Chair: Athanasios Ragkos

14:30	**OC 5.13**	**Perceived benefits from agroforestry landscapes across North-Eastern Europe: What matters and for whom?** *Marine Elbakidze*
14:45	**OC 5.14**	**Agroforestry business model innovation network (AF4EU)** *Maria Rosa Mosquera-Lousada*
15:00	**OC 5.15**	**Modelling shepherds' decision-making about grazing on forested mountain landscapes - contributions for keeping discontinuity** *Catarina Esgalhado*
15:15	**OC 5.16**	**Residual signature of sewage sludge in soil bacterial communities 15 years after application** *Maria Rosa Mosquera-Lousada*

6. Forest Landscape Restoration initiatives: biodiversity, economy and people: Oral Presentations – Room 110

Chair: Miguel Bugalho

14:30	**OC 6.4**	**Rehabilitation of Nothofagus pumilio forests in northern Chilean Patagonia** *Alejandro Huertas Herrera*
14:45	**OC 6.5**	**Can biochar amendment of forest fire-affected soil reduce soil erosion by water?** *Oscar Gonzalez-Pelayo*
15:00	**OC 6.6**	**Climate Resilient Forest Restoration** *Patricia Maloney*
15:15	**OC 6.7**	**What's the value of Seed Dispersal?** *José Benedicto Royuela*
15:30	**OC 6.8**	**Upscaling forest restoration with SUPERB: The Spanish demonstrative area** *Judit Torres Fernández del Campo*

Round Table: Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points – Teachers' Lounge

Chairs: David Ellison

14:30	**RT 4**	**IUFRO Forest and Water Task Force Roundtable Discussion: Managing the Forest-Water & Energy Nexus in an Increasingly Competitive & Challenging World** *Nadeem Shah; Irena Creed; Lars Högbom; Adam Wei*
16:00	**Coffee Break** – Room 129	

1. Human-nature relationships to support multifunctional forested landscapes, including socio-ecological approaches: Oral Presentations – Room 110

Chair: João Azevedo

16:30	**OC 1.6**	**Post-abandonment landscape trajectories in Terras de Trás-os-Montes, Portugal** *Lien Imbrechts*
16:45	**OC 1.7**	**Expert's Perception Analysis on Alternatives to Compensate Feed Deficits for Livestock during Shortage Periods in Dehesas** *Verena Arndt*
17:00	**OC 1.8**	**How people perceive the ecosystem services provided by Pyrenean oak forests** *Anabela Paula*

2. Innovative Tools, Methods and Approaches to improve decision-support and monitoring systems (e.g., coupling models, remote sensing, spatial tools, terrestrial sensors): Oral Presentations – Room 131

Chair: Anna Barbati

16:30	**OC 2.11**	**Landscape Approaches as operational artifacts to move towards more sustainable governance of rural land-uses in the Mediterranean macro-regional context** *José Muñoz-Rojas*
16:45	**OC 2.12**	**Towards a Forest Bocage: multifunctionality of a network of broadleaved hedgerows in a pine plantation landscape** *Nattan Plat*
17:00	**OC 2.13**	**Functional connectivity models to inform sustainable management practices in standard production forests** *Pedro A. Salgueiro*
17:15	**OC 2.14**	**Critical biomass harvesting for policy support in northern forests** *Cecilia Akselsson*

3. Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points: Oral Presentations – Room 124

Chair: Ana Cristina Gonçalves

16:30	**OC 3.11**	**Bridging experimental and monitoring research for the assessment of ozone impacts on Mediterranean trees** *Yasutomo Hoshika*
16:45	**OC 3.12**	**Unravelling bat species' response to environmental structure and patterns of occupancy in a Mediterranean landscape** *Frederico Martins*
17:00	**OC 3.13**	**Trends in airborne oak pollen: climate change effects in Oaks Forest in Alentejo Region (South Portugal)** *Elsa Caeiro*
17:15	**OC 3.14**	**Mediterranean woodlands on the edge – Road pressure on rodent-mediated seed dispersal** *João Craveiro*
17:30	**OC 3.15**	**Responses of *Quercus ilex* seedlings to combined, drought and *Phytophthora cinnamomi,* stresses: a metabolomic analysis** *Marta Tienda Parrilla*

4. Forest management, public policies, governance models and decision making: Oral presentations – Auditorium

Chair: Marine Elbakidze

16:30	**OC 4.14**	**Prescribed fire management strategy for post-harvest eucalypt plantations in Portugal** *Sofia Corticeiro*
16:45	**OC 4.15**	**Forging fire-resilient landscapes: fire-smart solutions for sustainable wildfire risk prevention** *Anna Barbati*
17:00	**OC 4.16**	**How willing are individuals to be involved in forest fire prevention in Portugal?** *Maria Eduarda Fernandes*
17:15	**OC 4.17**	**The effect of knowledge in stakeholders' involvement in forest management: the example of Matas do Litoral public forest** *Maria Eduarda Fernandes*

Round Table: Forest Landscape Restoration initiatives: biodiversity, economy and people – Teachers' Lounge

Chair: Pia Katila

16:30	**RT 5**	**Context matters for forest restoration** *Glenn Galloway, Wil de Jong, Pablo Pacheco, Carol J. Pierce Colfer, Georg Winkel*
18:00	**IUFRO General Meeting**	
19:30	**Conference Dinner**	

Friday, 27 October 2023

08:00 **Registration and Information desk**

Parallel Sessions (09:00-11:00)

1. Human-nature relationships to support multifunctional forested landscapes, including socio-ecological approaches: Oral Presentations – Room 131

Chair: Gerardo Moreno

09:00	**OC 1.9**	**The Portuguese natural resin sector: from resin tapping to the second transformation industry** *Joana Vieira*
09:15	**OC 1.10**	**Pine-based forestry deters forest restoration in tropical mountain landscapes with traditional agriculture in southern Mexico** *Mario González-Espinosa*
09:30	**OC 1.11**	**Charcoal production in Licuati key biodiversity area: A participatory assessment of forest management and degradation** *Filipa Zacarias*

2. Innovative Tools, Methods and Approaches to improve decision-support and monitoring systems (e.g., coupling models, remote sensing, spatial tools, terrestrial sensors): Oral Presentations – Auditorium

Chair: J. Tiago Marques

09:00	**OC 2.15**	**Fire severity effects on soil Carbon and Nitrogen stocks in southern Iberian Peninsula: comparing prescribed and wildfires** *Sergio Prats*
09:15	**OC 2.16**	**Effects of land-use changes and fire events in the population dynamics of Acacia dealbata: a hybrid modelling approach** *Cristina Lima*
09:30	**OC 2.17**	**National Evaluation of Invasive Tree and Understory Forest Plant Prevalence across the United States** *Kevin Potter*

3. Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points: Oral Presentations – Auditorium

Chair: J. Tiago Marques

10:00	**OC 3.16**	**Increasing disturbance activity in forest ecosystems – Tipping points and adaptive management** *Dominik Thom*

4. Forest management, public policies, governance models and decision making: Oral presentations – Room 131

Chair: Gerardo Moreno

10:00	**OC 4.18**	**Is Woodland Expansion an Economically Efficient Alternative for Offsetting Carbon?** *Paola Ovando*
10:15	**OC 4.19**	**Pruning the economy: implications of degrowth scenarios for the forest sector** *Paul Rougieux*
11:00	**Coffee Break -** Auditorium	

Round Table & Launching of the Research Group SILVOPASTORAL SYSTEMS and PASTORALISM, in IUFRO Div 8 – Forest Environment - Auditorium

Chair: Teresa Pinto Correia

11:30	**RT 6**	***Facing Global Change, which policies to support the resilience of Mediterranean forests?*** ***Organization: CHANGE – Institute for Global Change and Sustainability, Portugal*** ***With*** *Athanasios Ragkos, Agricultural Economics Research Institute , Athens & coordinator of the Prima Project PASTINNOVA* *Lilia Fidalgo, Regional Directorate for Planning and Environment (CCDRA), Alentejo, Portugal* *Gerardo Moreno, Universidad de Extremadura, Spain* *Ana Cristina Cardoso, Cork Supply* ***& Launching of the Research Group SILVOPASTORAL SYSTEMS and PASTORALISM, in IUFRO Div 8 – Forest Environment***
13:00	**Lunch –** Room 129	

Plenary Lectures

PL 1 ***Fire regimes of Portugal: pastoral, periurban, wild, and agricultural***

José Miguel Cardoso Pereira

PL 2 ***Living labs for systemic innovations in silvopastoral systems: opportunities and challenges***

Pier Paolo Roggero

PL 3 ***Forest governance in transition - caught between global agendas and local needs***

Camilla Sandström

PL 4 ***Innovations to Enable, Invest and Monitor Landscape Restoration Implementation: Public and private finance to restore 350 million hectares of degraded landscapes globally***

René Zamora Cristales

José M.C. Pereira is Full Professor at the Department of Natural Resources, Environment, and Land, School of Agriculture (ISA), University of Lisbon, where he teaches courses in forest ecology and management, and environmental remote sensing. He has an undergraduate degree in forestry from ISA and a Ph.D. in Renewable Natural Resources Studies from the University of Arizona. He coordinates ISA's Forest Research Centre, a research unit with 80+ researchers. (http://www.isa.ulisboa.pt/en/cef/about). His research focuses on pyrogeography, including remote sensing of fire, risk mapping, and anthropogenic vegetation burning. He is a member of the Lisbon Academy of Sciences, Earth and Space Science Branch.

PL 1 - Fire regimes of Portugal: pastoral, periurban, wild, and agricultural

José M.C. Pereira[a]

[a] Department of Natural Resources, Environment, and Land, School of Agriculture (ISA), University of Lisbon

A classification and map of fire regimes in Portugal was developed at the parish level, using official statistics and remotely sensed data. The initial classification is based on a cluster analysis of variables describing spatial, temporal and behavioral features of fire, namely burned area and its interannual coefficient of variation, mean size of the 10 largest burned areas, number of fires, fire radiative power, fire season duration, and importance of winter fire. Subsequently, the strength of the relationship between fire clusters and a set of antecedent variables – land cover, climate types, human population density – is assessed to support interpretation of the fire clusters obtained in the first step. Nine distinct fire regimes emerge, which can be grouped into four fire macro-regimes: pastoral burning, small periurban fires, forest wildfires, and agricultural burns. We conclude with a short discussion of management implications tailored for the specificities of each fire regime.

Pier Paolo Roggero is full professor of Agronomy and Crop Sciences at the University of Sassari, in Sardinia (Italy). He worked as researcher at the Centre for Mediterranean Pastures (CNR), and as associate and full professor at the Polytechnic University of Marche until 2006.

He is currently director of the Department of Agricultural Sciences, University of Sassari (some 90 faculty members, some 1,000 BSc and MSc students) and he was director of the Desertification Research Center (NRD), for 10 years. He was President of the Italian Society of Agronomy and Secretary General of Desertnet international. He is Editor in Chief of the Italian Journal of Agronomy (IF2021=1.6).

His research expertise includes sustainable agricultural soil and water management, Mediterranean agro-silvopastoral systems, climate change adaptation and mitigation in agricultural systems, water resources management. He is co-author of more than 250 scientific publications, of which over 100 in ISI/Scopus peer-reviewed journals.

PL 2 - Living labs for systemic innovations in silvopastoral systems: opportunities and challenges

PP Roggero[a], C Ceseracciu[a], G Branca[a] and R Deriu[a]

[a] Desertification Research Centre, University of Sassari, viale Italia 39a, 07100 Sassari, Italy

Mediterranean silvopastoral systems are here framed as rural socio-ecological systems (rSES), in which ecological and socio-economic processes are structurally coupled. These systems are rooted in centuries of integrated pastoralism, forestry and agriculture, which shaped a large proportion of Mediterranean rural landscapes and related ecosystem services. The systemic changes that occurred in the last few decades, marked by constraints on generational turnover in rural areas, coupled with emerging climatic pressures and related impacts, alongside a limited adaptive capacity, collectively threaten the long-term sustainability of Mediterranean silvopastoral systems. Such dynamics result in the loss of fundamental ecosystem services and identity landscapes. Living labs (LL) are gaining ground as a novel approach to tackling sustainability challenges in rSES. However, existing LL literature is urban-centered, and the linear transfer of such approaches to rSES is not straightforward. We address the question of whether an adaptive LL approach can effectively support systemic innovation in rSES. Drawing on a systematic literature review, we offer new perspectives on how LL can contribute to rSES innovative governance by providing new learning spaces and business opportunities, especially for youth and women. A critical discussion on the main constraints/challenges arising from the conceptualization and operationalization of LL will be introduced to provide key recommendations for a more effective and transparent design and implementation of LL in rSES. Preliminary evidence is presented from a new LL in the cork oak silvopastoral systems of Sardinia threatened by depopulation and abandonment, drawing insights from a case study of the PRIMA-funded SALAM-MED project.

Camilla Sandström is professor in Political Science, Umeå University, Sweden and Chairholder, UNESCO chair on biosphere reserves as labs for inclusive societal transformation.

She is specialized in environmental governance, focusing in particular on the development of collaborative governance approaches and conflict mitigating policy instruments in various fields of nature resource management.

Her work is inter- and transdisciplinary, with a strong focus on Arctic environments, however she has also studied environmental governance in several countries in Europe and Africa.

PL 3 - Forest governance in transition - caught between global agendas and local needs

Camilla Sandstrom[a]

[a] Umeå University, Sweden

Disagreement centered around forests as a common good or a sovereign national resource has for a long time hampered the development of a global forest convention. Despite attempts at the UN Stockholm Conference in 1972 and later in Rio 1992, the countries decided not to adopt a convention, but agreed on a set of Forest Principles and a chapter in Agenda 21 on combating deforestation.

Whereas a forests convention has remained elusive, several intergovernmental platforms have been developed to stop deforestation and promote sustainable forest management. In parallel several private alternatives, including certification schemes, have developed trying to assure the consumers that forest products have been produced in a sustainable manner.

Consequently, global forest governance is often considered to be fragmented or even contradictory, lacking the necessary guidance as well as enforcement mechanisms for actors at multiple levels. However, the increasing pressure to address climate change and biodiversity loss has also put pressure on governments to maintain political momentum behind the COP26 commitments on forests and to take into account possible alignment with the new Global Biodiversity Framework.

However, the global debate on the role of forests still seems to be far removed from the debate on forests at the local level. Hence, there is an imminent risk that despite favorable circumstances the conditions for agreeing on forest governance at a global level may be undermined, if the vital role that forests play as food, fuel and fiber in rural communities around the world, is not appropriately considered.

René Zamora Cristales is Guatemalan, Senior Manager Restoration Policy for the Global Restoration at the World Resources Institute (WRI). In this role he also directs the secretariat of Initiative 20x20 the Latin American platform in support to the UN Decade in Ecosystem restoration. He also coordinates the Landscape Policy Acceleration Program to encourage innovation in public economic incentives.

Rene has a Doctoral degree (PhD.) in Forest Engineering and Economics from Oregon State University, USA. In 2019 Rene received the recognition of “Outstanding Doctoral Research Award” from the International Union of Forest Research Organizations IUFRO.

René's work is reflected in more than 30 publications in scientific journals on topics related to economics, private investments, public incentives, landscape monitoring and mathematical optimization methods for natural resources.

PL 4 - Innovations to Enable, Invest and Monitor Landscape Restoration Implementation: Public and private finance to restore 350 million hectares of degraded landscapes globally

Rene Zamora Cristales[a]

[a] *World Resources Institute (WRI)*

Many countries around the world have pledged hectares to the Bonn Challenge, Africa 100 and Initiative 20x20 platforms under the UN Decade on Ecosystem Restoration. Several governments have developed robust plans and strategies to prioritize areas for restoration under multiple environmental, social, and economic objectives. However, the implementation of restoration at scale has faced several challenges including the lack of public funding and incentives to support restoration actions, perverse incentives in agriculture, mining, and other sectors, and low development of value chains. To overcome many of these challenges, innovative financial mechanisms have been developed by governments and private sector to scale up implementation in the ground. Once these mechanisms have been implemented, there is a need to monitor the performance and impacts of restoring key ecosystem services. This presentation will focus on how innovative solutions around bottlenecks in public and private finance are being addressed and how they can catalyze implementation of restoration to achieve local, national, and global targets. The presentation will address the following questions: How are governments improving accessibility of payment for ecosystem services, credits or guarantees to marginalized groups? how could carbon taxes and markets accelerate or impede land restoration in forest and agricultural landscapes?; What are innovative tools to monitor restoration performance and impacts? and how can we achieve a balance between different policy objectives to produce, protect, conserve, and restore? Examples of real-world cases will be showcased from Mexico, Chile, Costa Rica, Rwanda, Malawi Guatemala, and El Salvador including a Landscape Restoration Sustainability Index developed by one of the pioneering countries for adaptive management.

Keywords: Restoration, Investments, Incentives, Economics, Policy, Optimization, Monitoring

Oral Communications

Oral Communications

1. Human-nature relationships to support multifunctional forested landscapes, including socio-ecological approaches

OC 1.1 **Finding the path in the forest – An interdisciplinary approach towards multifunctionality in northern forests**
Cecilia Akselsson, Hanna Andersson, Marie Appelstrand, Ljusk Ola Eriksson, Maria Johansson, Renats Trubins, Henrik G. Smith

OC 1.2 **Effective Communication: Key to Advancing Multifunctional Forestry in the Climate Change Period**
Marcel Riedl, Vilém Jarský

OC 1.3 **Urban greenspace for Nature, Society and Culture across diverse landscapes and contexts in Eastern Europe**
Marine Elbakidze, Ivan Kruhlov, Lucas Dawson, Nataliia Korohoda, Tamari Kurdadze

OC 1.4 **Where Forest Meets the Ocean: Operationalising an Integrated Landscape-Seascape Approach in Eastern Taiwan (2016-2023)**
Kuang-Chung Lee, Paulina G. Karimova

OC 1.5 **Our Common Water**
Lars Högbom, Martyn Futter, Johan Heurgren, Tom Nisbet, Gregory Valatin

OC 1.6 **Post-abandonment landscape trajectories in Terras de Trás-os-Montes, Portugal**
Lien Imbrechts, João C. Azevedo, Peter H. Verburg

OC 1.7 **Expert's Perception Analysis on Alternatives to Compensate Feed Deficits for Livestock during Shortage Periods in Dehesas**
Verena Arndt, Jesùs Fernández-Habas, Norbert Weber, Pedro Sánchez-Zamora, Pilar Fernández Rebollo, Tom Vanwalleghem

OC 1.8 **How people perceive the ecosystem services provided by Pyrenean oak forests**
Anabela Paula, Isabel Passos

OC 1.9 **The Portuguese natural resin sector: from resin tapping to the second transformation industry**
Joana Vieira, Carlos Fonseca, Marta Martins, Rogério Rodrigues

OC 1.10 **Pine-based forestry deters forest restoration in tropical mountain landscapes with traditional agriculture in southern Mexico**
Mario González-Espinosa, Marisol Martínez-Ramos, Neptalí Ramírez-Marcial, Ricardo Pérez-López, Vianney Beraud-Macías, María Magdalena Alcázar-Gómez, Luis Galindo-Jaimes

OC 1.11 **Charcoal production in Licuati key biodiversity area: A participatory assessment of forest management and degradation**
Filipa Zacarias, Marina Temudo, Ana Cabral

2. Innovative Tools, Methods and Approaches to improve decision-support and monitoring systems (e.g., coupling models, remote sensing, spatial tools, terrestrial sensors)

OC 2.1 **Canopy-based Classification of Urban Vegetation from Very High-Resolution Satellite Imagery**
Fatimatou Coulibaly, Alessandra De Marco, Elena Paoletti, Pierre Sicard

OC 2.2 **The role of spaceborne LiDAR systems for forest monitoring**
Sérgio Godinho

OC 2.3 **Close range remote sensing of relative humidity**
Alexandru Claudiu Dobre, Ionut Silviu Pascu, Ștefan Leca, Ovidiu Badea

OC 2.4 **Improving conservation targets for forest biodiversity: toward operational solutions from space**
Sandra Luque

OC 2.5 **Species distribution models using remote-sensed dynamic habitat index**
Samuel Alleaume, Maxime Lenormand, Sandra Luque, Clémentine Préau, Maïri Souza Oliveira

OC 2.6 **Using remote sensing to model the breeding habitat of the Black Grouse, in open forest**
Alexandre Defossez, Mairi Souza Oliveira, Dino Ienco, Josselin Giffard-Carlet, Sandra Luque, Samuel Alleaume

OC 2.7 **Matching the effects of forest structure with management for predicting species occupancy at multiple spatial scales**
Adriano Mazziotta, Andreas Lindén, Kyle Eyvindson, Simone Bianchi, Annika Kangas, Juha Heikkinen, Leena Ruha, Jukka Forsman

OC 2.8 **Priority areas identification and management strategies for landscape forest restoration in Mozambique**
Frédérique Montfort, Clovis Grinand, Marie Nourtier, Agnès Bégué, Valéry Gond, Lilian Blanc

OC 2.9 **Hurricane Activities in Gulf of Mexico Lead to Conversion of Forested Land: Implications for Water Quantity/Quality**
Latif Kalin, Dongjun Lee

OC 2.10 **Prioritizing Woodland Expansion with ECOFOREST: A Web-Based Tool for Ecosystem Service-Based Spatial Targeting**
Alessandro Gimona, Bethany Wilkins, Andrea Baggio-Compagnucci, Marie Castellazzi, Faye Jackson, Iain Malcolm, Zisis Gagkas, Robin Pakeman

OC 2.11 **Landscape Approaches as operational artefacts to move towards more sustainable governance of rural land-uses in the Mediterranean macro-regional context**
José Muñoz-Rojas

OC 2.12 **Towards a Forest Bocage: multifunctionality of a network of broadleaved hedgerows in a pine plantation landscape**
Nattan Plat, Hervé Jactel

OC 2.13 **Functional connectivity models to inform sustainable management practices in standard production forests**
Pedro A Salgueiro, Francesco Valerio, Cláudio João, Carmo Silva, João E Rabaça, António Mira, Sara M Santos

OC 2.14 **Critical biomass harvesting for policy support in northern forests**
Cecilia Akselsson, Gunilla Pihl Karlsson, Per Erik Karlsson, Salim Belyazid, Sofie Hellsten, Veronika Kronnäs

OC 2.15 **Fire severity effects on soil Carbon and Nitrogen stocks in southern Iberian Peninsula: comparing prescribed and wildfires**
Sergio Prats, Nuno Guiomar, Sandra Nicolas, Sara De Paula, Agustin Merino, Pablo Souza, Jose Maria De la Rosa, José Antonio Gonzalez-Perez, Franciscus Verheijen, Javier Madrigal

OC 2.16 **Effects of land-use changes and fire events in the population dynamics of Acacia dealbata: a hybrid modelling approach**
Cristina Lima, João Cabral, Mário Santos, Rita Bastos, Eva Pinto, Joana Vicente

OC 2.17 **National Evaluation of Invasive Tree and Understory Forest Plant Prevalence across the United States**
Kevin Potter, Qinfeng Guo, Kurt Riitters

3. Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points

OC 3.1 **Effect of mixture and management of a Southern European beech forest on carbon stocks and sinks**
Lorenzo MW Rossi, Silvio Oggioni, Matteo Vizzarri, Sebastian Brocco, Giorgio Vacchiano

OC 3.2 **Impact of five tree species conversion modalities on fauna and fungi soil biodiversity as monitored by DNA-metabarcoding in temperate forests**
Vincent Moulin, Michaël Aubert, Lucie Vincenot, Robinson Ribemont, Fabrice Bureau, Lucas Poulard

OC 3.3 **Pyrenean oak forests under global change - integrating projected suitable areas in management plans**
Isabel Passos, Alice Almeida, Carlos Vila-Viçosa, Maria Margarida Ribeiro, Albano Figueiredo

OC 3.4 **How will climate change impact maritime pine forest distribution and productivity in Portugal?**
Cristina Alegria, Alice M. Almeida, Maria Margarida Ribeiro, Natália Roque, Paulo Fernandez, Saki Gerassis, Teresa Albuquerque

OC 3.5 **SWAT based responses on two contrasting eucalypt-dominated catchments under different climate scenarios**
João Rocha, Ana Quintela, Sérgio Fabres, David Carvalho, Jacob Keizer, Dalila Serpa

OC 3.6 **Soil organic carbon stock in managed, unmanaged, and disturbed Nothofagus forests in Chilean Patagonia**
Mónica Toro-Manríquez, Fernanda Rivas Guíñez, Macarena Luco, Cristofer Mardones, Alejandro Huertas Herrera

OC 3.7 **Even Cooler Insights: On the power of forests to (Water and Earth and) cool the Planet**
David Ellison

OC 3.8 **Landscape fire severity: a multi-scale analysis of the drivers**
Nuno Guiomar, Sérgio Godinho, Tiago Marques, Rui Machado, Paulo Fernandes

OC 3.9 **Temporal and spatial patterns of extreme wildfire events at the European landscape scale**
Vanda Acácio, Susana Dias, Inês M. Duarte, Conceição Colaço, Leónia Nunes, Catarina Sequeira, Iryna Skulska, Francisco C. Rego

OC 3.10 **Assessing the economic value of the Fire Protection Ecosystem Service in a mountainous landscape in northern Portugal**
Ângelo Sil, João C. Azevedo, Paulo M. Fernandes, João P. Honrado

OC 3.11 **Bridging experimental and monitoring research for the assessment of ozone impacts on Mediterranean trees**
Yasutomo Hoshika, Barbara Baesso Moura, Elena Paoletti, Elisa Carrari, Laurence Dalstein-Richier, Pierre Sicard, Stefan Leca, Ovidiu Badea, Diana Pitar-Silaghi, Anumol Shashikumar, Marie-lyne Ciriani

OC 3.12 **Unravelling bat species' response to environmental structure and patterns of occupancy in a Mediterranean landscape**
Frederico Martins, Sérgio Godinho, Nuno Guiomar, Denis Medinas, Hugo Rebelo, Pedro Segurado, João Tiago Marques

OC 3.13 **Trends in airborne oak pollen: climate change effects in Oaks Forest in Alentejo Region (South Portugal)**
Elsa Caeiro, Beatriz Tavares, Irene Câmara-Camacho

OC 3.14 **Mediterranean woodlands on the edge – Road pressure on rodent-mediated seed dispersal**
João Craveiro, Miguel Bugalho, Pedro Vaz

OC 3.15 **Increasing disturbance activity in forest ecosystems – Tipping points and adaptive management**
Dominik Thom

OC 3.16 **Responses of *Quercus ilex* seedlings to combined, drought and *Phytophthora cinnamomi*, stresses: a metabolomic analysis**
Marta Tienda Parrilla, Cristina López Hidalgo, Rocío Valderrama Fernández, María Dolores Rey, Jesús Jorrín Novo

4. Forest management, public policies, governance models and decision making

OC 4.1 **Landscape transformation through collaborative approaches**
Sandra Valente, Virgínia Rocha, Jorge Brito, Jorge Cunha

OC 4.2 **Collaborative and strategic landscape planning for wildfire management – evidence from Portugal**
Teresa Pinto-Correia, Nuno Guiomar, Jorgen Primdahl

OC 4.3 **Poor performance of community forests to sustainable livelihoods in Cameroon: long-term impact assessment and ways forward**
Guillaume Lescuyer, Fabrice Kengen Fotso, Ghislain Fomou, Félicité Bietchoua

OC 4.4 **Assessing Connectivity and Habitat Suitability of Green Infrastructure in the Boreal Forest of Sweden**
Ewa Orlikowska, Jakub Bubnicki, Bengt Gunnar Jonsson, Johan Svensson, Grzegorz Mikusinski

OC 4.5 **Moving to clear-cut free alternatives in Swedish forestry**
Renats Trubins

OC 4.6 **Spatial decision support tools for assessing land-based climate mitigation actions**
Ekaterina Tarasova, Giulio Di Lallo, Lucia Perugini, Maria Vincenza Chiriacò, Monia Santini, Riccardo Valentini

OC 4.7 **The Impact of Forest Management Plans on Forest Disturbances in Logging Concessions of the Congo Basin**
Marc Bouvier, Kenneth Houngbedji, Antoine Leblois, Jean-Sylvestre Makak, Benoit Mertens

OC 4.8 **Characterization and Analysis of Rural Property Register as an Instrument for Land Management**
Miguel Domingos Teixeira, Maria de Belém Costa Freitas, Carla Maria Rolo Antunes, Henrique César Ribeiro, Maria do Rosário Partidário

OC 4.9 **Forest certification and economic valorization in Europe: main drivers and limitations**
Sofia Corticeiro, Helena Vieira

OC 4.10 **Matching policy and academic practices – the case of the Montado results-based payments**
Mª Helena Guimarães, Isabel Ferraz-de-Oliveira, Teresa Pinto-Correia, Maria Freitas, Elvira Sales-Batista, André Oliveira, Maria Coelho, Tiago Marques, João Madeira, Maria Bastidas

OC 4.11 **Riparian buffer zones in production forests create unequal costs among forest owners**
Tristan Bakx, Renats Trubins, Nils Droste, William Lidberg, Cecilia Akselsson

OC 4.12 **Institutional structures for protecting biodiversity and preventing illegal activities in forested landscapes in selected Western Balkan countries**
Maja Radosavljevic, Mauro Masiero, Todora Rogelja

OC 4.13 **Private forest owners' organizations adherence to policy tools in Portugal**
Maria Eduarda Fernandes, Paula Simões

OC 4.14 **Prescribed fire management strategy for post-harvest eucalypt plantations in Portugal**
Sofia Corticeiro, Ana Quintela, Paula Maia, Bruna Oliveira, Carlos Alves, Célia Fernandes, Oscar Pelayo, Jan Jacob Keizer, Sérgio Fabres, Cláudio Teixeira, Paulo Fernandes

OC 4.15 **Forging fire-resilient landscapes: fire-smart solutions for sustainable wildfire risk prevention**
Anna Barbati, Silvio Oggioni, Eduard Plana, Davide Ascoli, Antonio Tomao, Mario Colonico, Francesco Giannino, Mauro Moreno, Gavriil Xanthopoulos, Miltiadis Athanasiou, Konstantinos Kaoukis, Conceição Colaço, Francisco Rego, Catarina Sequeira, Vanda Acácio, Marta Serra

OC 4.16 **How willing are individuals to be involved in forest fire prevention in Portugal?**
Marieta Valente, Maria Eduarda Fernandes, Lígia Pinto

OC 4.17 **The effect of knowledge in stakeholders' involvement in forest management: the example of Matas do Litoral public forest**
Maria Eduarda Fernandes, Carla Ferreira, Elisabete Figueiredo, Cristina Ribeiro

OC 4.18 **Is Woodland Expansion an Economically Efficient Alternative for Offsetting Carbon?**
Paola Ovando, Marie Castellazzi, Andrea Baggio-Compagnucci, Richard J. Hewitt, Alessandro Gimona

OC 4.19 **Pruning the economy: implications of degrowth scenarios for the forest sector**
Paul Rougieux, Sarah Mubareka

5. Silvopastoral systems and sustainable integrative solutions at the landscape level

OC 5.1 **Developing soil early indicators on Montados' soil functions**
Oscar Gonzalez-Pelayo, Helena Guimarães, Teresa Pinto-Correia

OC 5.2 **The positive effect of trees on pasture quality and soil carbon sequestration in holm oak savannas**
Alejandro Carrascosa Becerril, Gerardo Moreno, Cristina Frade, Ángel Valverde, José Mariano Igual, Sara Rodrigo, Víctor Rolo

OC 5.3 **The relationship between Canopy greenness and water availability in Cork and Holm Oak within the Portuguese Montado**
Danielle Rudley, Maria da Conceição Caldeira, Valentine Aubard, David Coomes, João M.N. Silva

OC 5.4 **Towards satellite remote sensing of quality of Mediterranean grasslands to support management in agro-silvo-pastoral systems**
Jesús Fernández Habas, Begoña Abellanas Oar, José Ramón Leal-Murillo, Mª Teresa Hidalgo-Fernández, José García Arnés, Pilar Fernández-Rebollo

OC 5.5 **The transformation of the silvopastoral landscape of Montesinho Natural Park (1995 – 2021)**
Vitor Seripieri, José Castro, Maria Madalena Silva, Marina Castro

OC 5.6 **Stakeholder-informed assessment of grassland management for ecosystem services in dehesa/montado systems**
Verena Arndt, Victoria Vicario-Modroño, Ricardo Zanatti

OC 5.7 **Don't Put All your Eggs in One Basket: Montado silvo-pastoral system as a case study of resilience**
Elvira Sales-Baptista, Isabel Ferraz-de-Oliveira, José Muñoz-Rojas

OC 5.8 **Potential of *Bituminaria bituminosa* as a new forage perennial legume in Montados and Dehesas of the Iberian Peninsula**
Jesús Fernández Habas, Daniel Real, José Ramón Leal-Murillo, Mª Teresa Hidalgo-Fernández, Pilar Fernández-Rebollo, Tom Vanwalleghem

OC 5.9 **How many trees to fall: how and where are we losing the Montado silvo-pastoral system?**
J. Tiago Marques, Nuno Guiomar, Teresa Pinto-Correia

OC 5.10 **Impact of cattle grazing spatiotemporal variation on cork oak seedling survival**
Abdullah Ibne Wadud, Joao Craveiro, Simone Erroi, Sandra Alcobia, Miguel Bugalho, Manuela Branco, Pedro Vaz

OC 5.11 **Effects of conservation zones on the biodiversity and ecosystem services of Mediterranean evergreen oak woodlands**
Miguel Nuno Bugalho, Teresa Mexia, Xavier Lecomte, Rui Morgado, Catry Inês, Rui Pedroso, Maria da Conceição Caldeira

OC 5.12 **MIXED production at the landscape level: an emergy assessment on different agricultural systems under the same management**
Joana Marinheiro, Ana Fonseca, Cláudia Marques-dos-Santos

OC 5.13 **Perceived benefits from agroforestry landscapes across North-Eastern Europe: What matters and for whom?**
Marine Elbakidze, Jose Muñoz-Rojas, Diana Surova

OC 5.14 **Agroforestry business model innovation network (AF4EU)**
María Rosa Mosquera-Losada, Nuria Ferreiro-Domínguez

OC 5.15 **Modelling shepherds' decision-making about grazing on forested mountain landscapes - contributions for keeping discontinuity**
Catarina Esgalhado, María Rivera, Teresa Pinto-Correia

OC 5.16 **Residual signature of sewage sludge in soil bacterial communities 15 years after application**
Vanessa Álvarez-López, Nuria Ferreiro-Domínguez, Antonio Rigueiro-Rodríguez, María Rosa Mosquera-Losada

6. Forest Landscape Restoration initiatives: biodiversity, economy and people

1. Human-nature relationships to support multifunctional forested landscapes, including socio-ecological approaches

OC 1.1 Finding the path in the forest – An interdisciplinary approach towards multifunctionality in northern forests

Cecilia Akselsson[a], Hanna Andersson[b], Marie Appelstrand[c], Ljusk Ola Eriksson[d], Maria Johansson[b], Renats Trubins[d], Henrik G. Smith[e]

[a] Department of Physical Geography and Ecosystem Science and Centre for Environmental and Climate Science, Lund University, Sweden
[b] Department of Architecture and Built Environment, Lund University, Sweden
[c] Department Business Law, Lund University, Sweden
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Recent focus on climate mitigation has highlighted the difficulties of simultaneously achieving multiple goals in forests. Identifying management strategies that promote multiple goals while accounting for potential conflicts between forest owners and other interest groups is a necessary step towards multifunctionality. Here we present an approach and preliminary results of an on-going project, focussing on southern Sweden with mostly privately owned productive forests, high biodiversity values and increasing demands from a growing population. The aim is to identify management strategies balancing and alleviating trade-offs between forest production, biodiversity, climate mitigation and people's perceived quality of life. To reach the aim, we work in an interdisciplinary research team in close collaboration with stakeholders representing different interests. We use the decision support system Heureka as a platform for trade-off analyses, to which we link improved models and indicators for biodiversity and perceived quality of life. Furthermore, we identify and evaluate the potential to implement policy instruments supporting management across scales, in interaction with stakeholders. Our studies so far have highlighted the importance of a common language to fit the widely different values into a common platform. A great effort has to be put on the translation between management alternatives and the values. For production it is relatively straight forward, whereas the prerequisites for biodiversity depends on time aspects and the spatial distribution of management alternatives. Consequences for people's perceived quality of life also involves perceptual and emotional processes. We have identified different options for spatial planning to alleviate trade-offs and started to link them to an optimal combination of instruments to tackle existing obstacles to management changes, taking into account legislative barriers as well as incentives for landscape scale planning.

OC 1.2 Effective Communication: Key to Advancing Multifunctional Forestry in the Climate Change Period

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The global economic crisis and climate change have underscored the importance of developing multifunctional forestry in the Anthropocene period in the Czech Republic. However, realizing this vision requires effective communication strategies both within and outside the forestry sector. One key area of focus is external communication, which is essential for achieving long-term social and political support for the goals of multifunctional forest management. Based on a quantitative study of 3,500 respondents, a communication strategy was proposed to address these issues and improve the forestry sector's public image and its positioning on the public perception map. This strategy utilizes a quintuple helix platform that involves academia, industry, government, civil society, and the public to promote collaboration and drive change. The platform would foster transparency, facilitate communication, and enhance social engagement with the forestry sector, promoting the integration of ecological initiatives and ensuring the sustainability of multifunctional forestry. Another important aspect is internal communication, particularly with small forest owners who may lack sufficient knowledge and motivation to actively manage their forests based on multifunctional forestry. To optimize the existing communication mix, CAWI research was conducted on 72 professional forest managers who oversee 70,530 hectares of forest owned by 56,618 small forest owners. Through this analysis, the communication and information needs of small forest owners were identified, and recommendations were made to improve communication channels and enhance their effectiveness. The research was supported by the NAZV projects QK21020371 and QK23020008.

OC 1.3 Urban greenspace for Nature, Society and Culture across diverse landscapes and contexts in Eastern Europe

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Global policies call for a transformation in society's relationship with nature and acknowledge the importance of increasing urban green space (UGS). This study explores how urban citizens' diverse values and perspectives in relation to nature could be used to develop transformative visions for urban planning. The study was conducted in five large cities with different physical landscapes and social contexts in Armenia, Georgia and Ukraine – countries of recent and ongoing armed conflicts, which impose additional burden on the provision of UGS in Eastern Europe. In total, we conducted 800 interviews, which concerned the different preferences and values that people attributed to UGS and included participatory mapping of preferred types of UGS. We used the Urban Nature Futures Framework to organize the preferences, perceptions and values that respondents attributed to different UGS along three principal axes: eco-centric intrinsic, utilitarian, and relational. By integrating qualitative and spatial information from interviews with biophysical landscape data, we identified and mapped areas in our studied cities according to three main classifications (i) UGS for Nature, areas with potentially high ecological values depending on efforts to protect, restore or sustain them; (ii) UGS for Society, areas with the potential to provide a range of benefits essential for human wellbeing; (iii) UGS for Culture, where people have opportunities to actively engage with nature in activities contributing to social cohesion, sense of place, cultural identity, and stewardship of nature. The results could provide methodological references for innovative planning of UGS as multifunctional urban green infrastructure along urban – peri-urban gradient towards sustainable urban landscape design. We discuss how this approach could transform the current planning process to co-design Nature Futures for urban areas across different contexts in Europe.

OC 1.4 Where Forest Meets the Ocean: Operationalizing an Integrated Landscape-Seascape Approach in Eastern Taiwan (2016-2023)

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Integrated landscape approaches are viewed as tangible local solutions to biodiversity conservation and sustainability challenges. Combined with the ridge-to-reef concept, they offer unique management solutions at the interface of both landscape and seascape. Our study introduces the Xinshe "Forest-River-Village-Ocean" Eco-Agriculture Initiative (the Xinshe Initiative) – an integrated landscape-seascape approach (ILSA) in the Xinshe Village, Hualien County, Taiwan. The Xinshe Initiative was established in October 2016 in response to the socio-economic pressures on local terrestrial and coastal biota. The multi-stakeholder platform for the Xinshe ILSA is comprised of two Indigenous communities and four government agencies and is facilitated by our team. Its main objective is socio-ecological revitalisation of the area by the means of eco-agriculture and agroforestry. The connectivity between the Xinshe ecosystem elements – from the protected national forest downstream to the Pacific Ocean – is central to the Xinshe ILSA. This is a case study of participatory action research based on mixed qualitative methods of data collection and analysis. The study results demonstrate the following observations. (1) Local and expert knowledge-based biodiversity monitoring of landscape-seascape resources (forest and river patrol, coral reef checks) have revealed a strong connectivity between the maintenance of forest cover and eco-friendly agricultural practices on land with the integrity and health of freshwater and marine ecosystems. (2) Adaptive co-management of the Xinshe ILSA has gradually evolved from focusing on the more familiar landscape restoration topics (organic farming, agroforestry, constructed wetlands) during the short-term phase (2016-2019) to a gradual inclusion of coastal management and marine-based livelihoods during the mid-term phase (2020-2023, ongoing). (3) Today, the lessons learned from the Xinshe ILSA are being actively promoted and applied across Taiwan.

OC 1.5 Our Common Water

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A sustainable future depends on communicating and addressing the forest, water, and people nexus. The way we treat our waters and forests impacts on the delivery of many ecosystem services vital for human wellbeing. Challenges and potential solutions need to be communicated, not only to the scientific community, decision makers and stakeholders but most importantly to the general public. The communication needs to be transparent and unbiased. Here we report on a project with the goal of communicating the intricate co-dependence of forests and waters in an easy to understand and attractive way. Diffuse pollution is a major problem not least in agricultural areas. About 60% of Europe's water bodies still fail to reach good ecological status due in part to diffuse pollution. The issue is hard to solve at the catchment scale and best addressed via "grassroots" local action. The Cost-Action "Payments for Ecosystem Services Forests for Water" demonstrated how tree planting and good forest management can tackle diffuse pollution. Here we will present a popularized on-line roadmap for achieving this goal. In many parts of Europe, trees, and forests play an important role in protecting waters, in addition to providing other better known environmental benefits like carbon sequestration. We have produced a film to help raise awareness of the value of trees and forests for protecting the freshwater environment and securing the benefits that we all rely on, e.g. clean water. We highlight the positive actions people can take to make a difference and improve the condition of our local waters; too many films about the environment highlight the harm people do to the planet. The film has a positive tone and is made to inspire. The presentation will highlight several key aspects of how trees, forests, and woodlands can benefit our well-being. It also highlights the importance of appropriate messaging when trying to engage the broader public to bring about change on the ground.

OC 1.6 Post-abandonment landscape trajectories in Terras de Trás-os-Montes, Portugal

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Terras de Trás-os-Montes (TTM) is a mountainous region in the northeast of Portugal that has experienced significant population declines since the 1950s. The region reveals strong landscape marginalization trends, including agricultural land abandonment, landscape polarization, vulnerability to climate change and an old, aging population. Rural land abandonment comes with many challenges, including food security, wildfires, loss of cultural heritage and changes in landscape patterns. However, there are also opportunities associated with abandonment, such as the potential for carbon sequestration alongside other ecosystem services, nature conservation, rewilding and restoration, as well as recreation and sustainable rural development. In this study, we aimed to map all emerging trajectories in TTM to spatially describe and quantify landscape persistence and differentiation alongside the dominant megatrends. To do this, we grouped possible land use transitions into seven distinct post-abandonment trajectories (*landscape preservation, agricultural intensification, agricultural extensification, agricultural (re-)integration, afforestation, revegetation through natural succession* and *urbanization*), based on the official Portuguese land use and land cover data (COS). We mapped the change trajectories across two time periods: 1995 to 2007 and 2007 to 2018. We analyzed the entire region on the local parish scale (*freguesia*) and included multiple covariates such as biophysical properties and demographic parameters to identify spatial patterns. Our analysis confirms the general trends, but also reveals land use dynamics that deviate from the dominant land use trends in specific locations, indicating that local drivers can have a stronger influence on land management decisions than formerly anticipated. This opens new pathways for research and policy interventions that aim to steer post-abandonment landscape trajectories in more favorable directions.

OC 1.7 Expert's Perception Analysis on Alternatives to Compensate Feed Deficits for Livestock during Shortage Periods in Dehesas

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The management of high nature value dehesa ecosystems is struggled by modern demands. At times when little to no food from the system itself is available to livestock, feed gaps are one of the greatest challenges. The delicate dehesa conservation status suggests current management measures do not achieve the desired effects. The study was interviewing experts, applying a DPSIR-framework to identify strategies for compensating the deficit in feed for livestock that are considered reasonable & to localize breaking points impeding farmer's approaches to succeed. The interviews were analyzed qualitatively according to MAYRING 2015. A literature review was conducted on current circumstances, the relevance of trees, & named possibilities to bridge/mitigate feed gaps. Results were proving experts to perceive the feed gap factor as crucial for the success of dehesa management and preservation. A variety of factors exacerbating feed gaps, or their potentially negative effects, were identified. As well as various influences of feed gaps on e.g. the ecosystem, management decisions, & the output. Experts were assessing current management approaches as little promising for long-term, sustainable dehesa conservation as farmers largely resort to buying feed externally, adding inputs to the system, which allows economically beneficial higher stocking rates, but alters/overburdens the system. The most recommended alternative was reserving plots & forage through a well-designed grazing system, possibly combined with pasture improvement. Also, an adaptation of the historically grown method of transhumance was considered conceivable. It was shown that the interviewed experts understand the multifactorial situation of farmers' decision making. However, purchasing feed was often interpreted in a convenience implying direction. An issue of insufficient trust in science on the managers' part became apparent, as well as a lack of successful communication causing relationship problems.

OC 1.8 How people perceive the ecosystem services provided by Pyrenean oak forests

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The Pyrenean oak (Quercus pyrenaica) is an autochthonous tree in Portugal, predominant in the supramediterranean north and center inland. Despite having an extensive potential area in Portugal, the species has a fragmented distribution due to the

long-lasting impact of agriculture and afforestation. The ecological meaning and the vast range of ecosystem services (ES) provided by oak forests are recognized by the scientific community. However, the public's perception of those forests' importance as ES providers, is unknown. We aim to evaluate people's perceptions on Pyrenean oak forests as a source of ES in the CULTIVAR project study area (www.icultivar.pt). An online survey was carried out to assess: a) which ES are assumed to be provided by those forests (provisioning, regulating and maintenance, and cultural services), b) which ES the respondents consider to benefit directly and c) how much they value the ES obtained and how to increase this value. The main perceived provisioning services were: the use of oak as firewood, the use of oak forest as a hunting site, a livestock grazing site, and for wild mushroom collection. Nevertheless, most respondents consider not directly profit from those ES, except for firewood and mushroom picking. In opposition, cultural services seem to be well perceived and enjoyed, being forest oaks considered as a natural heritage that must be preserved, and an important recreation and nature observation area. The ES respondents consider that society and themselves benefit directly from most of the regulation & maintenance ES provided by oak forest. The public's opinion about this forest value and ES are critical in helping policymakers' decisions and fostering more suitable policies for the sector. The perceptions about such forests and their benefits will also help to identify opportunities to improve communication strategies, which might greatly impact society and its various stakeholders.

OC 1.9 The Portuguese natural resin sector: from resin tapping to the second transformation industry

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Resin tapping is a traditional forestry activity in Portugal that dates to the Xth century. Natural resin was initially used in the naval industry, but to this day its applications have widened, making pine resin a highly valuable and sought-after non-timber forest product with multiple uses in many industrial sectors. In Portugal, resin tapping is mainly performed in *Pinus pinaster Ait*., a forest species that represents 20% of the Portuguese forest. Although in the 1970s Portugal was the third world producer of natural resin, extracting more than 100 k ton/year, production has decreased drastically reaching a minimum of 5 k ton in 2005. Aimed to revive the Portuguese natural resin sector, the Integrated Project RN21 - Innovation in the Natural Resin Sector to Strengthen the National Bioeconomy, was financed by the Bioeconomy Component of the Portuguese Recovery and Resilience Plan. RN21 involves all the sector stakeholders in a multidisciplinary approach to natural resin, designed to respond to the sector needs by promoting natural resin as a "bio" product, enhancing a wider range of market applications and to foster the revitalization of the value chain with emphasis on its modernization, sustainability, and incorporation of technical and scientific knowledge. To do so, RN21 has several measures that comprehend the development of new tools that will optimize resin collection; the development of training programs for resin workers; a genetic improvement program for resin production in *P. pinaster*; and the determination of resin tapping potential in other *Pinus species*. By involving all of the sector key stakeholders in a multidisciplinary approach to natural resin, RN21 aims to boost the natural resin sector, to create jobs in rural areas and to increase the human presence in the forest, potentially decreasing fire frequency and intensity, while promoting the resin transformation industry.

OC 1.10 Pine-based forestry deters forest restoration in tropical mountain landscapes with traditional agriculture in southern Mexico

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Land-use patterns alter the biotic composition, structure, and functioning of the resultant landscape mosaic. In addition to physical heterogeneity, complex landscapes in tropical mountains may emerge due to the relatively small spatial and temporal scales on which traditional agriculture systems operate. Understanding the dynamics and consequences of these interactions between society and nature is badly needed, as the highly diverse and restricted forest ecosystems in these regions face ongoing severe human impacts at both local and global scales. Over the last three decades we have collected extensive floristic and structural information on differently aged stands of tropical montane forests in human disturbed landscapes in Chiapas, southern Mexico.

Data include detailed accounts of forest composition and structure in many stands with different degrees of disturbance through pine logging and selective oak removal of preferred species for firewood, mostly after land clearing for *milpa* agriculture. We also have assessed the recruitment of native trees in forest landscape structures that differ in their degree of the induced hyperdominance by native *Pinus spp.* (pinatization). Recent work on the effects of pine-based stand management, and on the limited effectiveness of 20-35 years of forest restoration practices on the recruitment of shade-tolerant tree species, pinpoint to the long-lasting consequences of composition and structure degradation following land-use changes and pine rise in the regional landscape. The results highlight the role of native oaks (*Quercus spp*.) as a keystone group of tree species to support attributes of the livelihoods of indigenous peoples on a sustainable basis. We suggest novel forest restoration practices that could guide public policy recommendations during processes of bottom-up community territory planning aimed at the recovery and maintenance of highly structured forested landscapes in montane regions.

OC 1.11 Charcoal production in Licuati key biodiversity area: A participatory assessment of forest management and degradation

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Charcoal is the primary domestic energy source in developing countries on which half of the households in the world rely. Despite being considered an unsustainable renewable source, charcoal production impacts' assessment on land cover is challenged by the selective, itinerant and human-scale characteristics of its production system, taking place in infra-pixel and sub-canopy. A participatory approach was designed to cover all active kilns in Djabula, a typically dispersed settlement (212 Km2 area and 141 families) charcoal-producing village in the Mozambican Maputaland Sand Forest. The village limits overlay the Licuati Forest Reserve and Licuati Key Biodiversity Area from where local institutions assumed unregulated charcoal production was occurring. A total of 286 kilns were registered in all production stages, from biomass collection to commercialization. High explained variability (R2 > 0.7) and high statistical significance (p-value = 0.000) models were found to estimate volumes of stacked firewood in kilns, the number of charcoal sacs produced and areas cleared per kiln. External village limits and all its interior forest and residential subdivisions were made, led by the village heads. Forest degradation patterns revealed a negative movement forward, from selective to non-selective harvest. As the main targeted species *Newtonia hildebrandtii* becomes scarce, producers with higher production costs (chainsaw ownership and paid labor) are the ones who have access to the less degraded areas. The poorest are cutting in the most depleted ones, already closed to production, with the added risk of penalty for infringement of communitarian law. Findings also showed coherence between local territorial planning of charcoal production in Djabula and the production taking place. Production areas were all outside Licuati Key Biodiversity Area where no charcoal kiln was found.

2. Innovative Tools, Methods and Approaches to improve decision-support and monitoring systems (e.g., coupling models, remote sensing, spatial tools, terrestrial sensors)

OC 2.1 Canopy-based Classification of Urban Vegetation from Very High-Resolution Satellite Imagery

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Cities are facing too many challenges. Urban vegetation, in particular trees, are essential as they provide services in terms of air pollution mitigation, freshness, biodiversity, and citizens' well-being. Accurate data on location, species, and structural characteristics are essential for quantifying their benefits. However, the cost of measuring thousands of individual trees through field campaigns can be prohibitive and reliable information on domestic gardens is lacking due to difficulties in acquiring systematic data. The main objective of this study was to investigate the suitability of very-high resolution satellite imagery, e.g., WorldView-2, for detecting, delineating, and classifying urban vegetation in both public and private areas. The characterization of urban vegetation is difficult due to the complexity of the urban environment (buildings, shadows, open courtyards), the diversity of species and the spatial proximity between trees. To overcome these constraints, an object-based classification was developed with the selection of new relevant spectral and texture-based features for each plant species. Four spectral bands (blue, green, yellow, red) and four texture features (i.e., energy, entropy, inverse difference moment, Haralick correlation) were found to be the most efficient attributes for object-based classification from WV-2 images. Then, a classification of plant species, by using a Random Forest classifier, and ground validation were performed. In the two study areas, Aix-en-Provence (France) and Florence (Italy), 22 and 20 dominant tree species, and grassland, were identified and classified with an overall accuracy of 84% and 83%, respectively. The highest classification accuracy was obtained for *Pinus spp.* and *Platanus acerifolia* in Aix-en-Provence, and for *Celtis australis* and *Cupressus sempervirens* in Florence. The lowest classification accuracy was obtained for *Quercus spp*. in Aix-en-Provence, and *Magnolia grandiflora* in Florence.

OC 2.2 The role of spaceborne LiDAR systems for forest monitoring

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Accurate estimates of the vertical and internal structure of forests are a key step for the assessment of important biophysical and ecological processes, such as biomass allocation, carbon storage, habitat quality and biodiversity. Satellite remote sensing provides advanced technology with the potential to provide relevant information on vegetation structure in an effective, synoptic, systematic and consistent way. The quantification of 3D vertical vegetation structure, particularly vegetation height, is an essential aspect of forest ecosystems monitoring, as it is a key variable for estimating aboveground biomass, characterizing habitat structural heterogeneity, estimating microclimate conditions, and supporting fire management activities. Therefore, accurate monitoring and understanding of forests ecosystems processes, dynamics, and vulnerabilities depend on timely and high-resolution data about 3D vegetation structure parameters, such as vegetation height, canopy cover, and vertical complexity. Here, we evaluate and discuss how the current ICESat-2 and GEDI spaceborne LiDAR missions, in synergy with other optical and SAR instruments, have the potential to revolutionize forest 3D monitoring by providing precise and comprehensive information on forest structure at local, regional, and global scales.

OC 2.3 Close range remote sensing of relative humidity

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Laser scanners' reflectance in the form of echo amplitude or backscatter full wave form, can be used to extend the information associated to the point cloud geometrical attributes. This can be of use in a wide range of applications ranging from evaluation of relative humidity to development of vegetation indices. The original intensity data acquired by means of terrestrial laser scanners (TLS), cannot be directly used to retrieve target characteristics due to it being highly sensitive to several acquisition variables.

Main ones are the instrumental constructive characteristics, the atmospheric conditions, the target reflectivity characteristics and the scan geometry. In general, the reflectance intensity correction is based on a polynomial that allows the effects of incidence angle and distance to be eliminated. Instead, we implemented a method with a higher degree of applicability, based on reference targets of constant and known reflectivity. This helped in correcting for the effects of distance, incidence angle and atmospheric conditions. To implement the proposed methodology and obtain the relative humidity, one of the ICP Level II plots has been scanned alongside reference values corresponding to reflectance panels (under laboratory conditions). In an iterative process, each point of the scene, by integrating the defined ranges (weighted laboratory references, classes of angle and distance characteristic to points defining vegetation and stems) received the corresponding correction. Following this correction, to verify the obtained results, points characteristic to various types of scanned objects (i.e., stem, dead tree, terrain, mud) were compared to field humidity measurements. The obtained point cloud and the corrected intensity values can further be used to assess the tree damage and symptoms, deadwood biomass, foliar or stem biomass or to compute various vegetation indices with role in forest health status.

OC 2.4 Improving conservation targets for forest biodiversity: toward operational solutions from space

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Understanding ecological systems at a global or regional scale is a complex problem, requiring the integration of a wide variety of different sources, types of data and interdisciplinary expertise. To address the current forest conservation needs, we need operational methods to assess the distribution of forests while integrating information on habitat condition. Inform, also, conservation planning and support the assessment of forest ecosystem services. The understanding of complex processes at the forest landscape level can be supported by the variety of sensors available and the ability to develop original methods to use and combine information resulting in opportunities to predict the consequences of changes in drivers at different scales and plan for more efficient mitigation measures within a context of global change. The presentation will focus on the utility of mapping Ecosystem Extent, one of the key targets of the GBF, using current and new space-based observations. This presentation will highlight the ongoing work from CEOS (Committee on Earth Observation) to support CBD-GBF 2030 efforts on Key biodiversity indicators

OC 2.5 Species distribution models using remote-sensed dynamic habitat index

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Species Distribution Modelling (SDM) constitutes an important tool for biodiversity monitoring, based on the statistical correlation of species occurrences with environmental predictors. The radiometric indices of vegetation and soil can be used to synthesize annual variations by calculating Dynamic Habitat Indices (DHIs), which have shown good correlation with animal species richness at regional scales. DHI uses a combination of vegetation indices, such as the Normalized Difference Vegetation Index (NDVI) to create a map that identifies areas with high habitat quality and connectivity. The map is then used to identify priority areas for biodiversity conservation. In this study, we hypothesized that the DHI used as an indicator can improve the prediction accuracy in SDMs. We developed a comparative framework for two types of SDMs, based on predictors obtained from commonly used data (Land Cover classification - LC) and from remote sensing (RS) data, i.e. DHIs. The study area used to demonstrate the approach is the French region of Île-de-France, which is encroached by intensive agriculture and urban areas. We computed predictor sets based on classified LC and RS Sentinel-2 data. Initial analyses showed similar SDM prediction accuracy between the standard LC and RS based approaches. However, further analysis showed that the niches predicted by SDM from RS were larger than those predicted by SDM from LC. We determined that this difference was due to a threshold effect of binarization of potential presence scores on the distance variables to the LC classes. DHI, as a predictor in SDMs, may therefore be more suitable than LULC predictors for identifying species niches on a regional scale, which can be used in biodiversity monitoring. Overall, DHI can be a valuable tool for conservation as an operational method, providing an objective and efficient way to prioritize conservation efforts and monitor changes in habitat quality over time.

OC 2.6 Using remote sensing to model the breeding habitat of the Black Grouse, in open forest

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The Black Grouse (*Lyrurus tetrix*) is an emblematic alpine species with high conservation importance. The population size of these mountain bird tends to decline on the reference sites and shows differences according to changes in local landscape characteristics. Habitat changes are at the center of the identified pressures impacting part or all of its life cycle, according to experts. Hence, an approach to monitor population dynamics is through modelling the favorable habitats of Black Grouse breeding (nesting sites). Then, coupling modelling with multi-source remote sensing data (medium and very high spatial resolution), allowed the implementation of a spatial distribution model of the species. Indeed, the extraction of variables from remote sensing helped to describe the area studied at appropriate spatial and temporal scales: horizontal and vertical structure (heterogeneity), functioning (vegetation indices), phenology (seasonal or inter-annual dynamics) and biodiversity. An annual time series of radiometric indices (NDVI, NDWI, BI …) from Sentinel-2 has made it possible to generate Dynamic Habitat Indices (DHIs) to derive phenological indications on the nature and dynamics of natural habitats. In addition, very high resolution images (SPOT6) provided access to the fine structure of natural habitats, i.e. the vertical and horizontal organization by states identified as elementary (mineral, herbaceous, low and high woody). Indeed, one of the essential limiting factors for brood rearing is the presence of a well-developed herbaceous or ericaceous stratum in the northern Alps and larch forests in the southern region. A deep learning model was used to classify elementary strata. Finally, Biomod2 R platform, using an ensemble approach, was applied to model the favorable habitat of Black Grouse reproduction. Of all the models, Random Forest is the best performing, with TSS and ROC scores close to 1. In this model, the most important explanatory variables are the proportion of heathland, altitude and NDVI Max. Results from the habitat model can be used as an operational tool for monitoring forest landscape shifts and changes. In addition, to delimiting potential areas to protect the species habitat, which constitute a valuable decision-making tool for conservation management of mountain open forest.

OC 2.7 Matching the effects of forest structure with management for predicting species occupancy at multiple spatial scales

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We evaluated the impact that forest characteristics and conservation status of forests at three spatial scales have on grouse probability of occupancy. We specifically asked how forest structure and management for timber production or conservation estimated at different scales separately and jointly affect local species occupancy. To disentangle the impact of forest structure and of the forestry/protected areas´ networks on the species probability of occurrence, we fitted Generalized Linear Mixed Models (GLMMs) linking the stand-level presence/absence of forest grouse species in the Finnish forests with forest variables related with composition and structure, stand development classes (DC) and conservation areas. The GLMMs were developed separately at each of three spatial scales (local=stand level, home range=1 km within the stand centroid, wildlife triangle =5 km within the stand centroid) and with a multi-grain approach selecting the best predictors across scales. We found that some characteristics of the forest, like mean age, invariantly affected grouse occupancy at each scale. Others were important only at one scale, like peat and clear-felled areas, or two scales, like stem density. The network of protected areas increased grouse occupancy at 5 km scale, while biodiversity-friendly DC (e.g., uneven-aged and shelterwood) at stand scale. Stand-level variables were associated with biodiversity-friendly DC while 5 km variables with protected areas. In conclusion, our research demonstrates that modelling occupancy with forest variables at different spatial scales can better inform forest managers over species potential use of the landscape. The evidence highlights that biodiversity-friendly DC and protected areas´ network can increase occupancy at different scales, requiring a multiscale approach to conservation and management. Finally, the impact of management on forest characteristics should be considered for improving occupancy models at the relevant scale.

OC 2.8 Priority areas identification and management strategies for landscape forest restoration in Mozambique

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In the last decades, Forest Landscape Restoration (FLR) emerged as a solution to restore ecological integrity while enhancing human well-being in deforested or degraded forest landscape. One key challenge in implementing FLR includes the identification of suitable intervention areas according to the restoration strategy (active or passive restoration) and the local socio-bioophysical constraints. The aim of this study was to develop a new approach to locate where forest landscape restoration would enhance multiple ecosystem functions and identified management strategies (passive or active restoration) in two districts in central Mozambique. The methodology involved (i) the ecosystem functions mapping to identify multifunctional hotspot and (ii) the assessment of the land-use history to differentiate areas with low or high regeneration potential. We derived three spatially-explicit ecosystem functions (biomass, soil carbon sequestration potential and forest connectivity) and one characteristic (woody species diversity potential) based on field inventory. We mapped and analyzed land-use history, defined by the current fallow age, the time since the first forest clearcutting and the number of crop-fallow cycles. The results showed that 118,629 ha were identified as priority areas (10.9% of the study area) for forest landscape restoration, with 42,255 ha (36%) with natural regeneration potential and 76,373 ha (64%) with low regeneration potential and would require human activities to recover ecosystem functionality and ability to provide ecosystem services. This study provides new insights for integrating ecosystem functions at landscape scale to support decision making for forest restoration and support the Mozambican government commitments to restore degraded landscapes at national scale.

OC 2.9 Hurricane Activities in Gulf of Mexico Lead to Conversion of Forested Land: Implications for Water Quantity/Quality

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Due to climate change, the intensity and frequency of extreme events, such as hurricanes and tropical cyclones, are increasing. In particular, these extreme events can adversely affect the hydrological systems in coastal areas by damaging forests and lead to disturbance of delicate balance of the coastal ecosystems. There is evidence of forested land being converted into pasture, other agricultural crops and residential areas along the northern Gulf of Mexico (GOM), USA, due to the increased hurricane activities and strengths. This study assessed the impacts of future land use change due to hurricane activities on water quantity and quality in the Perdido Bay watershed (>3200 km^2). The Soil and Water Assessment Tool (SWAT) was used to assess the potential impacts on future water quantity and quality (TSS, nitrogen, phosphorus, and carbon) for the period 2050-2100. The model was first parameterized for dominant forest species and subsequently calibrated and validated with monitored flow and water quality data from 2001 to 2020. Downscaled climate data from the Coupled Model Intercomparison Projects (CMIP6) under selected Shared Socioeconomic Pathways (SSPs) have been used to drive the SWAT model for future conditions. Hypothetical land use scenarios were considered to understand the combined impacts of land use and climate change. Initial results show that conversion of forested ecosystems to other land uses, such as pasture, agriculture or urban land can have significant implications on the Emerald coast of Florida. This study is part of a larger project funded by the US National Academy of Science. Future efforts will extend this work to the whole Northern Gulf of Mexico.

OC 2.10 Prioritizing Woodland Expansion with ECOFOREST: A Web-Based Tool for Ecosystem Service-Based Spatial Targeting

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Forest ecosystems provide essential benefits, including carbon sequestration, mitigation of diffuse pollution, flood alleviation, soil protection, and biodiversity conservation. Forests also provide numerous social and economic benefits, such as timber production, recreation, and cultural values. These benefits have been partly lost in many areas of the world due to deforestation, and re-expanding woodlands can therefore contribute to societal wellbeing by regaining some of those benefits. However, this is best done while avoiding disbenefits due to -for example- loss of non-woodland habitat, loss of prime agricultural land, and loss of carbon storage from carbon-rich soils. Spatial decision-making based on many positive and negative criteria can be cognitively difficult for several reasons. Firstly, the multiple factors considered spatially interact. Secondly, the choice of criteria often involves subjective judgments, and different decision-makers and stakeholders may have different opinions on the inclusion and the importance of each factor. Thirdly, spatial decision-making frequently involves large amounts of data that need to be analyzed, visualized, and synthesized, which can be time-consuming and require specialized technical skills. Finally, it is difficult to compare the different options for woodland expansion resulting from different priorities. Interactive software tools that address these difficulties are very useful for planner and land managers. ECOFOREST (Ecosystem Services-based Criteria for Forest Expansion Tool) is a web-based application that allows users to prioritize specific areas for forest expansion, and the exclusion of other areas. The resulting maps are interactively updated based on the preferences of the users, allowing exploration of different options. This approach and tool are currently being utilized in Scotland to aid policy-making and the implementation of targeted woodland expansion incentives.

OC 2.11 Landscape Approaches as operational artifacts to move towards more sustainable governance of rural land-uses in the Mediterranean macro-regional context

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Landscape approaches (LAs) aim to foster sustainable strategies that reconcile agriculture, nature conservation and competing land-uses. LAs have been advocated as strategic tools for devising and implementing novel governance strategies for rural regions. Testing and operationalization of LAs is however still scarce across the Mediterranean macro-regional context. This is despite the region being a hotspot for the SDGs and 2030 agenda of the UN. This is an agenda that condenses the majority of the challenges for which the Landscape Approach is directly relevant. In this paper we will argue and discuss how adopting a LA may help resolve some key governance challenges faced in rural Mediterranean areas, and the main barriers and opportunities encountered. Methods Firstly, we identified 5 key rural governance challenges in the Mediterranean and examined the opportunity to tackle them using the 10 LA principles. To do this, we examined the scientific and grey literature for each of these 5 trends.
Based on this same body of literature, the key barriers and opportunities for implementing the 10 principles of a LA could be identified. Results and discussion There is ample potential to apply the 10 principles of a LA to help resolve key governance challenges in the Mediterranean context. The following aspects could be identified: i. Cultural barriers exist that hamper innovation, cooperation and trust, ii. Land property structures and related inequalities are also in place, that do not facilitate the implementation of novel governance mechanisms for the resolution of land-use conflicts, iii. Administrative procedures are too frequently inflexible, hampering implementation of LAs and related principles iv. Despite all the aforementioned barriers, multiple opportunities are also in place that relate to the increasing conscience by farmers, local actors and policy makers about the need to move towards enhanced sustainability standards and practices.

OC 2.12 Towards a Forest Bocage: multifunctionality of a network of broadleaved hedgerows in a pine plantation landscape

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Many studies have shown greater biodiversity and better resistance to disturbances in mixed forests compared to monospecific forests. However, stand-level species diversification is difficult for managers to adopt because of the complexity of mixed forest management. Another option is to diversify forests at the landscape scale.

Here, building on the tradition of agricultural bocage, we propose to develop a new form of forest landscape diversification using a dense, connected network of broadleaved hedgerows between pine stands. This method of ecological restoration follows the concept of Nature-Based Solution with the objective to improve the resistance of pine plantations to disturbance while promoting biodiversity by providing habitat and dispersal corridors for species.

To test these hypotheses, broadleaved hedgerows were selected in a landscape of maritime pine plantations based on their connectivity and the amount of broadleaved habitat in their environment. In these hedgerows, multi-taxonomic inventories were conducted (insects, flora, birds, bats, reptiles) using acoustic recorder, traps or visual observations. In addition, damage caused by the pine processionary moth (*Thaumetopoea pityocampa*), the main defoliator of maritime pine, was recorded in adjacent pine plantations. Using linear mixed models, we showed that pine processionary infestations decreased with the amount of broadleaved habitat in the surrounding landscape, proximity to an oak hedge, and the height of that broadleaved hedgerow. Most taxonomic groups sampled showed greater species richness in deciduous hedgerows than in pine edges. The effect of the connectivity of these hedgerows varied by taxa, according to their dispersal traits.

The concept of forest bocage thus appears to be a promising way to reduce biotic risks while improving the biodiversity of intensive plantation landscapes. Its effect on abiotic risks such as fire remains to be verified, as well as its acceptability by stakeholders.

OC 2.13 Functional connectivity models to inform sustainable management practices in standard production forests

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Production forests are subjected to intensive forestry activities resulting in dynamic heterogeneous landscape mosaics of well-defined patches. Such landscapes are highly susceptible to habitat fragmentation effects, which can ultimately imperil species persistence. Functional connectivity models (FCM) can inform forest management plans and capacitate producers and managers to target sustainable practices and decrease the net-impact of resource exploitation over biodiversity. However, there is still limited knowledge on how FCM determines the spatial distribution of species, so that can be useful for managing purposes. We set up non-manipulative experiments in pine tree standard production forests to demonstrate how FCM expresses the ability of species to reach suitable habitat patches (landscape filtering) and mediate local species assemblages. Single- and multispecies spatially explicit FCM framed within graph-based and circuit theories, were applied to a small mammal and four bird species, to weight the effects of connectivity on species occurrence and community assemblage. We found that single-species FCM contributed positively to the occurrence of each species, showing that habitat reachability influences their distribution, as suitable habitat patches not within range were unoccupied. However, multispecies FCM offer a better competing alternative in predicting community parameters. Incorporating multispecies connectivity showed more consistent effects for all community parameters than single species models, since the overlap between species' dispersal abilities shows poor agreement. FCM based on multispecies movement ability enable accurate predictions of possible dispersion barriers and identify areas more susceptible to isolation, further improving mitigation measures through the design of key corridors within a complex network matrix or preview impacts due to changes in management schemes.

OC 2.14 Critical biomass harvesting for policy support in northern forests

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Climate change has increased the demand for forest biomass production to contribute to renewable energy. Whole-tree harvesting, where not only stems, but also branches and tops are harvested, may however have negative environmental effects. In this study we demonstrate how the concept of critical biomass harvesting, focusing on nutrient sustainability and acidification, can be used for policy support for sustainable forestry. Critical biomass harvesting is based on Critical Loads, a long-used concept to bridge between science and policies related to acid deposition. In an acidity balance with sinks and sources, a critical limit is set for the acidification status of the water leaving the root zone. Based on that, the maximum harvest that can be allowed without exceedance of the critical limit can be calculated, and compared with the actual harvest. We made calculations for 12 000 coniferous sites from the National Forest Inventory in Sweden. We then compared the results with the present status, from measurements of acidification in soil solution on sites across Sweden. The calculations showed substantial exceedance of critical biomass harvesting after whole-tree harvesting in the south of Sweden, where the forest productivity, and thus the losses at harvesting, are the highest. The result indicates that whole-tree harvesting can slow down the recovery from acidification in these parts if the losses are not compensated for, e.g. by wood ash recycling. The data of present acidification shows a similar general gradient, with more acidified soils in the south of Sweden, where the acid deposition has been the highest. There are, however, sites that don't fall into the gradient, showing the importance of the soil weathering. The results can form the basis in the evaluation of Environmental objectives, for planning measures and recommendations for sustainable forestry at national and regional levels.

OC 2.15 Fire severity effects on soil Carbon and Nitrogen stocks in southern Iberian Peninsula: comparing prescribed and wildfires

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It is accepted that prescribed fires generally led to low losses of the organic and mineral superficial layers, especially as compared to the moderate or high intensity burning of wildfires. Consequently, prescribed fires have been largely used to reduce wildfire risk or change the land use. Still, the effects of the fire in the soil C and N pools are not totally understood. The main objective of this research was to assess the effects of prescribed versus wildfires on the soil C and N stocks of Mediterranean forest and shrublands. Additionally, the relation of proxy visual indicators, such as the Soil Burn Severity (SBS) with the maximum temperature reached at different depths was also assessed in the prescribed fires. Pre-/unburned and post-fire/burned organic (L, FH) and mineral soil samples (0-2, 2-5, 5-10 cm) were gathered from three prescribed fires and four wildfires. The three prescribed fires burned at low SBS (Cartaya: 2.2, Doñana20: 1.9 and Doñana21: 0.7), two wildfires burned at moderate SBS (Casares: 3.2 and Bermeja-L: 2.7) and two at high SBS (Monchique: 4.4, Bermeja-H: 3.9). Pre-fire C stocks ranged from 70-15 Mg ha-1 in the prescribed fire sites; and from 60-30 Mg ha-1 in the wildfire sites. All fires dropped the C and N contents on the organic layers, and the effect consistently decreased with increasing the mineral soil depth. The consumption of the C stocks was, on average, 50, 34 and 14%, respectively for Cartaya, Doñana20 and DOñana21 prescribed fires; while in the moderate wildfires it was 26% and 12% (Casares and Bermeja-L) and 38-39% for the high severity wildfires. The consumption of the N stocks on the prescribed sites was high (37 to 13%) if compared to the moderate wildfires (8-2%) but similar to the 35-27% consumption in the high severity wildfires. The pre-fire soil C and N stocks, as well as the conditions at which prescribed fires were carried out should be re-evaluated to prevent high consumptions of the soil organic matter.

OC 2.16 Effects of land-use changes and fire events in the population dynamics of Acacia dealbata: a hybrid modelling approach

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Land use and related anthropogenic pressures such as fires strongly affect the establishment and spread of invasive plants. *Acacia dealbata* is a widespread invasive alien plant in Portugal that holds well-known fire-proneness traits and strategies with potential to cause economic damage and modification of ecologic regimes. In this work we used a hybrid (i.e. mechanistic and correlative) modelling approach to understand the interplay between land-use changes and fire occurrences in the population dynamics of Acacia dealbata, using the Alto Minho region as a test area. The model integrates 4 sub-models used to simulate: 1) the population dynamics of A. dealbata, assuming acacia life-stages stratification (in terms of abundance estimates); (2) land-use change scenarios based on dominant land use intensification or extensification in the study area; 3) the occurrence of fire events and 4) the landscape permeability to invasion given the interaction between land use changes and frequency of fires events. The simulations show that, in both areas of low and high density of A. dealbata, fire events promote the species' invasibility (i.e. higher density of seedlings and saplings). Furthermore, differences in the effect of land use scenarios in the acacia population dynamics assume greater expression at larger spatial scales. By delivering projections of long-term population trends under realistic social-ecological scenarios, this study provides a better understanding of the mechanisms involved in the spread of A. dealbata at different spatial scales. In addition, by focusing on earlier stages of invasion, the approach constitutes a promising step forward for establishing appropriate management actions, thereby enhancing the efficiency of control actions on major forest invaders.

OC 2.17 National Evaluation of Invasive Tree and Understory Forest Plant Prevalence across the United States

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Non-native species alter forest ecosystem processes, cause landscape change, interfere with services provided by native trees, and contribute to biotic homogenization. More than 60 percent of U.S. forests have been invaded by nonnative plants, resulting in significant economic and ecological losses. To fulfill national and international sustainability reporting requirements, the United States Department of Agriculture Forest Service assesses the extent and importance of non-native trees and understory plants across the nation. These assessments rely on data collected from more than 140,000 forest plots across the national Forest Inventory and Analysis (FIA) network. In the conterminous United States, we identified 16 highly invasive and four moderately invasive tree species, with invasive species richness highest in Midwest, Mid-Atlantic, and Southeastern States. We identified seven highly invasive tree species in Hawai‘i and 17 in Puerto Rico. Meanwhile, we found that at least 63 million ha of forest were invaded by understory non-native plants (36.2 percent of inventoried area). The highest rates of invasion occurred throughout the South, in urban and agricultural areas of the North, and throughout Hawai‘i. Forest in the South had the highest proportion of invaded forest area (57.7 percent of inventoried area, 52.7 million ha), followed by the North (54.5 percent), while forest in the West (except Hawai‘i) was considerably less invaded. Additionally, the large proportion of invaded forest was in private ownership, consistent with previous research showing that privately-owned forest lands in the eastern U.S. had the highest rates of invasion, likely because they are closer to human land uses which contribute seed sources that are responsible for plant invasions. The results of these assessments offer insights into which species are most likely to alter forest ecosystems and which forests may be effectively managed to control invasive trees and understory plants.

3. Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points

OC 3.1 Effect of mixture and management of a Southern European beech forest on carbon stocks and sinks

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Beech forests in Italy represent 10% of the country's forest area and are hotspots of carbon storage. In the central-northern Apennines, where 61% of Italian beech coppice forest area is found, improved management practices can increase the territory's economic value through the generation of voluntary carbon credits. However, the effect of management models, the degree of mixture, and the effect of abandonment are poorly understood. Management models are i) coppice with standards, where shoots are cut down on short rotation allowing resprouting from dormant buds on the stump, ii) high forest as single-stemmed trees from seed with longer rotation times, and iii) coppice rewilding left to natural evolution from more than 60 years. Mixed forests are usually a mixture of abandoned coppice with other broadleaves at lower elevations and with silver fir at higher elevations. We analyse the effect of species mixture and management on carbon stocks and sinks of beech forests in the Appennino Tosco Emiliano National Park. We sampled 60 beech forest plots (12 for each mixture or management treatment) and implemented allometry-based biomass estimates, dendrochronological analysis of tree cores, and CHN analysis of soil. Generalized Linear Models were used to analyse the results while controlling for environmental variables' effects. Mixture or management had limited influence on soil carbon stocks. On the contrary, mixture and management strongly affected biomass stocks, with abandoned beech coppice mixed with broadleaves having the highest stock (1150 Mg CO_2eq. ha^{-1}), followed by monospecific beech rewilded coppice (900 Mg CO_2eq. ha^{-1}). Rewilded coppice also had the highest carbon sink (14 Mg CO_2eq. ha^{-1} yr^{-1}), while high forest had the lowest (10 Mg CO_2eq. ha^{-1} yr^{-1}). These results shows that rewilding of coppice forest can be an interesting management option when the objective is to increase the carbon stocks and sinks, also due the co-benefits in terms of structural complexity and biodiversity. However, the long term natural transition of coppice to high forest could slow down these effects.

Also, they question the practice of active conversion into high forest: in case of climate change mitigation, tree density reduction might be counterproductive. Promoting forest mixture with broadleaf species can be beneficial for carbon stocks. These results, however, do not consider the climate induced stresses (e.g. droughts, wildfires). A long term modelling work with different climatic scenarios is needed to better define the best management practices for beech forests in Italy.

OC 3.2 Impact of five tree species conversion modalities on fauna and fungi soil biodiversity as monitored by DNA-metabarcoding in temperate forests

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Climate change is characterized by changes in local temperature and precipitation. Hence, present tree species face in a near future the risk of living out of their optimal ecologic range. This would aggravate forest dieback and also impact forest ecosystem services. In order to adapt forests, forest managers are changing they practices, thus impacting current biodiversity for instance in forest soils hosting complex multi-taxonomic networks. Among new adaptative practices, managing new tree species to ensure forest sustainability appears as one of the best solutions. While the impact of tree species substitution was studied for the substitution of a broadleaf species to a resinous one or the reverse, we have fewer information for broadleaf to broadleaf or resinous to resinous substitution. Thus, the aims of this study were to address changes in soil fauna and fungi communities with tree substitution and the underlying mechanisms behind these changes. We focused on tree substitution in the same tree category (broadleaf or resinous). Four types of tree species substitution in five forests of northern France were selected. Two substitutions involved deciduous trees: from mature *Fagus sylvatica L.* towards young *Quercus sp.* with either an even aged or uneven aged management. The two other were substitutions from mature *Pinus sylvestris L.* to young *Pinus nigra var. corsicana Poir.* or *Quercus rubra L.* . Soil (0-15cm) and litter were sampled in 5 points over 69 forest stands to monitor soil fauna and fungal community composition by metabarcoding with the COI and ITS loci, respectively. Using the BOLD, GENBANK and UNITE databases taxonomical identity was assigned to sequences using DADA2 and PIPITS. Soil parameters (C stock, N stock and humus forms), botanical surveys, trees basal area and canopy openness were assessed in order to explain soil communities' variations. We identified the impacts of substitution on soil fauna, plant and fungi using common descriptors of community diversity (richness and Jaccard distance). Also, community composition data were used along functional traits and trophic information retrieved from FUNGUILD to highlight what ecological functions can be gained or lost with those practices of climate change-adapted forestry. First results show that *Fagus sylvatica* and *Quercus sp* canopies were more closed than the *Pinus sylvestris L.*, *Pinus nigra var. corsicana Poir.* and *Quercus rubra L.* ones and that canopy closure correlates with both the *Morteriellomycota* and the herbaceous layer richness. *Ascomycota* and *Basidiomycota* richness in soils were correlated to the tree layer richness. However, only *Ascomycota* richness in litter was correlated to the tree layer richness. Finally, *Ascomycota*, *Basidiomycota* and *Morteriellomycota* richness were more important in litter than in soil. Results on soil fauna highlight database incompleteness that does not allow to identify taxa at fine and pertinent taxonomical level. Consequently, for now, the effect of tree substitution on soil fauna could only be analysed using diversity analysis without linking taxa to its functional traits. We advocate the increase in soil fauna sampling and barcoding efforts to address this issue.

OC 3.3 Pyrenean oak forests under global change - integrating projected suitable areas in management plans

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Forests provide broad ecosystem services (ES), and their contribution to regulation and maintenance services (e.g. carbon sequestration, soil formation, habitat protection, erosion control) explains why forest recovery/expansion is an effective nature-based solution for climate change mitigation. Thus, forest restoration measures must integrate results about expected changes in species distribution, as future climate change may promote range shifts and suitable habitat loss, followed by species turnover. Expected changes in forest species' potential distribution should be considered in forest ecosystem restoration planning actions, to increase long-term success, and enhance ES at long term. Pyrenean oak (*Quercus pyrenaica*) is a native species to the western Mediterranean Basin, and a structural tree in central and northern inland Portugal forests, together with pedunculate oak (*Q. robur subsp. broteroana*). Despite the extensive potential growing area, it has a fragmented distribution due to fast-growing forest species reforestation, agriculture, and other land-use impacts. In this work, we used species distribution models (SDMs) to assess changes in suitable areas for the Pyrenean oak under two climate change scenarios (SSP370 and SSP585), aiming to guide forest recovery measures dedicated to ES enhancement at long term. The Pyrenean oak's entire native range was considered in the models' calibration, and different algorithms were used. The results suggest that the species' total suitable area will be negatively affected by climate change in the future, with a clear suitability turnover with other oak species, namely more dryness-adapted ones. Overall, *Quercus pyrenaica* suitable area will decline, and management actions should consider this aspect in future restoration plans, especially at the edges of its current distribution area.

OC 3.4 How will climate change impact maritime pine forest distribution and productivity in Portugal?

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Portuguese maritime pine forests are severely affected by forest fires. The study aimed at modelling: (1) species' current distribution and productivity; and (2) species' distribution for projected future climate change scenarios. The land cover, national forest inventory, and environmental data were used. A Bayesian Machine Learning (ML) analysis allowed exploring the most influential environmental variables. Species' spatial productivity was modelled by stochastic Sequential Gaussian Simulation.

Species' potential distribution modelling was performed using two methodological approaches: (1) ML algorithms (Random Forest and Maximum Entropy); and (2) GIS map algebra (ecological envelopes) maps regarding a set of environmental variables and previously known thresholds. Results showed that species distribution was mainly determined by precipitation-related variables, but elevation and temperature-related variables were important to differentiate species productivity. Species' distribution for the present using ML modelling provided fitting efficiencies around 70% and matched well the species' current distribution. The species ecological envelope map for the present was closer to the species' empiric potential distribution. Climate change impacts on species' future distributions by the ML approach were moderate with areas being relocated (47.3% regular-medium-high suitability area to 48.7%–48.3% in the future). The impacts in species' ecological envelopes maps were higher and with greater future losses than the latter (76.5% regular-favourable-optimum suitability area to 58.2%–51.6% in the future). The two approaches showed a 44% concordance in the present, decreasing to 30%–35% in the future. These maps are key to support recommendations to set species' best suitability areas in planning future afforestation to attain fire-resilient landscapes, enhanced forest ecosystems biodiversity, functionality, and productivity under climate change scenarios.

OC 3.5 SWAT based responses on two contrasting eucalypt-dominated catchments under different climate scenarios

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Forests cover about 36% of the Portugal area and assume a significant role on water cycle and water balance regulation. Research on forest hydrology is an added-value to support management strategies and for the establishment of climate change adaptative approaches. This work intended to assess the impacts of climate scenarios on two constraining edaphoclimatic catchments namely on hydrological responses and on biomass production. The Braçal terraced catchment is characterized by a Mediterranean-type climate with an oceanic (Atlantic) influence. From 2018-2022 the average annual temperature and rainfall were, respectively, 15°C and 1300mm. The Caniceira catchment is shaped by a Mediterranean climate with mild winters and dry warm summers, registering a severe water-deficit during summertime. From 2013-2022 the average annual temperature and rainfall were, respectively, 20°C and 661 mm. SWAT ecohydrological (SWAT2012) was run on a daily basis for the 2012-2022 to provide scenario simulations to assess the impacts of future climate conditions for three periods (2024-2036; 2036-2048; 2048-2060) on two eucalypt-to-eucalypt succession catchments. The results revealed an overall reduction on streamflow and water yield in the catchment in line with the projected reduction in total annual precipitation and a slight shift on seasonal streamflow of up to two months. Addressing water-related interactions in forest areas is particularly complex because of the intricate relations resulting from the forest functioning and dynamics, compositional, structural, management practices and environmental variability. Still, current findings provided valuable insights on climate change impacts on forest catchment responses. SWAT ecohydrological model provided site-specific information (water yield and biomass production) was proven to be a valuable tool to assess climate change impacts on eucalypt-dominated catchments and be use as decision-support tool for forest managers.

OC 3.6 Soil organic carbon stock in managed, unmanaged, and disturbed Nothofagus forests in Chilean Patagonia

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The Chilean Patagonia has the largest area of native forest and the country's largest reservoir of forest carbon (e.g., soil organic carbon). However, these forests have been subjected to multiple human pressures and silvicultural practices commonly carried out in native forests of the Nothofagus genus do not consider the role of trees in the carbon cycle. Forest management considers a knowledge gap on the incidences of soil carbon stocks along productivity gradients, microenvironmental conditions, and disturbances. Consequently, it is necessary to identify how management practices favor soil organic carbon (SOC) stocks. The objective was to analyze the SOC variation in managed, unmanaged, and disturbed Nothofagus forests along two West-East precipitation gradients (from ±4000 mm yr-1 to ±500 mm yr-1). Deciduous forests *N. pumilio*, *N. antarctica*, and evergreen forests dominated by *N. dombeyi* were studied. The treatments were: unmanaged forests, forests under current and old silvicultural management, and disturbed forests. Along the two gradients, 80 plots were studied, soil samples were collected, and the SOC (including roots and decaying wood) and its relationship with tree regeneration were calculated. The highest SOC were found in soils with more significant established natural regeneration, located in a greater precipitation gradient, independent of forest management. In *N. pumilio* forests, with a gradient of less rainfall, SOCs are higher when there is more decaying wood. Soils in areas disturbed by fires, SOC are lower in sectors with less precipitation and higher with more significant precipitation. With these results, it will be possible to propose guidelines that help improve these forests' current management and conservation guidelines with a solid ecological base and a transcendent look to face climate change through SOC quantification.

OC 3.7 Even Cooler Insights: On the Power of Forests to (Water the Earth and) Cool the Planet

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Conventional predictions about the consequences of forest cover for albedo, surface temperature and global warming suggest climate policies should favor deforestation in some regions. Like previous findings, the IPCC's AR6 WGI report states, "land use and land cover changes over the industrial period introduce a negative radiative forcing by increasing the surface albedo. This effect increased since 1750, reaching current values of about –0.20 Wm^2 (medium confidence)," (our italics). Based on modeled results produced with the aid of Global Climate (GCM's) and Earth System Models (ESM's), progressive deforestation has historically cooled the Northern Hemisphere (NH). Warming is thus the assumed consequence of reforestation. The observational literature, however, suggests deforestation leads to surface warming, and that increasing forest cover typically results in surface cooling. Current understanding of the interactions between albedo, forest cover and water, as well as our ability to measure them, may well drive this gaping discrepancy. Forest-water interactions govern the intensity of the hydrologic cycle, which again drives the partitioning of latent and sensible heat. Imbalances in these relationships lie at the root of local and global warming/cooling effects. Comparatively simple analysis and comparison of the multiple causal pathways by which carbon, water and energy cycle interactions affect climate and surface temperatures suggests increasing forest cover will realistically promote both comforting surface temperature change, as well as substantial global cooling benefits.

OC 3.8 Landscape fire severity: a multi-scale analysis of the drivers

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The needed paradigm shift in fire-prone regions of southern Europe, claimed by several researchers, implies changes in the way public agencies measure the effectiveness of the fire management system. Instead of being evaluated by the annual burned area, as is currently done, must be determined by the damages avoided. In this context we assessed the effects of several landscape drivers to explain the spatial distribution of fire severity in large fires in different fire-weather condition and scales. At the class scale, fire severity increases with the spectral heterogeneity of forest patches, regardless of forest composition. The R2 resulting from the linear relation between mean fire severity (measured by RBR) and the variability of pre-fire NDVI values in the large fire of Góis in 2017 varied between 39.8% (in chestnut stands) and 44.4% (in maritime pine stands). Within a forest patch with homogeneous overstory, the variability in the vertical continuity between understory and crown fuels is sufficient to increase fire severity at the patch scale and, therefore, spatially scattered fuel treatments may be insufficient to reduce fire severity. The spatio-temporal variability of fire severity considering the hourly fire evolution shows a positive relationship between fire expansion rates and fire severity, showing dependence on fire behavior, which is determined by a complex interrelation between fuels,fire-weather and topography.

OC 3.9 Temporal and spatial patterns of extreme wildfire events at the European landscape scale

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In recent decades, the frequency of Extreme Wildfire Events (EWE) has been increasing in Europe, particularly in the Mediterranean region, due to changes in land use and climate. However, the classification of a wildfire as extreme depends on different aspects, such as: (1) fire behaviour characteristics, (2) operationality, (3) anomalies in historical data, and (4) magnitude of impacts. Such distinct definitions hinder the understanding of EWE temporal and spatial patterns in Europe. In this study, we aim to analyse temporal and spatial patterns of EWE development in Europe, in order to predict possible future trajectories affecting European forest landscapes. We used the 4 above-mentioned criteria to select all EWE that occurred in Europe in 2008-2022 and compiled a database of EWE text-based reports, using EFFIS annual reports, scientific and grey literature. Selected EWE were then compared with anomalies in historical data for the same period, using individual fire sizes from EFFIS database, for each EU country. Finally, we quantified landscape dynamics and metrics in 1990-2018 associated with the occurrence of EWE, for each European country, using fire size spatial data from EFFIS and LULC data from Corine Land Cover. Preliminary results show that wildfires classified as extreme have been increasing in recent years across Europe, based on both text-based reports and historical anomalies. However, criteria used for EWE classification vary widely across countries, and identified anomalies are very distinct among European regions. Homogenization of forest landscapes and increased areas with wildland-urban interface seem to be consistently associated with the occurrence of EWE in Europe. This study is under development within the EU H2020 project FIRE-RES (Innovative technologies and socio-ecological-economic solutions for fire resilient territories in Europe) and will provide guidelines to increase the resilience of forest landscapes to EWE in the future.

OC 3.10 Assessing the economic value of the Fire Protection Ecosystem Service in a mountainous landscape in northern Portugal

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In this study, we applied the Fire Protection Ecosystem Service (FPES) concept to anticipate future socioeconomic impacts of wildfires in a fire-prone mountainous landscape in NE Portugal under global change. FPES supply results from the capacity of landscape features in regulating fire regime by maintaining fire frequency, intensity and spread within acceptable bounds that provides protection to people and their livelihoods (e.g., reduction in damage costs). We run the LANDIS-II forest landscape model (2020 – 2050) to simulate the effects of climate change (RCP 4.5 and RCP 8.5 scenarios) and farmland abandonment on fire activity and landscape dynamics under four fire management strategies (FMS): business-as-usual (BAU) focused on fire suppression, and fire-smart (FS) strategies (forest- and silvopasture-based) focused on fire prevention. Then we combined model outputs with economic valuation methods to assess the economic value of FPES. To do this, we performed a cost-benefit analysis of the market value of four provisioning ecosystem services protected from fires and the economic costs of wildfires and landscape management based on the net present value (NPV) that we used as a proxy for the FPES economic value. Also, we performed a cost-effectiveness analysis to identify trade-offs among FMS. We found NPV to be positive for all FMS, although NPV yield by FS strategies outweighs BAU in both climate scenarios. Nonetheless, NPV under RCP 8.5 is lower than in RCP 4.5 regardless of the FMS due to higher economic costs of fire. Although fire-smart strategies show different levels of effectiveness, they are more cost-effective than BAU, as they reduce costs and increase benefits, e.g. decreasing the occurrence of large fires and burned areas above the firefighting capacity or yielding additional ecosystem services' economic value. Based on our results, we discuss planning and management of Mediterranean fire-prone landscapes in the future.

OC 3.11 Bridging experimental and monitoring research for the assessment of ozone impacts on Mediterranean trees

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Tropospheric ozone (O_3) is a significant phytotoxic air pollutant for plants. Visible foliar injury by O_3 (O_3 VFI) is known as a bio-indicator to assess potential phytotoxicity of O_3. O_3 VFI may closely relate to O_3 uptake through stomata, i.e. Phytotoxic Ozone Dose above a threshold Y of uptake (PODY). To estimate PODY, accurate parameterization of the stomatal conductance (gs) model is essential. Model parameters and O_3 VFI descriptions are available for several dominant tree species in Europe (e.g., *Fagus sylvatica*, *Quercus ilex*). However, more information is needed for various plant species especially in the Mediterranean Europe. In this presentation, we will present current developments for: 1) the validation of O_3 VFI and 2) the parameterization of forest tree species, by using the Free-air O_3 eXposure (FO_3X), which is a unique facility in Mediterranean Europe within the framework of the European AnaEE Research Infrastructure. Regarding 1), we compared O_3-like VFI registered in the southern European forest sites with actual O_3 VFI observed in a FO_3X experiment. The O_3-like VFIs were evaluated by eye in forests and thus it was subjective. According to a new imaging analysis, we firstly demonstrated that major parts of the colors for O_3 VFI were similar in the field and the FO_3X. Regarding 2), we worked with tree and shrub species that occur at the forest sites. gs model parameters were species-specific and Alnus glutinosa had a very high gs showing rapidly O_3 VFI in the elevated O_3 treatment, while species with low gs such as Arbutus unedo showed just a few or absence of injuries. We calculated a flux-based threshold for the O_3 VFI onset at the FO_3X, which ranged from 4.9 to 18.1 mmol m^{-2} POD1. In late summer, O_3 exposed deciduous trees especially showed a less efficient stomatal control, i.e. stomatal sluggishness, which may cause further O_3 uptake. Considering stomatal sluggishness, the development of gs modelling will be also discussed.

OC 3.12 Unravelling bat species' response to environmental structure and patterns of occupancy in a Mediterranean landscape

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In an increasingly modified ecosystem, land cover changes are conditioning wildlife's available habitat. The effect of habitat limitation on species depends on the landscape structure, composition and the species' environmental requirements. Due to their broad ecological diversity, we investigated species-specific bat occurrence concerning land cover and landscape structure while considering imperfect detection. We hypothesise that heavily human-influenced habitats constrain bat species' occupancy. We acoustically sampled bats in 59 locations in southern Portugal. Landscape structure was obtained from the Sentinel mission, specifically vegetation canopy height and enhanced vegetation index; Land cover classes were also remotely obtained from Copernicus global land service. To estimate occupancy and detection probabilities, we implemented an occupancy modelling strategy that uses a Bayesian framework with Pólya-Gamma data augmentation, enabling a faster and more efficient inference. We obtained a significant association between the vegetation metrics and forest-associated species' occupancy allowing us to produce maps of predictive occurrence probability for these species. In contrast, generalist bat species showed low responsiveness to the structure and land cover. Detection probability was strongly linked to landscape features, with infrastructure such as roads reducing the likelihood of detecting bats while the presence of water bodies increased this probability. Our findings highlight the importance of incorporating remote sensing data to estimate ecologically relevant species' parameters. The occurrence of bats at the landscape level appears to be highly species-specific, whereas the acoustic detection of bats is influenced by a limited set of variables, underscoring the significance of accounting for imperfect detection when studying elusive species like bats.

OC 3.13 Trends in airborne oak pollen: climate change effects in Oaks Forest in Alentejo Region (South Portugal)

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Oaks (*Quercus sp*.) plants are characteristics of the Alentejo region landscape, very present in Portugal Forest, with a great ecological and socioeconomic importance. Objectives: To analyze: 1) the prevalence and aerobiological behavior of *Quercus* pollen in the Alentejo region, 2) the influence of meteorological factors on atmospheric pollen concentrations; and 3) the temporal trends of airborne oak pollen seasons. Methods: In this study, daily *Quercus* airborne pollen data of Évora monitoring station of the Portuguese Aerobiology Network (2002 to 2019), and daily data of meteorological factors from the Portuguese Institute for Sea and Atmosphere were used. Results: *Quercus* pollen was the predominant pollen type in the pollen spectrum of Évora atmosphere, representing an average of 28% of the total atmospheric pollen collected. The average Annual Pollen Integral was 23127 ± 8780 pollen/m^3. The main pollen season lasted 62 ±15 days, started in mid-March/early April and ended in May/June, depending on the year. Pollen peaks were registered in March, April and May, mostly in April and with magnitude values mostly in the order of thousands. 2019 was the most markable year, with the highest number of days recording high concentration levels in allergological terms. This study showed an increase in the Annual Pollen Integral values, pollen peak values, pollen seasons with later starting dates, earliest end dates and shortest pollen seasons trends. Statistically significant correlations were obtained between atmospheric *Quercus* pollen concentrations and meteorological factors, being positive with temperature, light and wind factors and negative with relative humidity, precipitation and specific wind directions. Conclusion: The aerobiological information provided by the Portuguese Aerobiology Network provides important information for plant phenology studies, crop management and climate change effects.

OC 3.14 Mediterranean woodlands on the edge – Road pressure on rodent-mediated seed dispersal

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Edges influence more than half of the world's forests and are increasing with growing road networks. For forests such as Mediterranean oak woodlands partially depending on rodent-mediated seed dispersal to persist or expand across their edges, increasing road networks are puzzling. Roadside verges can have high densities of acorn scatter-hoarding rodents, but these may avoid crossing the road, especially if paved. To evaluate effects of road type (paved vs. unpaved) and forest edge (roads skirting [edge] vs. crossing [non-edge] oak woodlands), we tracked 1440 marked holm oak (*Quercus rotundifolia*) acorns from November 2022 to April 2023 in 12 1-km road stretches (6 edge, 6 non-edge) in Alentejo, Portugal. To isolate road effect, each site included a similar stretch without road (bordering or interior to edge and non-edge sites, respectively). To examine the effect of rodent density on acorn dispersal, we also conducted live trapping at the locations of the acorn supply stations. Roadsides had between 3.3 and 2.2 times more rodents than bordering and interior stretches. As hypothesized, our ongoing study indicates that acorn dispersals across roads were relatively few – 6.4% of dispersals crossed roads. Further, acorns crossed 2.1 times less the paved roads than similar unpaved roads. Intriguingly, at both edge and non-edge sites, the number of road crossings was similar to that of bordering and interior stretches. Across sites, the longest movements were along roadsides, where the acorns moved an average of 5.6 m (median = 1.6 m, maximum = 62.7 m). At edge and non-edge roadsides, dispersal distances were 2.0 and 1.4 times greater than those in border and interior stretches, respectively. Our study is the first empirical example showing that the higher density of seed-dispersing rodents at roadsides can translate into longer dispersal distances along the verge and to provide strong evidence that seed crossings, although uncommon, can vary with road type.

OC 3.15 Responses of *Quercus ilex* seedlings to combined, drought and *Phytophthora cinnamomi*, stresses: a metabolomic analysis.

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The research group "Agroforestry and Plant Biochemistry, Proteomics, and Systems Biology" at the University of Cordoba is currently investigating different aspects of the molecular biology of Holm oak (*Quercus ilex*), the most emblematic and representative species of the Mediterranean forest and the agrosylvopastoral ecosystem "dehesa". By integrating different approaches, mainly -omics, from genomics to metabolomics, it is pretended to determine mechanisms of resilience to the decline syndrome and climate change, and to identify molecular markers to be used in breeding programs based on the selection of elite genotypes. By using an LC-MS/MS, non-targeted, metabolomic approach, the effect and the responses to combined drought and Phytophthora cinnamomi stresses, have been analyzed in Holm oak saplings from three individuals with contrasting responses to each individual stress. Leaves from nine-month-old seedling subjected to combined stresses were collected at times corresponding to 30 and 50 % reduction in photosynthesis. By LC-MS 17664 compounds were resolved in either positive or negative modes. Out of them, 3100 were tentatively annotated, belonging to different chemical families. Filtered raw data by consistency, were subjected to statistical Kruskal-Wallis and PCA analysis. Qualitative and quantitative differences (0,5 > fold-change > 2) among treatments were found in number of 340. PCA showed more differences between individuals than between treatments, 57,1 and 8,5 % of the original raw data. Out of the 3100 putative annotated metabolites, those that increased in abundance at the first sampling time, corresponding to an early response, showed fold-change values > 2, and common to the three individuals were selected. The group of secondary metabolites, mostly phenolics, was the most represented, and included, among others, scopolin, 5-O-caffeoyl shikimic acid, p-coumaroyl quinic acid, catechin 3-O-alpha-L-rhamnoside and 5,6,7,3',4',5'-hexamethoxyflavanone. Others, such as abscisic acid and glutamic acid were identified. These changes have been reported as responsive to stresses in quite a number of plant species. Work is now in progress to integrate metabolomic analysis with transcriptomics and proteomics in order to propose gene markers of resilience in Holm oak.

OC 3.16 Increasing disturbance activity in forest ecosystems – Tipping points and adaptive management

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Climate change-induced increases in disturbance activity pose a great challenge to forest management. In extreme cases, disturbances can drive tipping points after which forest ecosystems develop towards an alternative state, causing vast decreases in ecosystem services supply and biodiversity. I have conducted a literature review for boreal and temperate forests (i) to investigate the vulnerability of forests to disturbance-induced tipping points, and (ii) to compile a set of adaptive measures aiming to mitigate increasing disturbances. Only few studies indicate that forests experienced a tipping point driven by recent increases in disturbance activity. Hence, many forest ecosystems are likely able to cope with future increases in disturbance activity to some degree. Yet, tipping points likely vary across ecosystems dominated by different disturbance agents. While wind and bark beetles mainly affect canopy trees, fire and drought also diminish tree regeneration, thus reducing the capacity of ecosystems to recover and reorganize. Hence, forest ecosystems in which fire and drought are the dominant disturbance agents might approach tipping points earlier than forests dominated by other agents if disturbance activity continues to increase. While there is no "one-size-fits-all solution”, a number of adaptive measures are available to mitigate increasing disturbances. These can be divided into proactive and reactive measures at stand and landscape level for dominant disturbance agents. While proactive measures, such as enhancing multiple facets of diversity, are more effective in the longer term, reactive measures, such as salvage logging and decortication against bark beetles, operate without long time lags. Broader landscape-scale management concepts, such as "functional networks" or "disturbance-based forest management", embrace various adaptive measures. They diversify risks and provide a broad spectrum of potential development pathways in the reorganization phase after disturbance on the landscape.

More research is needed to quantify the effectiveness of adaptive measures at regional scales.

4. Forest management, public policies, governance models and decision making

OC 4.1 Landscape transformation through collaborative approaches

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RESIST project will develop innovation strategies targeting climate change adaptation across four European regions. Portugal is one of these regions, with different case studies in Central Region (Coimbra Region and Médio Tejo). At Coimbra Region, RESIST will target landscape resilience to wildfires and sustainability. Integrated into the Portuguese Landscape Transformation Program, several policy instruments are in place to foster new land use and land cover practices, such as the Integrated Landscape Management Areas (AIGP) and Villages Condominium. These instruments will also contribute to overcome constraints related to small-scale forest ownership, contributing to land consolidation and joint interventions. Greater use of participatory approaches in policy-making drifts from failures of top-down policies and an increased perception of a better performance of participatory and bottom-up decisions. The AIGP and Villages Condominium instruments may benefit from stakeholder engagement, strengthening a shared vision regarding the aims, activities, roles, and responsibilities. This communication will present the preliminary results of six case studies where AIGP and Village Condominium instruments are emerging, especially concerning who is involved and the main constraints and barriers. This information will enable the design of a future stakeholder engagement plan while respecting diverse biophysical and sociocultural contexts.

OC 4.2 Collaborative and strategic landscape planning for wildfire management – evidence from Portugal

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Extreme fire events represent an increasing threat in the forested landscapes of Portugal, as in many other Mediterranean forest areas, accentuated by Known scenarios of climate change. In the mountain regions of Portugal, there is a double process of decaying landscape care: (1) abandonment of forest management due to the extremely small property lots and low profitability of the forests; (2) closing of the landscape by shrub encroachment due to abandonment of the extensive grazing of the open patches. Consequently there is an increase in fire prone biomass and in the continuous cover of forest and shrub. Shrub encroachment leads to a narrative among those involved, of marginalization of farming and decaying community and this narrative accentuates the difficulty in breaking the abandonment circle. With reference to evidence from other landscapes in Europe, where also forestry and extensive grasslands are major landscape components, we present a framework contribution of local level collaborative strategy making as a novel and integrated approach to promote landscape governance which can support coherence of collective and individual initiatives towards a more sustainable future. By 'collaborative' we mean a process in which stakeholders – public and private – through dialogues of risks, options, and other conditions agree on solutions and by 'strategic' we mean priorities for protection, investments and principles for landscape management. Based on two local case studies, Monchique and Serra da Estrela in Portugal, we discuss management practices developed so far and we propose the pathway for better approaches to management of landscapes vulnerable to wildfires. We close the paper by discussing four arguments for the need for collaborative and strategic planning as a wildfire approach.

OC 4.3 Poor performance of community forests to sustainable livelihoods in Cameroon: long-term impact assessment and ways forward

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Community forestry in Cameroon has not been a smooth ride. After a craze for this form of decentralised forest management in the 2000s, requests for new community forests and their implementation on the ground have been rapidly decreasing every year over the last decade. The article reviews the main difficulties encountered by this policy and assesses its various impacts on the ground. We use the sustainable livelihoods framework to estimate the performance of fifteen community forests (CF) compared to counterfactual sites without community forests. Preliminary results show that (1) the CFs only marginally reduce deforestation and forest degradation (natural capital); (2) they provide individual income, notably through the wages associated with timber exploitation, but this very rarely complies with legality (financial capital); (3) collective income does not allow for significant and sustainable improvement of collective infrastructure (physical capital); (4) training courses do little to strengthen the capacities of rural populations, who are still dependent on external partners to create and manage their CFs (social capital); (5) most of the funds supposed to support populations in managing their CF are used by the external partners to comply with regulatory procedures. Several insights are discussed to put community forestry back on the path to sustainability in Cameroon: (1) resource management inspired by customary knowledge, practices and institutions; (2) a major revision of the regulations; (3) promote and support polyvalent sustainable development initiatives rather than mainly timber exploitation.

OC 4.4 Assessing Connectivity and Habitat Suitability of Green Infrastructure in the Boreal Forest of Sweden

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Natural and primary forests and their biodiversity continue to decline worldwide due to anthropogenic impacts. The boreal forests in Fennoscandia have been subject to intensive clearcutting since the middle of 20th century. Currently, only a fraction of forests with long temporal continuity remains at the landscape level. In Sweden, some of these primary forests have been formally protected, whereas other high conservation value forests (HCVF) are not. Both protected and not protected HCVF are now included in a nationally delineated network of HCVF. Besides the HCVF, older forests that have not been clearcut since the mid-1900s, i.e., “proxy continuity forests” (pCF) have recently been mapped across the entire boreal biome in Sweden. The purpose of this study is to analyze how these pCF may strengthen the HCVF network from a green infrastructure perspective. Methods used include: 1) evaluation of the spatial overlap between pCF and HCVF; 2) large-scale connectivity analysis; 3) assessing habitat suitability for virtual species specialized in pine, spruce, and broadleaf forests. Our results show that adding pCF located outside HCVF strongly increased the structural connectivity of the protected forests’ network. There are large regional differences in the ability to secure habitat and thereby functional green infrastructure by considering currently unprotected primary forest. We demonstrate that, by adding those forests to the network, the habitat area for low-demanding species dependent on spruce or pine forests can be largely increased. By contrast, there is not enough valuable broadleaf forests remaining to provide a suitable habitat for their associated species. We conclude that forest restoration is needed in the landscape matrix for pine- and spruce- dependent high-demanding species and at the landscape-scale for the broadleaf-dependent species.

OC 4.5 Moving to clear-cut free alternatives in Swedish forestry

Renats Trubins

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The clear-cut management system in Swedish forestry has come under criticism from environmentally oriented stakeholder groups, while the forest sector still largely supports it due to its high productivity and ease of execution. However, clear-cut free alternatives are being considered, such as single-tree selection and gap cutting methods. The forest sector's main concern with these alternatives is their long-term production capacity, which is currently uncertain. Apart from the long-term production capacity, there are questions around the transition period from even-aged to uneven-aged stand structures. The conversion from even-aged to any form of uneven-aged structure is bound to cause production losses under the transition period, regardless of the long-term productivity of the alternative system. This study investigates production losses during the transition period from even-aged to uneven-aged stand structures using a simple stand simulator. Equal long-term productivity of the clear-cut and the alternative systems is assumed. The results indicate that production losses during a transition period of 10 to 80 years in coniferous stands range from a few to as much as 44 mean annual increment equivalents, depending on factors such as the number of age cohorts, their distribution over the rotation age, the stand age at the start of the transition, and site fertility. The present analysis is most pertinent to gap cutting systems. However, we believe it can provide some indication of the least possible loss levels also for the single tree selection system. In summary, a rapid and large-scale introduction of clear-cut free alternatives in Sweden may imply a significant temporary production loss at the national level. A gradual introduction of the methods over a prolonged period may attenuate the effect. The question of the post-transition production potential in comparison to the clear-cut system of the alternatives remains to be answered.

OC 4.6 Spatial decision support tools for assessing land-based climate mitigation actions

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Human activities have a huge impact on greenhouse gas emissions through land use change, land cover change and land management practices. Despite the fact that mitigation measures are given considerable attention in the climate policy of the public sector, there is a need to find complex compromises across the various services that the land sector can provide. The benefits of mitigation through conservation, restoration and improvement of land management practices are becoming increasingly evident. The protection and increase of forest biomass through afforestation/reforestation activities and sustainable forest management are considered the most promising and effective land mitigation approach. Environmental challenges can be addressed with the help of policy instruments that aid governance actors. Support is required for policymakers to find land management techniques that boost carbon sequestration and lower emissions. Even though this topic is receiving more scientific attention, there is a shortage of comprehensive information about the modern techniques for evaluating, analysing, and implementing the optimal land use management for maximising carbon sequestration. A systematic review of the literature was conducted in order to search for spatial decision support tools to provide support for decision makers in the field of land policy.

From the 187 publications that met the specified requirements, 68 tools were chosen. Furthermore, 18 tools were chosen for the final study as a result of using the exclusion criteria. These tools were categorised as suitable and not very suitable for policy makers based on input and output. As a result, 5 suitable tools with open access, 6 suitable tools with closed or restricted access, and 7 not very suitable tools were ultimately discovered.

OC 4.7 The Impact of Forest Management Plans on Forest Disturbances in Logging Concessions of the Congo Basin

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Forestry regulations in the Congo Basin require Forest Management Plans (FMP) for logging concessions to balance timber production and conservation while also safeguarding the livelihoods of local communities. However, the implementation of these reforms has been uneven across countries and many logging concessions operate without FMPs due to various external factors. This study exploits the staggered adoption of the reform to examine the impact of FMPs on forest disturbances across Cameroon, the Central African Republic, Congo, Gabon, and the Democratic Republic of the Congo using high-resolution forest maps and official logging concession records from 2000-2020. Our preliminary results suggest the FMP approval reduces tree cover loss in logging concessions with a FMP. Specifically, having an FMP is associated with a decrease in forest degradation, which ultimately leads to lower levels of tree cover loss. Additionally, the findings indicate that the avoided tree cover loss in concessions with an FMP varies over time and across concessions. Concessions that approved their FMP earlier exhibited higher levels of avoided deforestation and forest degradation compared to those that validated their FMP later.

OC 4.8 Characterization and Analysis of Rural Property Register as an Instrument for Land Management

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Land management is a relevant problem in rural areas, conditioning the planning decisions and the applicability of planning instruments. Within this framework, this study intends to analyze how rural property registration conditions land management instruments, with the aim of drawing attention to the importance of articulating the territory management instruments with heritage issues, since the lack of knowledge on this topic can be an obstacle to combine planning with the specificities of the region. The study was carried out in the parish of Alferce, Monchique, Portugal, which was affected by big fires, in 2003 and 2018. The physiographic characterization of the area reveals that this territory has steep slopes, with the soil predominantly occupied by forests and bushes. Eucalyptus is the main specie, representing about 80% of the parish's forest area. In terms of land use capacity, 94% of the area is classified in class E, whith limitations and risks for its occupation and use. The socioeconomic analysis revealed a population of 391 inhabitants, with a predominant economy in the agricultural and forestry sector. According to the convenience sample collected through interviews with forest owners in Alferce, there is a high rate of population aging, a low population density and a low level of schooling. Interviews have already been carried out with 18 forest owners in the study area, their properties having been registered in the Geographic Information Systems software (QGIS 3.22) and assigned a code that represents the owner anonymously. This information allows to understand the real state of properties' fragmentation and their real dimensions, in order to create a database that will allow the analysis and characterization of the Alferce rural property register. So far, 137 properties have been registered, representing around 11% (1023.31ha) of the 9611ha of the Alferce parish. After collection, an analysis of the register will be carried out.

OC 4.9 Forest certification and economic valorization in Europe: main drivers and limitations

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In recent years, there has been an increasing demand for certified forest products in Europe. This has been driven by consumer awareness of sustainability issues and demand for environmentally friendly products, as well as by public policies that promote sustainable practices. These trends are related to major worldwide challenges, such the need to decarbonize economy and mitigate climate change. But can forest certification also be a driver of investment and economic valorization? The aim of this study was to provide a systematic overview of the levels of forest certification across Europe and to identify key factors influencing the relationship between forest certification and investment or economic valorization in the forest-related markets, using a vast range of scientific publications, technical reports and police briefings. The findings showed that certification has grown in significance throughout Europe with a rising percentage of certified forest area in most countries, but not in equal terms amongst member states. By examining individual countries across Europe, it was possible not only to identify unique variables for some groups of countries that determine their impact into the forest related markets but also to identify several factors that influence the implementation and impact of forest certification schemes into their market share. Results suggested that forest certification can be a driver of investment in the sector and different types of public policies and related industries also influence the impact of such schemes into the European market value. This study offers new perspectives to both natural and social scientists but also to industry and policy makers by connecting the scientific research, the economic trade-offs of forest certification, and the market value of forestry-related products. This work was funded by the ERA Chair BESIDE project financed by the European Union’s Horizon Europe under grant agreement No 951389.

OC 4.10 Matching policy and academic practices – the case of the Montado results-based payments

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The Montado silvo-pastoral system is a high nature value farming system in decline in the southern region of Portugal. In order to reverse this trend, targeted policies are urgent. Sectorial policies in the framework of the Common Agricultural Policies have contributed to the Montado decline by motivating changes in livestock population and intensification of stock density. Policies that promote an integrated view are needed and a results-based model for agri-environmental payments for the Montado appears as a possible solution for the policy gap identified. This model implies an integrated approach able to deal with the complexity of the system and simultaneously provides economic return for ecosystem services not currently valued by the market. At the start of 2023 we were able to put in practice such policy instrument in two pilot areas under the agri-environmental payments of Pillar 2 of the Common Agriculture Policy implementation in Portugal. In this paper we systematize the challenges faced and the lessons learned during the implementation period. This is the first time in Portugal that a research center is responsible for the coordination of a policy instrument which implied a unique opportunity for discussing the necessary adjustments so that science and policy interface can improve. Such discussion can also contribute to an international discussion about the achievements and challenges of implementing result-based model policies.

OC 4.11 Riparian buffer zones in production forests create unequal costs among forest owners

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Riparian buffer zones (RBZ) are an important instrument for environmental policies for water and biodiversity protection in managed forests. The implementation of RBZs reduces forest owner's income but because streams are heterogeneously distributed in the landscape, we can expect the cost of implementing RBZs in landscapes with private forest owners to be unequally distributed. We investigate the variation of the cost of implementing RBZs within different property size classes across the size range of non-industrial forest owner properties in southern Sweden. Further we studied if the relationship between cost variation among owners and the property size class was linear. Using the Heureka PlanWise decision support system, simulated forest growth and management to quantify the cost of setting aside RBZs, or applying alternative management in them, as the relative loss of harvest volume and of net present value per property. We did this for multiple simulated as well as real-world property distributions to cover a broad range of property sizes. The variation of cost distribution among small properties was 4.2 to 6.9 times than among large properties. The inter-property cost inequality decreased non-linearly with increasing property size, and levelled off from around 200 ha. We conclude that RBZs, due to the irregular distribution of streams, cause highly unequal financial consequences for owners, with some small property owners bearing a disproportionally high cost. This adds to previous studies showing how environmental considerations differentially affect property owners. We recommend decision makers stimulate the uptake of RBZs by alleviating these inequalities between forest owners by including appropriate costs sharing or compensations mechanisms in their design.

OC 4.12 Institutional structures for protecting biodiversity and preventing illegal activities in forested landscapes in selected Western Balkan countries

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Despite all the efforts to address deforestation and forest degradation, illegal logging remain a globally widespread problem, representing a major threat to forested landscapes. Wood harvesting and trade have been identified as direct deforestation and forest degradation drivers and their impacts are emphasized by illegal practices that have devastating impacts on forests' health and biodiversity. While various policies and initiatives for biodiversity protection and prevention of illegal practices exist at both the international and European levels, their enforcement remains sometimes uneven as national states have sovereignty in transposing international obligations to national policy and legislation. The Western Balkan (WB) countries host a significant forest stock and a high share of highly biodiverse virgin and old-growth forests and they show raising illegal logging figures and are recognized as a priority area for enforcing EU legislation, including in the field of forest conservation and contrasting illegal practices. Despite this, scientific research on institutional structures for preventing illegal activities in forested landscapes in WB countries is still limited. This study presents an up-to-date overview of the extent of illegal activities in forestry and nature protection areas in selected countries and analyses public and private policies and initiatives for promoting sustainable forest management, biodiversity conservation and contrasting illegal practices. Based on desktop research and the analysis of scientific and grey literature, as well as key informant interviews, the current institutional structures for preventing illegal activities in forested landscapes in WB countries are presented and analysed. Building on results and commenting on them vis-à-vis previous studies, this study discusses the implications of existing institutional structures on illegal forest activities and biodiversity loss and provides recommendations for policymakers.

OC 4.13 Private forest owners' organizations adherence to policy tools in Portugal

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Portuguese authorities have been working to stimulate private forest owners' cooperation and active management to ensure a sustainable forest management. Policy tools created to pursue that goal include the legal institution of Forest Intervention Zones (ZIF) in 2005, Forest Management Entities (EGF) and the Forest Management Units (UGF), established in 2017 and finally, in 2020, the creation of the Integrated Landscape Management Areas (AIGP). Effectiveness of these policy tools depends beforehand on their adoption by private forest owners' organizations (PFOO) and this study analyses their level of acceptance. Also, it identifies the main reasons for that adherence (or not) and explores whether benefits generated by PFOO activities differ between who adhere and who do not. For this purpose, a survey was conducted amongst Portuguese PFOO, who were asked to answer an online questionnaire. With a 47% answer rate, corresponding to 59 Portuguese PFOO, results show that 54% of PFOO inquired are currently managing entities of ZIF, EGF, UGF or AIGP and 49.2% are working on the creation of at least one of this type of policy tool. If ZIF are the most adopted by the PFOO of our sample (with a total of 103), the high dynamism in the creation of AIGP (45 AIGP being created compared with the current 4) reveals a high level of acceptance of this policy tool. The most frequent reasons selected to justify the adherence were the need to create scale for forest management and forest owners' interest as well as motives related to monetary support, namely, the facilitated access to funds and the monetary support from central government. Additionally, from a list of 22 potential benefits resulting from PFOO activities presented to respondents, only 3 registered statistically significant differences between adherents and non-adherents. Therefore, it is questionable whether these policy tools potentiate the benefits of cooperation as they were meant to.

OC 4.14 Prescribed fire management strategy for post-harvest eucalypt plantations in Portugal

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The use of prescribed fire may be an alternative practice for fire risk mitigation in post-harvested plantations, however efforts need to be done to determine its the impact on the sustainability and productivity of *Eucalyptus globulus*. Previous work determined the technical basis for using prescribed fire in Portuguese eucalypts plantations, although the operational use of fire lacks the study of adequate management plans to maximize fuel reduction, minimizing adverse effects on trees. The main goal of the current work was to establish baseline conditions for soil and fuel moisture contents, as well as post-harvest stand status, that would allow for the most effective use of fire in managing wood debris while having the least amount of an impact on the soil and on the productivity of the forest plantation. Three study areas were established in recently harvested mature eucalypt plantations. The distribution and accumulation of biomass was assessed prior and after the fire. Immediately prior to the fire, soil, litter and biomass samples were collected to moisture content determination. Soil burn severity were evaluated immediately after the fire by visual assessment of soil and forest floor changes. Results demonstrated that prescribed fire was effective in diminishing biomass loads and in reducing fire risk in all study areas. Soil burn severity was low, averaging class 1 in all cases, according to visual indicators of severity assessment. The mineral and organic soil layer (lower duff) were unaffected, without or with low presence of ashes. Results from the present work will contribute to establish the criteria and to develop the technical guidelines for the suitable use of prescribed fire in wood debris management in *E. globulus* plantations as a fire risk mitigation strategy. This work was supported by FirEProd (PCIF/MOS/0071/2019) funded by FCT and by BESIDE project financed by the European Union's Horizon Europe under grant agreement No 951389.

OC 4.15 Forging fire-resilient landscapes: fire-smart solutions for sustainable wildfire risk prevention

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Forging fire resilient forested landscapes is acknowledged as a key strategy for large wildfires risk reduction. Fuel management, though, generally lacks economic sustainability. Consequently, in marginal areas of southern Europe, fuel treatment programs hardly reach the critical scale of interventions required to significantly modify landscape flammability. This work presents some key fuel management initiatives implemented in agro-silvopastoral Mediterranean landscapes to show the breadth of possibilities to make wildfire risk prevention sustainable in such territorial settings. Initiatives were selected in the framework of the European project PREVAIL (PREVention Action Increases Large fire response preparedness) through bottom-up identification of a sample of 38 projects in four countries (Portugal, Spain, Italy and Greece). The sample was analysed systematically through a set of fire-smart criteria: (i) sustainability, (ii) cost-efficiency in risk reduction, (iii) synergies and cooperation, (iv) knowledge exchange and transfer, and (v) adaptive management. Lessons learned are summarized to identify solutions and functional approaches to scale up the implementation of sustainable fuel management under fire-smart territories principles. Fire-smart solutions use private, public and European funding in synergy to activate value chains from products, by-products, and ecosystem services generated by fuel management activities. The financial mechanisms include fire marketing, Payment for Ecosystem Services schemes, specific taxes, or environmental compensatory measures. These mechanisms catalyze the interest of multiple stakeholders, thus increasing the cost-efficiency of landscape fuel management while reinforcing the sense of commitment of society to the making of more fire-resilient forested landscapes.

OC 4.16 How willing are individuals to be involved in forest fire prevention in Portugal?

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Objectives Portugal, like other southern European countries, loses forest area to wildfires every year. Issues related to land management, property and responsibility compound natural causes. Forest fire prevention strategies can include different types of actions (such as monitoring, cleaning, etc.) and can involve different stakeholders. Not only landowners are affected, private and public, but also local communities and economic agents who are directly threatened and impacted by forest fires, as well as the general population who ultimately values forest as natural capital, and directly and indirectly, benefits from the many services forests provide. Some of these actions would require financial (money) and human (time) resources often not available for one specific action. One alternative is to crowdsource these tasks atomistically to individuals who are willing to take part in it, either through monetary contributions or by dedicating time. Methods In this study we conducted a questionnaire with 501 Portuguese residents and tested whether and how they would be willing to become directly involved in forest fire prevention. Respondents answered several questions as to their perceptions of forest values, responsibilities and causes for wildfires and possibilities of involvement. Results indicate that most respondents are willing to become involved in forest fire prevention, in particular when this takes the form of actively performing tasks and allocating time. The least preferred choices involve spending money. Conclusions Population involvement in certain forest fire prevention activities can be an alternative to more centralized and costly strategies. The respondents in our study indicate that they are willing to be involved in different crowd sourced strategies.

OC 4.17 The effect of knowledge in stakeholders' involvement in forest management: the example of Matas do Litoral public forest

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Forest resources are crucial for the conservation of biological diversity thus its sustainable management is becoming mandatory. To this purpose, stakeholders' involvement in forest management and planning is more and more recommended, to guarantee the balance between Societies' interests and needs and Nature's paces. Although, several dimensions of stakeholders' involvement in forest management have already been studied, the importance of their knowledge about those management processes is still underexplored. The current study intends to fill this gap by exploring the relationship between stakeholders' knowledge, involvement, profile, level of influence and interest in relation to public forest management policies. Using as a case study a Portuguese public forest area – Matas do Litoral – an online structured questionnaire was sent to the 237 stakeholders identified, and a 76% answer rate was obtained. More than half of the respondents declare to know Matas do Litoral management policies, but only a few are in fact involved in those processes. Knowledge emerges as a factor positively correlated with stakeholders' perceived influence and involvement in management policies. Also, their involvement in Matas do Litoral management policies results into a high level of perceived influence in those same policies. Furthermore, the level of agreement with management policies for the territories of Matas do Litoral differs from the level of influence in those policies and the stakeholders' profile. For example, Governmental Organizations, that refer to have a high level of influence agree with the management policies performed. These findings emphasize the role knowledge plays in forest management promoting well-informed and collaborative governance. Additionally, this study highlights the importance of an adequate information and knowledge management for the involvement of all stakeholders and the development of bottom-up sustainable forest management strategies.

OC 4.18 Is Woodland Expansion an Economically Efficient Alternative for Offsetting Carbon?

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Offsetting greenhouse gas emissions (carbon [CO$_2$ equivalent] hereinafter) through forest-based investment has been the subject of controversy due to allegations such as over-crediting and lack of permanence. This calls for a critical analysis of the potential and feasibility of forest-based investments to generate carbon units that are truly additional and long-lasting. In this paper, we analyse the economic potential of using woodland expansion to offset carbon, considering high resolution data for a case study area (Scotland), accounting for spatial variability in timber yield classes for six different types of tree species and in soil carbon, as well as climate effects on timber yield. Carbon additionally from planting woodlands, particularly in upland areas of Scotland used mostly for livestock farming, has been questioned by a few recent studies, especially when organic soils and intensive ground preparation practices are concerned. The latter has important economic implications, as planting trees is expensive and low carbon sequestration rates on poorer quality lands may make woodland expansion an unattractive investment. Furthermore, changing the use of land conveys opportunity costs in terms of livestock farming benefits forgone for landowners and/or land tenants, but also loss of flexibility when land is converted to forest which can result in short–term devaluation of afforested land. This paper develops an optimal land use change and forest management economic model, that accounts for timber and carbon net benefits, the costs of different forest planting and management intensities, and land opportunity costs from livestock farming. The model addresses restrictions to peatland planting and a scenario where there are financial penalties from livestock carbon emissions. We explore the cost-effectiveness of woodland expansion and the role of spatial heterogeneity in forest productivity, soil attributes, livestock stocking rates and land use typologies.

OC 4.19 Pruning the economy: implications of degrowth scenarios for the forest sector

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Efficiency improvements give hope for a low carbon future. However the rebound effect will make it very hard to decouple GDP growth from CO_2 emissions by 2050. Among the multiple pathways to reach decarbonization targets, scenarios of reduced consumption remain under-explored, according to the IPCC AR6 assessment report on mitigation options. What would be the effect of degrowth and fair redistribution scenarios on forest products demand? Our baseline is the shared socio-economic pathways 2 middle of the road scenario. We compare it to a GDP fair redistribution scenario from the Potsdam Institute for Climate Impact Research. We use the Global Forest Products Model to analyse how degrowth and fair redistribution policies would affect global wood demand, production and trade. In this model, changes in national revenue impact changes in demand among the four main types of secondary wood products: sawnwood, wood panels, paper and paperboard, and wood fuel. In turn, changes in production of those secondary products impacts roundwood harvest demand. Simulation results show the EU roundwood harvest could increase by 35% between 2020 and 2050 in the SSP2 scenario and decrease by 50% in the degrowth scenario. Such large changes in harvest regime have broad implications for the carbon sink, the exported footprint of wood consumption as well as for biodiversity and other ecosystem services.

5. Silvopastoral systems and sustainable integrative solutions at the landscape level

OC 5.1 Developing soil early indicators on Montados' soil functions

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Agro-forestry are important social-ecological systems as they deliver a wide range of ecosystem services (ES). Among all the different agro-forestry systems in the word, the Portuguese Montado is a culturally embedded agro-silvo-pastoril system that has survived for centuries. However, climate change and intensification in production systems are negatively impacting Montados, decreasing its size and health. In face of such sustainability problem we have established a transdisciplinary research approach for the Montado. These means that our research evolves alongside with a regular and structured dialogue with the stakeholders involved in managing the Montado and in policy making that affects the system. We developed an integrated methodology to develop soil early indicators to assess Montados' soil functions. We focus on soils because of its fundamental role in ecosystem processes and, consequently, its centrality for assuring the provisioning of ES. Thus, the methodology developed and that we will present, seeks to quantify the supporting and regulating ES provided by the Montado system and will help to understand better how management practices impacts soil ES. Field and laboratory data gathering is making use of already established soil quality indicators in literature (SQIs) (i.e. bulk density, soil aggregate stability, soil organic carbon, soil microbiology) into a selected set of treated (soil amendment by dolomitic limestone)/control paired-plots, at each of the three major soil types in the central Alentejo region. We assess, using a chrono sequence approach, the suitability of selected SQI of soil functionality to assess health of Montados. The quantification of changes in soil functions through its changes in SQIs in time, is of paramount importance to select promising soil early indicators by each type of soil and thus, for communicating soil diversity relevance to society, mainly to those responsible of promoting these land-use-changes.

OC 5.2 The positive effect of trees on pasture quality and soil carbon sequestration in holm oak savannas

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In the Iberian Peninsula, silvopastoral systems, known as "dehesas" or "montados", occupy more than 3 million hectares and are currently undergoing an opposite trend of abandonment or intensification (legumes sowing, rotational grazing…). Previous studies point to the possible buffer effect of dispersed trees against the negative effects of livestock intensification, and their key role in the adaptability of livestock production to global change. This paper evaluates the influence of trees on productivity and quality of pasture and carbon sequestration in the soil in this context of changes in livestock practices and climate change. We have taken data from 15 "dehesas" subjected to different livestock management and distributed along a climatic gradient. In each one we have measured 8 points (4 under the canopy and 4 outside the canopy) where we have quantified the annual pasture production, its quality, and the organic carbon content of topsoil (SOC). In addition, the herbaceous vegetation at each point was characterized by measuring several of its aerial and root functional traits. Soil texture and nutrient concentration have also been evaluated. The effect of trees, management and the other variables analyzed were evaluated by constructing a structural equation model (SEM). The results show that scattered trees have a remarkable positive effect on pasture quality and SOC, partly mediated by their positive influence on soil fertility and functional traits of herbaceous vegetation such as foliar N. In addition, trees have no effect on pasture productivity. These relations are constant among all types of livestock management and along the entire climatic gradient studied. Thus, we can conclude that dispersed trees can maximize the provision of environmental services of the pasture without compromising its productivity, being a key element to conserve for the sustainability and adaptability of extensive livestock farming.

OC 5.3 The relationship between canopy greenness and water availability in Cork and Holm oak within the Portuguese montado

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The increasing frequency and severity of droughts in the Mediterranean will influence forest health, particularly in silvopastoral systems such as the Portuguese *montado*. Thus, this study aimed to quantify the relationship between vegetation greenness, a proxy of health, and relative water availability at different timescales within the montado region in Portugal focusing on two main oak species - Cork oak (*Quercus suber*) and Holm oak (*Quercus ilex*). To quantify vegetation greenness, we used the annual mean Normalized Difference Vegetation Index (NDVI) of July and August, the period of higher spectral contrast between the tree canopy and herbaceous understory, to focus on greenness trends of the tree canopy. We obtained and inter-calibrated NDVI values from Landsat satellites 5, 7, and 8 via Google Earth Engine (GEE). We used the Standardized Precipitation Evapotranspiration Index (SPEI) to determine water availability, calculated using monthly Climatic Water Balance (CWB) values over different aggregated periods. We calculated SPEI from 1-48 months using CWB values from the Terraclimate dataset obtained through GEE. We focused on five land use classes: Cork Forest, Cork Agroforest, Holm Forest, Holm Agroforest, and Mixed Cork and Holm Agroforest. We further subdivided these classes based on a previous study that identified increasing and decreasing NDVI long-term trends for a subsample of 1,000 stratified random sampling points. We successfully quantified the SPEI Accumulation Periods (SAPs) most correlated with long-term NDVI trends. We did not observe significant differences between land use classes (forest vs agroforest) or between Cork and Holm oak, but rather between opposing NDVI trends. Interestingly, the histograms of the selected SAPs were less dispersed in areas with increasing NDVI trends (~5-12 months). Areas with decreasing NDVI trends, which may be more subjected to drought effects, had a larger decoupling between NDVI and SPEI (~2-17 months).

OC 5.4 Towards satellite remote sensing of quality of Mediterranean grasslands to support management in agro-silvo-pastoral systems

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Grasslands are the main resource to feed livestock in Mediterranean agro-silvo-pastoral systems. Mediterranean grasslands are characterized by strong temporal and spatial variations in biomass and quality. The ability of grasslands to sustain livestock production is determined to a large extent by their quality, measured by parameters such as crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and enzymatic digestibility of organic matter (EDOM). The development of tools that provide information on the temporal and spatial variations in pasture quality could prove valuable information for the management of grasslands and livestock. The information provided by current and future satellites brings the opportunity to obtain information on the pasture quality at farm level in a cost-effective way. This study investigates the potential of the configuration of two satellites that provide freely available data to assess pasture quality of Mediterranean grasslands: i) Sentinel-2, with 13 multispectral bands, 5-days revising time, and spatial resolution of 10, 20 and 60 m; and ii) the forthcoming satellite of the ESA mission: “Copernicus Hyperspectral Imaging Mission for the Environment·(CHIME), a hyperspectral satellite with more than 200 narrow bands of 10 or less nm and similar spatial and temporal resolution than Sentinel-2. BOA-reflectance of Sentinel-2 and CHIME-simulated data from field spectroscopy were used to fit PLS models to assess CP, NDF, ADF and EDOM. Models built with Sentinel-2 showed moderate predictive ability to assess CP, with mean R2test=0.50 and RPDtest=1.54. The rest of parameters showed low predictive ability. Models built with CHIME-like data reported promising results for NDF and especially for CP with mean R2test=0.82 and RPDtest=2.47. These results suggest that data provided by Sentinel-2 could allow qualitative assessment of CP while the forthcoming CHIME satellite could improve the predictions up to quantitative level.

OC 5.5 The transformation of the silvopastoral landscape of Montesinho Natural Park (1995 – 2021)

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In the grazing areas of the Montesinho Natural Park (PNM), the diet of small ruminants is shaped by the available landscape, through the daily routes chosen by the shepherd to feed his flock. Thus, in addition to grazing, sheep and goats benefit from a combination of agricultural by-products and spontaneous vegetation, such as stubble fields, chestnut and olive groves, leftovers and pruning, as well as forests and scrubland. Changes in land use inevitably lead to adaptations in pastoral routes. An analysis of the evolution of the landscape explains the changes in the various land uses that make up the landscape, whether natural, semi-natural or anthropic, and which have been determined by global changes, in particular climate change. This study updated PNM's Natural and Semi-Natural Vegetation Map (1995), an analogue cartography of great historical value that was transferred to digital format, requiring a refinement of its geometry and classification to ensure that the results were not affected by the different methodologies inherent in its creation. To achieve this, we chose to adapt the polygons of the original cartography to the currently available land structure geometry, namely the ISIP geographical database, and to update it based on images from 2021, complemented by field visits and visual interpretation of other images from different seasons and dates. The data were processed in a GIS environment, using the QGIS tool, which allowed the interpretation of the landscape transformation in the last 26 years, quantified by a transition matrix, and the trend for the next 26 years. From the results we can conclude that there has been a drastic decrease in the areas of extensive and intensive dry farming (-47%), while an increase perennial plantation (olive and chestnut groves) (+38%) has been observed, with some peculiarities. The other categories remained constant and are expected to continue to increase, albeit at a slower rate.

OC 5.6 Stakeholder-informed assessment of grassland management for ecosystem services in dehesa/montado systems

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The Dehesa, covering 3.1 million hectares in Spain and Portugal, is recognised as a High Nature Value (HNV) farming system due to its multifunctionality. This Iberian HNV system, known as Montado in Portugal, is an agrosilvopastoral ecosystem in which Permanent Grassland (PG) constitutes an essential component. Therefore, this study aims to assess the feasibility of multiple PG management options and innovations in terms of their ease of implementation, likely uptake by farmers, and potential to deliver ecosystem services (ES) under different farming intensity types (including organic and intensive/extensive non-organic farms). Agronomy-related practices regarding sward manipulation (sward renewal, overseeding), grazing management (GPS collars, rotational grazing) and high-tech innovations (monitoring and predicting grass growth by satellite and drone technology) were considered. To test the feasibility of the management options, a modified Delphi technique was used to explore the opinions and attitudes of an interdisciplinary group of ten scientific experts. Additionally, farmer interviews (n=75) were conducted to identify their familiarity, experience, and intention to adopt. The results provide insightful information for designing policies supporting the implementation and research of relevant grassland-related management practices in the context of Mediterranean Dehesa/Montado systems, and starting points for a better understanding of how farmers can be supported to adopt positive technologies for multiple ES delivery on PG. Almost all technologies can potentially contribute to providing sustainable policy goals, such as the EU's Green Deal. Among the strategies assessed, sward renewal displayed the lowest feasibility, while rotational grazing emerged as the most viable and beneficial in terms of ES, specifically under Mediterranean Dehesa/Montado conditions. Furthermore, remote sensing technologies, such as satellites and drones, are expected to play a crucial role in the near future. They offer unprecedented potential for precision agriculture, crucial for sustainable grassland management. Thus, our study offers both a snapshot of current possibilities and a roadmap to the future of sustainable grassland management.

OC 5.7 Don't Put All your Eggs in One Basket: Montado silvo-pastoral system as a case study of resilience

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The silvo-pastoral Montado is a semiarid Mediterranean system maintained by generations of farmers along the centuries in Portugal. Poor soils and frequent droughts are main abiotic limiting factors to which this system is well adapted. The Montado high biodiversity and low intensity farming approach, enables its classification as a High Nature Value Farming System. The main characteristic underlying farm management practices is multifunctionality. Farmers business strategies vary widely across farms as a consequence of a wide diversity of available resources, management practices and ecosystems goods and services. The opportunity to choose among a wide range of existing options creates a complex decision matrix that enables farmers to adapt to seasonal changes and disruptive events. We discuss the resilience of the Montado by retrospectively analysing results and findings from 2 different research projects to evidence the diversity of choices made, focusing on grazing livestock production, a determinant sector for the farmers' income. Resilience is hereby understood as an outcome of balanced economic, social and environmental capital. Data from the surveys conducted (170 farmers) revealed a diversity of livestock production models with different holding area, herd sizes, grazing management systems, commercialization models and product certification. Such array of conditions and decisions result in high standards of resilience. However, our data also point out to apparent weaknesses of the economic and social capital such as the high dependency of farmers on public funds (100% received CAP direct payments) and the low cooperation levels among farmers (23% belonged to a production organization). Regarding environmental capital, although no overall biodiversity change was found due to management practices, lower levels of tree regeneration were detected in more intensively grazed areas what should be considered an alarm sign.

OC 5.8 Potential of *Bituminaria bituminosa* as a new forage perennial legume in Montados and Dehesas of the Iberian Peninsula

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Mediterranean open woodlands of evergreen oaks, known as Montados in Portugal and Dehesas in Spain, cover 3.1 million ha in the Iberian Peninsula. This agro-silvo pastoral system is challenged by the inter- and intra- annual variability of rainfall, which poses serious drawbacks to feed livestock. Climate change will increase the seasonally of rainfall and decrease the annual rainfall. The use of drought-resistant perennial legumes could buffer the effect of seasonality and provide out-of-season forage during feed gaps. *Bituminaria bituminosa*, especially the varieties of the Canary Islands, have shown outstanding drought resistance and good forage quality. A new variety has been developed under the trademark of Lanza®. This communication presents results on the performance of the variety Lanza® in: i) soils con contrasting texture (sandy/clay) with high soil water content, with and without competition from *Lolium multiflorum* in a pot experiment, ii) shade effect on phenology, and iii) effect of 33% rainfall reduction and conditions of culture (competition vs monoculture) in a field experiment during two years. The results showed that Lanza® might have low competitive ability with fast-growing grasses, which might limit its establishment. Shadow has a strong impact on the phenology of Lanza®. In field conditions, it showed early phenology and high biomass production. Rainfall reduction did not reduce biomass production although it induced an advanced phenology. In the first summer, it maintained green leaves but dropped most of the leaves during the second summer, maybe due to the drier conditions and higher biomass accumulation. Leaf of Lanza® shows good forage quality (CP>13%), although total shoot quality was low in the second year due to a reduced leaf:stem ratio. Future research should investigate measures to reduce early competition and suitable partner species to successfully establish Lanza®, and the effect of phenology and management on leaf shedding.

OC 5.9 How many trees to fall: how and where are we losing the Montado silvo-pastoral system?

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The montado is a traditional agroforestry system in Portugal that combines cork or holm oak trees with pastures and crops. It provides multiple ecosystem services and supports rural livelihoods. However, in recent decades, the montado has faced several threats that have caused its decline and degradation. This paper analyses recent changes in montado cover and reviews the main drivers. The decline of this system has been identified by several researchers and stakeholders. However, the recent quantification of the declining montado areas is missing. Here, we provide an updated and extensive estimation of the decline of the montado system in Portugal. We used a 2006 montado cover map as a baseline and overlayed it with aerial photographs of 2018. We checked the montado drawn areas for land use change by installation of intensive crops, wildfire occurrences or the plantation of new areas of montado. We categorized the main driver of change and quantified its overall effect. Most of the areas were in average condition but 3.2% have changed to intensive agriculture (olive groves, almond-tree orchards). We also identified burned montado areas from previous wildfires (3,7%). In contrast, afforestation areas occupied 7.1% of the total area but a few areas had very low tree growth (4,3%) or had wildfire markings (7.8%). However, the most pervasive negative impact identified was the reduction on tree density in the Montado areas due to tree loss. This widespread phenomenon was identified in 43% of the areas and had a stronger impact on the several areas inland and southern locations. Some areas in the interior showed the tree loss process in a more advanced stage, with the formation of wide clearings (>1ha). Our results are a up to date baseline map that is essential for research and to find solutions for its conservation and restoration.

OC 5.10 Impact of cattle grazing spatiotemporal variation on cork oak seedling survival

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Overgrazing can hinder the survival of tree seedlings in silvopastoral systems such as the montado. Many farmlands exclude or rotate cattle between plots, generating a spatiotemporal variation in grazing pressure. To evaluate the effects of time since cattle grazing (old [cattle grazing older than two years and no subsequent grazing] vs. recent) and cattle grazing pressure (moderate [<150-cattle unit days] vs. high [>150]) at farmland scale, we monitored the survival of 8255 Cork oak (*Quercus suber*) seedlings within the state-owned farm Companhia das Lezírias, central Portugal (38º49'49.526 "N 8º49'15.899 "W), from November 2021 to February 2023. We collected the data within a 20 m radius of 78 adult focal cork oak trees in 26 plots, combining treatments in a full factorial design plus 18 trees in ungrazed plots for more than 12 years. Irrespective of the cattle grazing pressure, the mortality of cork oak seedlings was 30% higher in grazed plots (70% mortality) relative to ungrazed plots (40% mortality). Plots with moderate grazing had seedling mortality similar to control plots (~40%). Overall seedling mortality peaked at 67% in August 2022. Between August and September, the pace of mortality increase slowed down, and then there was 16% seedling resprouting between September 2022 and February 2023. The mean distance from seedlings to shrubs was 20% greater in dead seedlings (~1 m) than in surviving seedlings (~0.8 m). Combining long-term grazing records with extensive samples of cork oak seedling survival, our ongoing study is an empirical example that spatiotemporal variation in grazing pressure can lead to large heterogeneity in seedling mortality. Our data will assist managers identify plots with better grazing histories towards optimizing the regeneration of Mediterranean cork oak woodlands.

OC 5.11 Effects of conservation zones on the biodiversity and ecosystem services of Mediterranean evergreen oak woodlands

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Implementing conservation zones, that is, areas of non-use or where management activities, such as grazing, are halted or substantially reduced, is a common standard of sustainable forest management practices. Here we investigate the effects of implementing conservation zones, where grazing was excluded, on the biodiversity and ecosystems services of mixed Cork (*Quercus suber*) and Holm (*Q. rotundifolia*) oak woodlands in southern Portugal. We compared plant and bird diversity and above ground carbon storage and fire hazard, in conservation zones, where grazing was excluded, and control areas. We also investigated how biodiversity and ecosystem services varied in conservation zones where grazing had been excluded for 10, 14 and 20 years. We found that the structural diversity of the shrub understory was higher in conservation zones than in control areas and that structural diversity increased with time of grazing exclusion. The number of bird species found in conservation zones was similar to that found in controls (52 versus 50 species, respectively) although species communities were different: species depending on open areas were more common in control, grazed areas, whilst species dependent on shrubby and woodland habitat were more abundant in conservation zones. The number of shrub species found in conservation zones with 10 years of grazing exclusion was not significantly different from that found in control areas (12 versus 14 species, respectively) but these differences increased with time of grazing exclusion. In long-term grazing exclusion conservation areas, the above ground carbon storage was significantly higher than control, grazed, areas. Higher above ground carbon storage in conservation areas, however, needs to balanced with higher fire hazard. Establishing conservation zones, where grazing is excluded, leads to trade-offs in biodiversity and ecosystem services of evergreen oak woodlands, which needs to be considered during management decisions.

OC 5.12 MIXED production at the landscape level: an emergy assessment on different agricultural systems under the same management

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Mixed production – integrated crop-livestock system - at farm scale level is decreasing due to obstacles as costs associated to livestock, decrease on knowledge and changes in regulations. On the other hand, mixed production at a landscape level is an interesting way to develop new synergies and to promote socioeconomic benefits to the farmers. Through a spatial organization and land-use allocations it allows several economic opportunities. By promoting these synergies between farms, it enables the enlargement of product scope and the exchange and reutilisation of materials (i.e., feed, tools, machinery). Montado is a typical Mediterranean extensive silvo-pastoral system with cork and holm oak production and animal grazing. In Alentejo, south Portugal, it is common for farmers to have different farms to offset modifications in regulations – in particular subsidies - and conventional market price fluctuations of different products. In this study, we are evaluating three different farms under the same owner: two farms with Montado and an olive and hay production farm. Between these three farms, there is a direct raw materials exchange and a temporal and spatial integration between them. Allowing several management conducts to be held depending on actual conditions - both external and internal to the farms. To address these complex systems at a landscape level, we did an emergy assessment to measure and understand its economic, social, and ecologic contributions and implications. Emergy methodology, accounts for all types of energy required to produce a service or a product. It is a tool grounded on thermodynamics and general ecological system's theory used to assess the performance and sustainability of a system, in this case agroecosystems. To understand the system's sustainability and resilience, indicators such as the environmental loading ratio (ELR), emergy yield ratio (EYR), the emergy sustainability index (ESI) and the renewability (%R) were used.

OC 5.13 Perceived benefits from agroforestry landscapes across North-Eastern Europe: What matters and for whom?

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Agroforestry landscapes are crucial to human wellbeing; however, they are in sharp decline across Europe. An improved understanding of the complexity of agroforestry landscapes within different biophysical, sociocultural, economic and governance contexts is essential for designing effective policy and management interventions that are more tightly aligned with societal expectations and aspirations. This paper identifies and compares values people attribute to agroforestry landscapes across North-Eastern Europe, using case studies in Sweden, Latvia, Belarus, and the Russian Federation. We apply the multiple-value approach to an assessment of agroforestry landscapes. Using data from a total of 1634 face-to-face structured interviews, we (i) analyze and explore the preferences of diverse groups of respondents for agroforestry landscapes; (ii) identify a broad range of nature's contributions to people (NCP) that were attributed to agroforestry landscapes by respondents; and, (iii) analyse values of
agroforestry landscapes across different contexts in NorthEastern Europe. We found that a highly heterogenous group of people – broadly irrespective of age, education, gender, place of residence, political, economic, or social-cultural context – perceive agroforestry landscapes as important to their quality of life. Respondents attributed multiple NCP to agroforestry landscapes, and nonmaterial NCP are the most frequently assigned in all four countries. Most respondents across all case studies considered relational values of agroforestry landscapes to be important for their quality of life, with identity as the most often associated with agroforestry landscapes. We discuss how relational values might be incorporated in policies and practices related to agroforestry landscapes in North-Eastern Europe.

OC 5.14 Agroforestry business model innovation network (AF4EU)

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As world population increases, the need for more productive and sustainable food and land use becomes urgent. Thanks to its multifunctional properties, agroforestry is part of the solution to address sustainability issues, including environmental, economic or social. Considering this urgent necessity, the overall objective of the EU-funded AF4EU project is to promote the European agroforestry through the development of a multi-actor interactive and innovation-driven expanded agroforestry network. This will be based on the sharing of successful practical experiences and existing research knowledge connected through ICT-Tools, with a special focus on the development and implementation of new cost-effective practices, business models and agroforestry extension services considering the whole food chain and therefore including consumers. AF4EU will include 11 Regional Agroforestry Innovation Networks around Europe with relevant actors (farmers and foresters, researchers, advisors, consumers, NGO's, retailers and policy-makers) and specially operational groups. Moreover, a set of 33 successful agroforestry farm business models will be analysed across Europe from a sustainability perspective (economic, environmental and social). The project builds up on previous H2020 projects and aims at developing an agroforestry knowledge platform that integrates an end-user (i) searchable knowledge reservoir namely Knowledge cloud, (ii) an alive-handbook, (iii) an agroforestry innovation business decision support tool (AFi-Bus DSS) including a business and a business environment analysis targeting agroforestry policy in Europe and a Multilingual Massive Open Online Course (MOOC) with training modules targeting farmers and advisors. AF4EU will definitively contribute to the implementation and uptake across Europe thanks to the supply of cost-effective business models techniques and a successful communication, dissemination and exploitation planning reaching a large audience in Europe.

OC 5.15 Modelling shepherds' decision-making about grazing on forested mountain landscapes - contributions for keeping discontinuity

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Pastoral systems have been key in the sustenance of marginal territories, shaping open areas in forested landscapes by providing important shrub control services. In Serra da Estrela, the largest and highest mountain area in Portugal, livelihoods used to be largely based on the rearing of autochthonous sheep breeds. The mountain's landscape was, until a few decades ago, composed of large forest patches in a mosaic with open natural pastures. But the grazing pressure in Serra da Estrela has been reducing due to social and economic drivers that have pushed shepherds and sheep to the foothill, or plainly out of the sector. Shrubs start to encroach on previously grazed land and the impacts of the resulting increase in landscape continuity have been made clear in the extreme fires of 2017 and 2022. As fire risk is likely to increase with climate change, it becomes urgent to understand what strategies can be deployed to keep fragmentation in these forested landscapes. However, this discussion often fails to include shepherds' reasoning to give up seeking altitude pastures. With this study we assessed the variables that can influence shepherds' willingness to resort to altitude grazing. We used a fuzzy cognitive modelling (FCM) approach. FCM uses fuzzy-graph structures that represent causal reasoning and allow to unveil direct and indirect feedback mechanisms within the system. We drew a cognitive map of the silvopastoral system in Serra da Estrela, including main variables and how they connect, based on local stakeholders' and experts' knowledge. Fourteen shepherds were then asked to create their own connections between variables and to provide a value to each connection. With these quantifications, we built an FCM-based scenario analysis to understand what variables are more relevant in generating changes. We expect the results to provide insightful information on which strategies and entities should be involved in keeping altitude pastures open and to inform policy making.

OC 5.16 Residual signature of sewage sludge in soil bacterial communities 15 years after application

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Despite their important role in soil systems, compositional and functional responses of bacterial communities to different land use and management regimes are not fully understood. For example, soil fertilization is known to significantly affect soil bacteria, but studies on the residual effects of these practices on soil microbial communities are still scarce. In this study, we investigated the residual effect of sewage sludge addition (alone or in combination with $CaCO_3$) to a silvopastoral system (*Pinus radiata* + pasture) in the NW of the Iberian Peninsula (15 after the last application) on the soil bacterial communities using a high-throughput sequencing technology. Moreover, results were correlated with soil physico-chemical properties such as pH, available P, total N, organic C and exchangeable nutrients. The soil bacterial composition (considering most abundant families and most abundant genera) was clearly differentiated according to the soil treatment at the genus level, and this distinction was less evident at the family level. The $CaCO_3$ addition resulted to be the main factor explaining the whole dataset of genera abundance suggesting that the application of $CaCO_3$ together with sewage sludge may have a more lasting effect. The effects could be due by adding nutrients but also microorganism to soil. However, it is hard to causally differentiate between bio augmentation (adding organisms) and bio stimulation (adding growth substrates for indigenous organisms) as the mechanisms responsible for changes in microbial structure. It has been reported that most of the introduced microbes may not adapt well to the soil environment, but some of them may nevertheless survive in the new environment. The results of the present study show that although no major statistical differences on soil physicochemical properties were observed, these seem to be of major biological significance since changes in bacterial communities were still observed 15 years after fertilization.

6. Forest Landscape Restoration initiatives: biodiversity, economy and people

OC 6.1 Learning from the past to face future challenges: gathering expert knowledge on the evolution of forest restoration in Europe

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The growing recognition that healthy forests are key to tackle many of the challenges humanity faces (e.g., biodiversity, water and climatic crises) is resulting in a historical momentum encouraging forest restoration at the global, national and regional scales.

This momentum is accompanied by multiple initiatives and policies that call, for example, for the restoration of at least 30% of the degraded ecosystems by 2030. However, the translation of these ambitious goals into reality is still a major challenge due to multiple limitations and uncertainties. One such challenge is that the success and failure of past restoration efforts remains poorly documented and disseminated. Thus, there is a clear need to capitalize upon past experiences in forest restoration to minimize mistakes and maximize the efficient use of resources in the future. We address this challenge by collating information on the major practices and historical evolution of forest restoration in Europe. We aim to 1) examine the ecological, social, political and economic characteristics of the main forest restoration and adaptation initiatives across Europe, 2) understand how the nature of these initiatives has evolved over time and what the main drivers of change have been, and 3) synthesize the lessons learned from past and present restoration practices to help guide future forest efforts. This will be achieved by analyzing and synthesizing the detailed information provided by 31 national experts from 20 European countries in the form of narratives. These narratives are being elaborated following a comprehensive template that includes 38 indicators and different historical periods. Considering the extensive spatial coverage as well as the wealth of knowledge embodied by the experts, the outcome of this joint effort is bound to be of great relevance to inform the success of future restoration initiatives and strengthen the role of forested landscapes in addressing the pressures of the Anthropocene.

OC 6.2 Trees4Water– Tree-based solutions for water quality improvement

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Introducing forests is seen as an interesting natural strategy to face the undeniable consequences of global change, while promoting the conservation of biodiversity and the alleviation of economic and social problems. Among other benefits, tree-based solutions are often associated with a reduction in diffuse water pollution, which has agricultural activities as a primary source.

However, there is weak evidence supporting the effective impact of tree-based solutions on the reduction of diffuse water pollution and the assessment of the respective costs and benefits. Trees4Water aims to evaluate the environmental effectiveness and the costs and benefits of introducing tree-based solutions to improve water quality: i) at the landscape scale to achieve good ecological status under the WFD, and at ii) drinking water abstraction source to a possible reduction on water treatment costs.

Two river basins were used as case studies, representative of a climatic and environmental gradient in northern Portugal: the Cávado and the Sabor river basins, where SWAT hydrological model was applied with a good agreement between observed and simulated values for discharge, sediments, and nutrients. Forestation scenarios were developed based on the feedback from the local water company “Águas do Norte (AdN)”. Finally, cost-benefit analysis was applied to support local sustainable development strategies. Results indicate that a forest area increase has a key role in reducing sediments and nutrient exports to the rivers, especially if filter strips are used around farmlands. Preliminary results on the cost-benefits analysis show that the benefits of having trees exceed the costs of forest area increase, especially if other co-benefits of forests are considered, thus contributing to improving understanding on the instruments and incentives for the promotion of ecosystem services and the role of forests in sustainable development strategies.

OC 6.3 Seedballs: Exploring its potential for an alternative planting strategies in elevating forest landscape restoration effort for Sarawak, Malaysia

Annya Ambrose[a], Fellicia Inching Uchang[a], Sabrina Aslan Joe[a], Norsyarina Welman[a], Erica Medina Hadari[a], Pang Shek Ling[a], Jack Liam[a], Hamden Mohammad[a], Zarina Shebli[a], Happysupina Sait[a]

[a] Forest Department Sarawak

Forest Landscape Restoration (FLR) is as an effort that aims to regain ecological integrity and enhance human well-being in degraded forest landscapes. 237,411 ha were identified as FLR areas in Sarawak, Malaysia. The Forest Department of Sarawak (FDS) has pledged to plant 35 million trees by the year 2025 to ensure sustainable forest management (SFM) in Sarawak. The primary method of reforestation and restoration uses seedlings grown in nurseries and manual labor for field planting. However, conventional tree planting is unlikely to achieve this goal, due to Sarawak's remote and inaccessible steep terrain as well as limited labor availability. Initiated in May 2021, "The Seed Balls Project" is an innovative means to complement conventional planting with the aim of speeding up the FLR effort. Nursery trials were conducted to evaluate the most suitable composition of seed balls of two fast indigenous tree species, *Neolarmackia cadamba* and *Nauclea orientalis*. The findings showed that the best seed ball composition was premixed organic planting mixture mixed with clay as a binder and soil, giving 100% germination and emergence. Subsequently, a 1-hectare field trial was established in May 2022 at a degraded peat swamp area to evaluate the growth and survival of the seed balls. Seed balls of six indigenous forest tree species—*Neolarmackia cadamba*, *Nauclea orientalis*, *Duabanga moluccana*, *Cratoxylum arborescens*, *Syzygium grande*, and *Campnosperma coriaceum* were deployed in this study, and as of present, initial emergence rates were recorded at 15% with varying heights. Although the number of seed balls that managed to germinate and survive is not substantial, this study still concludes that seed balls showed a promising result. This paper will also discuss the potential of seed balls to empower economic growth and livelihood through the engagement of the community in the production of seed balls as well as the supply or sourcing of forest tree seeds for FDS.

OC 6.4 Rehabilitation of *Nothofagus pumilio* forests in northern Chilean Patagonia

Alejandro Huertas Herrera[a], Fernanda Rivas Guíñez[a], Macarena Luco Molina[b], Cristofer Mardones Muñoz[a], Mónica Toro Manríquez[a]

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[b] Facultad de Ciencias Forestales y Recursos Naturales, Universidad Austral de Chile

In northern Chilean Patagonia, over 3.5 million hectares of *Nothofagus* native forests were fired by settlers in the early 20th century to promote the generation of pastures. The fires created extensive mineral soil areas and grasslands, facilitating the spread of invasive species (e.g., *Lepus europaeus*- European hare). Rehabilitating these temperate forests is a regional forest plan to counteract the environmental imbalance resulting from the impacts received. However, the rehabilitation of these temperate forests with native species requires guidelines to achieve the recovery of the degraded areas. This work aims to present empirical experiences of a failed rehabilitation effort (after ten years of establishment) and a theoretical proposal for rehabilitation based on cluster planting to improve the recovery potential of lenga forests (*Nothofagus pumilio*) degraded by fires. The empirical evidence showed that browsing damage to the individuals of *N. pumilio* caused changes in their growth by forming new branches that compete for apical buds, affecting the desirable form of plants (deforming them). In addition, climatic factors and planting season may have an essential effect on plantation success, where quantifying the impact of introduced herbivores allows for improving guidelines for management and conservation. Given that traumatic exogenous factors can compromise plant survival, areas with abundant herbivores need control actions that prevent or mitigate predation (e.g., offering artificial protection during the early stages of plantations). In this context, the strategy proposes lenga surrounded by nursery plant (*Embothrium coccineum* - notro) to accelerate the development of lenga seedlings through facilitation mechanisms, such as improving microclimatic conditions and protecting seedlings from possible herbivore damage. This proposal could be used in Protected Wild Areas, productive forests, and landscapes fragmented by historical fires.

OC 6.5 Can biochar amendment of forest fire-affected soil reduce soil erosion by water?

Oscar Gonzalez-Pelayo[a,b], Behrouz Gholamahmadi[b], Marjan Jongen[c], Frank G.A. Verheijen[b]

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[c] MARETEC—Marine, Environment and Technology Centre, LARSyS, Instituto Superior Técnico, University of Lisbon, 1049-001 Lisbon, Portugal

Wildfires destroy vegetation cover and alter the properties of the soil through heating and combustion processes, promoting off-site effects by soil erosion. Soil erosion mitigation actions based on biochar incorporation reduce erosion by 16% on average, but results vary widely and very few studies on degraded forest soils have been published. In 2022, biochar was included in the Fertilising Products Regulation, which has opened the Single Market to biochar and other organic and waste-based fertilisers. So, biochar suffers a high variation in prices, so selecting the proper type and application rate are mandatory. This study aimed to investigate whether a biochar amendment ("structure" feedstock biochar - mixed wood sieving) available to farmers (in our case through novocarbo company), can be used as a tool to reduce soil erosion by water in degraded dystric leptosol soil, a typical burned forest soil in Portugal. We conducted a box lysimeter study from October 2019 to September 2020 (an entire hydrological season, 11 rainfall events) at the University of Aveiro, Portugal (Long-term annual precipitation is 907 mm, with 88% of the precipitation being confined to the growing season (October 1 to May 31). Our treatments were: (i) forest control soil with 0% biochar; (ii) forest soil amended with 2% biochar, and forest soil amended with 4% biochar by weight. The soils were sown with a biodiverse seed mixture to help establish a vegetated soil cover. The hypothesis was that biochar incorporation would reduce runoff/erosion and increase vegetation growth. Our results showed that the 2% biochar treatment decreased runoff by 19%, as compared to the control treatment while the 4% biochar treatment showed a 17% reduction in runoff. Soil erosion was reduced by 63% in the 2% biochar treatment, and by 43% in the 4% biochar treatment, compared to the control treatment. Aboveground biomass at the end of the growing season increased by 142% in the 2% biochar addition and more than doubled (+104%) with 4% biochar addition. However, the addition of biochar did not result in significant changes in the relative abundance or cover of grasses, legumes, or forbs. Our experimental set-up does not allow to assess effects on soil biodiversity. However, biochar amendment may be a useful tool - among other options - to restore forest fire affected soils.

OC 6.6 Climate Resilient Forest Restoration

Patricia Maloney[a], Shannon Lynch[b], Susan Ustin[c]

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Over the last decade, climate-driven weather patterns have devastated California's wildlands through wildfires, pest outbreaks, and prolonged drought. Given the scale and extent of habitat loss, the development of resilient approaches that integrate genetics, remote sensing and geospatial datasets in combination with traditional methods are needed to improve ecosystem restoration outcomes and secure biodiversity. Restoration strategies guided by a better understanding of how native plants evolve in response to drought, pest outbreaks, and wildfire can amplify population resiliency to these pressures. Resilient approaches steered by advances in technological and scientific understanding can equip land managers with effective adaptive restoration tools to respond to extraordinary changes in forested landscapes and facilitate ecosystem recovery. Employing remote sensing technologies and advanced algorithms, we will develop a model to evaluate survivorship of thousands of sugar pine seedlings.

Deployment of an unmanned aerial vehicle, UAV, will generate high-resolution microtopographic maps. These maps will be used with remote sensing imagery and other geospatial datasets to develop GIS algorithms that identify site conditions (e.g., late-lying snow patches, soil properties, canopy and soil water status) to select appropriate microsites for planting locally sourced and diverse seed material representing extant plant populations and individuals that have proven to be resilient to anthropogenic stressors. We can also foster a diverse and equitable workforce around forestry and restoration throughout California while increasing the scope and scale of ecosystem restoration. We will train and provide the California Conservation Corp (CCC) with applied experience in STEM (e.g., drone technology, GIS science, plant sciences, and ecosystem restoration) and build upon past work and improve project outcomes by strengthening our partnership with the CCC.

OC 6.7 What's the value of Seed Dispersal?

José Benedicto Royuela[a], Sara Mendes[a], Ruben Heleno[a], Joaquim Sande Silva[a,b], Helena Freitas[a], José Miguel Costa[a], Pedro Lopes[a], Sérgio Timóteo[a]

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World forests face many threats, including wildfires, which have tremendous ecological, social, and economic implications. While Mediterranean ecosystems have evolved in the presence of fire, changes to fire regimes pose new challenges to forest post-fire regeneration. Community regeneration is largely dependent on plant adaptations to survive fire, or to quickly recolonize burnt areas through abiotic or biotic seed dispersal. However, the value of the service provided by wild animals to post-fire forest regeneration has not been evaluated. We estimate the economic value of seed dispersal service in post-fire restoration in Portugal. For that, we reported costs of governmental Emergency Stabilisation Reports plans with a network analysis that estimated the dependency of the Portuguese flora on biotic seed dispersal and on alternative post-fire regeneration strategies. We estimate that the value of animal seed dispersal for post-fire regeneration amounts to 21,371,929.8 €/year. The other strategies were also evaluated.

OC 6.8 Upscaling forest restoration with SUPERB: The Spanish demonstrative area

Judit Torres Fernández del Campo[a], Rocío Gallego García[a], Iñigo Oleagordia[b], Rafael García[b]

[a] *Fundación Cesefor*
[b] *Junta de Castilla y León*

The need to restore forest to enhance biodiversity and ecosystem services is widely recognized. But how to do this for managed forests in diverse socio-economic settings that need to fulfil a variety of functions, not only strict protection of biodiversity? The H2020 SUPERB project addresses this issue as its main topic, through the evaluation of 12 demonstration areas across Europe. One of these is the Spanish Demo, where the rural abandonment and the lack of forest management accentuates the processes of scrubbing of the landscape and homogenization of the territory. This leads to an increment in the forest fuel resulting in large forest fires. Moreover, large forest fires are a major impediment to the recovery of the Cantabrian brown bear (**Ursus arctos*), which is one of the most endangered mammals in Europe. The recovery of the Cantabrian brown bear is tightly linked to the improvement of its habitat and increasing forest resilience necessarily involves improving forest management to change the fuel model. We have, therefore, three main aims to solve that are connected: to face the rural abandonment, to change the fuel model of the forest and to improve brown bear habitat. To deal with these issues we are implementing restoration activities: i) silviculture treatments to increase forest resilience, ii) enrichment plantations in oak and pine forests with seedlings of native species of fruit trees that enhance biodiversity and improve feeding for the brown bear and iii) sweet chestnut plantations to contribute to rural development. We are also carrying out other socio-ecological activities to ensure the success of the restoration, assess the process and scale up the results (Stakeholder Engagement Strategy; Monitoring, Reporting and Verification of Biodiversity and Ecosystem Services; Upscaling Restoration Plan). We are currently implementing the whole restoration process, as the SUPERB project lasts until 2025, with some lessons learned so far.

Round Tables

Round Tables

RT 1 **Forest Landscape Restoration: resilient socioecological landscapes in the making**
René Zamora Cristales, Judit Torres, Mónica Toro-Manriquez, Alejandro Huertas

RT 2 **Air pollution and Climate change impacts**

Yasumoto Hoskhika;Ovidiu Badea

RT 3 **A Nexus approach to improving biodiversity and ecosystem services for sustainable landscapes on the road towards 2030 conservation targets**

Paulina Karimova; Marine Elbakidze

RT 4 **IUFRO Forest and Water Task Force Roundtable Discussion: Managing the Forest-Water & Energy Nexus in an Increasingly Competitive & Challenging World**

Nadeem Shah; Irena Creed; Lars Högbom; Adam Wei

RT 5 **Context matters for forest restoration**

Glenn Galloway, Wil de Jong, Pablo Pacheco, Carol J. Pierce Colfer

RT 6 ***Facing Global Change, which policies to support the resilience of Mediterranean forests? Organization: CHANGE – Institute for Global Change and Sustainability, Portugal***
Athanasios Ragkos, Lília Fidalgo, Gerardo Moreno, Ana Cristina Cardoso

& Launching of the Research Group SILVOPASTORAL SYSTEMS and PASTORALISM, in IUFRO Div 8 – Forest Environment

Round Table: Forest Landscape Restoration initiatives: biodiversity, economy and people

Chairs: Anna Barbati [a]; John Devaney [b]; João Carlos Azevedo[c]

RT 1- Forest Landscape Restoration: resilient socioecological landscapes in the making

René Zamora Cristales[d], Judit Torres [e], Mónca Toro-Manriquez [f], Alejandro Huertas [f]

[a] University of Tuscia, Italy
[b] Maynooth University, Ireland
[c] Instituto Politécnico de Bragança, Portugal
[d] World Resource Institute, Washington DC, USA
[e] CESEFOR foundation, Spain
[f] Centro de Investigación En Ecosistemas De La Patagonia (CIEP), Chile

Globally, forest loss due to land-use conversion and climate change is jeopardizing the integrity of Forest Landscapes (FLs) and contributing to the ongoing decline of biodiversity and associated ecosystem services. After the global call to action of the Bonn Challenge and UN Decade on Ecosystem Restoration, many countries have committed to fostering political and technical cooperation around forest landscape restoration through various regional platforms (e.g., Africa 100, Initiative 20x20, ECCAS 30).

The implementation of forest landscape restoration programs faces several technical and social challenges, including the long-term financing of restoration projects, addressing potential trade-offs between conflicting objectives, and monitoring restoration performance and impacts. The socio-economic demands of different regions coupled with global change pressures require context-specific solutions to balance multiple goals: forging climate- and fire-smart landscapes, ensuring the maintenance of food security, water supply, and biodiversity, and boosting value chains from agro-forestry-pastoral and tourism activities in restored forest landscapes. In the face of these challenges, the round table aims to bring to the fore approaches to design, implement and monitor FLs restoration initiatives, convening stakeholders from the academia, NGOs, government, the private sector. **SUGGESTED PARTICIPANTS** René Zamora Cristales – World Resource Institute, Washington DC, USA Judit Torres – CESEFOR foundation, Spain Natalia Fracassi – National Institute of Agricultural Technology of Argentina (INTA, Argentina) Alejandro Huertas Herrera and Mónica Toro Manriquez – Centro de Investigación En Ecosistemas De La Patagonia (CIEP), Chile

Round Table: Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points

Chairs: Pierre Sicard[a]; Alessandra De Marco[b]

RT 2 - Air pollution and Climate change impacts

Yasumoto Hoskhika[c], Ovidiu Badea[d]

[a] ARGANS
[b] ENEA-SSPT, Italy
[c] CNR, Italy
[d] INCDS, Romania

Forests are strongly affected by climate change and air pollution, two significant interacting stressors. Sustainable forest management (policies and practices) is essential to maintain healthy forests, for adaptation to climate change and also for economic growth, food security and biodiversity conservation. New forest policy strategies will lead to improved mitigation of impacts. This session aims to improve our understanding of the multi-faceted aspects of forest degradation and of the processes regulating the interactions between forests and climate to facilitate the development of science-based strategies for policy-makers and managers. The session will discuss novel emergencies, e.g. air pollution and climate change impacts on forest health, and solutions, e.g. forest supersites and sustainable harvesting, and how to make forests more resilient against climate change, halt forest degradation and achieve healthy and functional forests. The proposed session contributes to i) develop a better understanding of interaction and feedbacks between air pollution and climate change impacts on forest, resilience and associated services, by combining new experts and approaches (e.g. modelling, in-field surveys, space observations); ii) provide options and best practices for sustainable forest management; iii) guide management decisions and efficient policy recommendations toward increased health, sustainability and productivity forest resilience worldwide.

Round Table: Human-nature relationships to support multifunctional forested landscapes, including socio-ecological approaches

Chairs: Sandra Luque[a]; Paulina G. Karimova[b]

RT 3 - A Nexus approach to improving biodiversity and ecosystem services for sustainable landscapes on the road towards 2030 conservation targets

Mehnaz Akhtar, *Marine Elbakidze[c,d]*

[a] *INRAE*
[b] *National Dong Hwa University, College of Environmental Studies and Oceanography/ Forestry Bureau, Taiwan*
[c] *Swedish University of Agricultural Sciences), School for Forest Management, Sweden*
[d] *Ivan Franko National University of Lviv, Ukraine*

The conservation of biodiversity has become a major challenge for sustainable development at local, national to global levels. To address the current conservation and development needs (including their synergies and trade-offs), it is important to gain real-time knowledge on ecosystem conditions and drivers of change. A holistic and multi-dimensional approach can ensure more efficient response options to enhancing and sustainably managing resilient landscapes in various world regions. The Nexus is an integrated approach that aims to address the complex interlinkages among biodiversity, water, food, health, and climate. To improve biodiversity and ecosystem services for sustainable landscapes. the Nexus approach seeks to balance the needs of different multiple stakeholders to ensure that decisions are based on sound scientific evidence, are place- and context-sensitive, and policy-relevant. It also recognizes the importance of involving Indigenous peoples and local communities (IPLC) and other often marginalized stakeholders (women and youth) in decision-making processes to ensure that their perspectives and needs are carefully taken into account. In this round table we aim to showcase a series of studies from different world regions (Americas, Asia and Europe) and robust feasible frameworks that demonstrate how the Nexus approach supports understanding of complex landscape processes, multi-stakeholder interactions and adaptive (co-)management arrangements. These case study examples of the on-the-ground Nexus response options (e.g., agroforestry, silvopastoral, eco-agriculture, payment for FES, NbS, integrated landscape-seascape management, etc.), will serve as the basis of the follow-up open discussion on the role and future potential of holistic integrated approaches for sustainable landscape management. The round table discussion outcomes will be synthesized and considered for publication in a scientific journal.

Round Table: Global change, vulnerability and adaptive management of forested landscapes – How to manage increasing pressures and threats above the current resilience tipping points

Chairs: David Ellison[b]

RT 4 - IUFRO Forest and Water Task Force Roundtable Discussion: Managing the Forest-Water & Energy Nexus in an Increasingly Competitive & Challenging World

Nadeem Shah[c], Irena Creed[e], Lars Högbom [f], Adam Wei [g]

[b] LS-SLM, Institute of Geography, University of Bern; Scientific Collaborator, Swiss Federal Institute of Technology (ETH Zurich), Switzerland
[c] Forest Research, Northern Research Station, UK

[e] University of Toronto
[f] Swedish Forestry Agency, Sweden
[g] IUFRO Forest and Water Taskforce Lead

How should we best understand the critical juncture we face? Population growth, competitive land use demands, ever growing water use, along with global warming and climate change, impose greater and greater pressures on the ability of ecosystems to provide resilient and sustainable settings for human survival and general well-being. Natural ecosystem function and forest water interactions are diminished by ecosystem loss and land use conversion. How can we ensure the ability of ecosystems to provide adequate rainfall, process and purify water, restore precious groundwater resources, regulate the climate, geographically distribute terrestrial water supply, and buffer Nature's extremes (drought, deluge, solar radiation, and winds)? What are the key forest-water research innovations and how can they best be mobilized to enhance forest landscape resilience and improve the quality, range, and depth of the hydrological cycle across terrestrial surfaces? Does the current state of knowledge support improved responses to creating and reinvigorating natural ecosystem function? With so many goals – biodiversity protection, the preservation of natural ecosystems, carbon sequestration, forest landscape restoration, resilience, sustabgv inability – which pathways should be favored? How does knowledge about forest-water interactions across multiple spatiotemporal scales help us to make these choices? And what are the governance innovations necessary to drive progress forward? How do we tailor governance systems to respond to all the ecosystem challenges emerging around the globe? How do we enhance the science-to-policy interface such that the requirements of natural ecosystem function are adequately recognized in decision-making frameworks and integrated into future policy outcomes? What are the principal barriers to the positive emergence of resilient and sustainable forest ecosystem landscapes, and can humanity's dream of a sustainable and bounteous future be realized?

Round Table: Forest Landscape Restoration initiatives: biodiversity, economy and people

Chair: Pia Katila [a]

RT 5 - Context matters for forest restoration

Glenn Galloway[b], Wil de Jong[c], Pablo Pacheco[d,e], Carol J. Pierce Colfer[e]

[a] Natural Resources Institute, Finland
[b] University of Florida
[c] Renmin University of China, School of Agricultural Economics and Rural Development; and Professor Emeritus, Kyoto University
[d] World Wide Fund for Nature (WWF)
[e] Center for International Forestry Research-World Agroforestry (CIFOR-ICRAF)

The decline of forests, the erosion of biodiversity, and climate change are being addressed in many parts of the world with measures to restore forest biomes. Most forest or tree-cover restoration, whether pursed nationally or internationally, by government agencies, non-government and/or private sector actors is often expected to benefit people who reside in and/or depend on these forests and trees for at least a portion of their livelihoods. Whether and how 'local actors' benefit or rather incur harm from these initiatives and the factors or conditions that favor the emergence of benefits or detriments require much greater attention. As an example, governance of land and resources, i.e., policies and their implementation, legal frameworks, the distribution of power and resources among different actors, all manifested at international, national, and local levels and their intersections, shape restoration praxis and outcomes. Interests, capacities, resources, and social and cultural capitals of actors that can influence restoration, access to value chains and markets, and the actual or anticipated benefits or detriments do so as well. Local biophysical and climatic conditions also contribute to forest restoration's local potential and outcomes. These and other factors and conditions interact in complex ways in locations where restoration is pursued. While restoration is pursued to tap into important opportunities, it includes considerable risks for local actors. Thus, a better understanding of how these factors and conditions interact to shape local outcomes, can help improve decisions regarding where restoration is more likely to achieve desired outcomes, and what measures might be taken to enhance the effectiveness/success of restoration in different contexts.

The thematic session, proposed here, discusses these issues shedding light on the complexities that affect forest restoration and its outcomes and impacts of relevance to local actors.

Plenary Round Table

Chair: Teresa Pinto Correia[a]

RT 6 - Facing Global Change, which policies to support the resilience of Mediterranean forests?

Organization: CHANGE – Institute for Global Change and Sustainability, Portugal

Athanasios Ragkos[b], Lília Fidalgo[c], Gerardo Moreno[d], Ana Cristina Cardoso[e]

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[b] Agricultural Economics Research Institute , Athens & coordinator of the Prima Project PASTINNOVA
[c] Regional Directorate for Planning and Environment (CCDRA), Alentejo, Portugal [d]Universidade de Extremadura, Spain
[e] Cork Supply Portugal (Cork Processing Industry), São Paio de Oleiros

PRESENTATION of the Research Group SILVOPASTORAL SYSTEMS and PASTORALISM

To be presented at the IUFRO Div8 Conference in Évora, October 2023

Coordinator Teresa Pinto-Correia, University of Évora, Portugal

Deputies Marina Castro, Polytechnic Institute of Bragança, Portugal

Gerardo Moreno, University of Extremadura, Spain

Sónia Ribeiro, Federal University of Minas Gerais, Belo Horizonte, Brazil

The Research Group promotes and facilitates the understanding and ackowledgement of silvo-pastoral systems and their complexity and dynamics, in order to support knowledge based management and decision making both by private owners and managers, and in public policies. For these open or low density forests, this understanding and management can only be done with the integration of the extensive grazing systems that maintain the undercover clean of shrub, reduce fire risk, increase biodiversity levels and make use of the available foraging resources. This also means complex governance systems, where different users make use of specific resources within the same space, and therefore also are subject to different institutional arrangements.

The Research Group works for the application of silvo-pastoral concepts in policies and practice worldwide where these systems are relevant or can become part of the solution for resilient land use. The Research Group also encourages communication and interaction among scientists with an interest in silvo-pastoral systems and open forests, their management, governance mechanisms and policy intervention, and cross comparisons across the different silvo-pastoral systems of the world. It aims to develop integrative solutions, promote knowledge exchange and capacity building, inform policy and decision-making. These aims are accomplished by providing a forum for the exchange of ideas; creating and maintaining personal contacts; promoting the dissemination of research results; promoting a uniform terminology; convening periodic meetings; promoting cooperation with international organizations; and supporting young researchers through workshops and targeted seminars organized by the Research Group members.

The Research Group gathers researchers and other players as policy makers and technical staff in the sector, to progress in the co-construction and exchange of knowledge on silvo-pastoral systems, their dynamics of change, their management and the services they provide to society at different scales.

The Research Group acknowledges the full spectrum of regional determinants and characteristics of silvo-pastoral systems all over the world, from Southern Europe to Scandinavia, Northern Africa, Southern and Central America, and regions of Africa, Asia and Oceania.

It has regional representatives that help to coordinate concerted actions, identify regional needs and particular interests, spread the voice of the Research Group activities and goals to gain new members, support the organization of conferences and organize regional workshops.

Poster Presentations

P 1 **The Deforestation in Brazil Tropical Forest and its Ecological Consequences for Pollination and Honey Production. Case of Study: Melipona Bees & Coopmel**
Pâmela Ramos Borges, Edna Cabecinha, Milada Šťastná

P 2 **Peri-urban Forest Management: Enhancing Forest Stability and Resilience in the Face of Climate Change and Urban Expansion**
Serban Chivulescu, Raul Gheorghe Radu, Mihai Hapa, Nicolae Cadar, Stefan Leca, Florin Capalb, Alexandru Claudiu Dobre, Ovidiu Badea

P 3 **Developing Criteria to Estimate Permaculture's Influence on Urban Resilience**
N. Nihan Parlak, Alev Gurbey

P 4 **Monumental Sweet Chestnuts (*Castanea sativa Mill.)* in Galicia's Cultural Landscape (NW Spain)**
Antonio Rigueiro Rodríguez, Ignacio Silva de la Iglesia, José Gaspar Bernárdez Villegas

P 5 **Effect of Landscape Structure on Abundance of Native Honeybee in *Citrus tamurana* Orchards in Aya UNESCO Biosphere Reserve**
Yasushi Mitsuda, Satoshi Ito

P 6 **Could Space Borne Multispectral Images Be Used to Assess Ecosystem Services Provided by Agroforestry Landscapes? - A Systematic Review**
Anabela Paula, Albano Figueiredo, Fernando Pulido, Paula Cristina de Oliveira e Castro

P 7 **A New Detection Tool for the Pinewood Nematode Based on Optimized Sensor Systems for Volatile Organic Compounds – The PURPEST Project**
Jorge M.S. Faria, Dora Martins Teixeira, Luís Bonifácio, Edmundo Sousa, Maria L. Inácio

P 8 **Spatial Analysis of Changes in Vegetation Cover and Structural Connectivity of the Cloud Forest Landscape in Western Mexico**
Edgar G. Leija, Manuel E. Mendoza, Sandra Luque

P 9 **Intensive Phenological Monitoring through the Use of Multitemporal TLS Observations**
Ionut Silviu Pascu, Alexandru Claudiu Dobre, Ștefan Leca, Ovidiu Badea

P 10 **Using Soft Operational Research Methods to Advance SDGs Strategic Planning**
Renata Aguayo Lopes da Silva, Renato Cesar Gonçalves Robert

P 11 **Automatic Classification of Forest Cover Using Sentinel-2 Images and Google Earth Engine. A Case Study in North Spain**
Iyán Teijido-Murias, Carlos A. López-Sanchez, Marcos Barrio-Anta

P 12 **Predicting Future Suitable Environment for South East Madagascar Endemic Species for an Effective Protected Network**
Pauline Jitte, Marie Nourtier, Frédérique Montfort, Clovis Grinand, Eddie Rakotondraso, Nicolas Dubos

P 13 **Arboreal Camera Trapping Reveals Vertical and Diel Niche Differentiation of Frugivore Communities Feeding on *Ficus nota***
Etienne Joaquim Cancio, Lillian Jennifer Rodriguez

P 14 **Use of RGB Imagery from UAVs to Enhancement Satellite Data in a Agroforestry Plantation**
Jose Javier Santiago-Freijanes, Muhammad Kamran Shafi, Nuria Ferreiro-Domínguez, María Rosa Mosquera-Losada

P 15 **Forest Microclimate: Measuring and Modelling this Unique Forest Property for Biodiversity Conservation**
Jan Wild, Josef Brůna, Martin Kopecký, Martin Macek, Matěj Man, Vojtěch Kalčík

P 16 **Characterization of Functional Traits of Old-Growth and Young Mediterranean Pines (*Pinus nigra* and *Pinus pinea*)**
Rosario Gonzalez-Cascon, Lucía Casillas Martinez, Mirian Sanz Gonzalez, Javier Vazquez Pique, Reyes Alejano, Andrea Hevia, Ana Isabel Calzado, Guillermo Madrigal Casanueva, Marta Pardos Minguez, Rafael Calama Sainz

P 17 **Seasonal Change of Edge Effects on Plant Species Diversity in a Teak Plantation in East Java, Indonesia**
Takuro Mizokuchi, Satoshi Ito, Yasushi Mitsuda, Ryoko Hirata, Adi Setiawan, Yasa Paraguna Umar, Hagus Tarno

P 18 **Soil P Dynamics after Wildfires and Prescribed Fires and Subsequent Recovery: A Case Study in the Southern Iberian Peninsula**
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P 1. The Deforestation in Brazil Tropical Forest and its Ecological Consequences for Pollination and Honey Production. Case of Study: Melipona Bees & Coopmel

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Deforestation and forest degradation are essentially driven by a shift to agriculture to fill a growing demand for palm oil, soy, cattle, and meet a demand for bioenergy. The loss of natural habitats has significant implications for biodiversity, including pollinators.

Pollinators are a source of multiple benefits for people, in addition to providing food, playing a vital role as an ecosystem regulating service in nature. The main objective of this dissertation is to understand the current situation of deforestation in Brazil and its impacts on ecosystem services (ES), namely on pollination and consequently in honey production. In this context, the Cooperative of Breeders of Indigenous Bees of the Amazon of Boa Vista do Ramos (COOPMEL) was used as a case study to analyze the influence of deforestation at a local scale in ES, pollination and honey production by *Melipona sp*, namely species of *Melipona interrupta* and *Melipona seminigra*. The SWOT assessment methodology was used in this work to analyze the COOPMEL Cooperative's internal and external potential in relation to production, the market, brand visibility, among other information. The evaluation questionnaire was designed to assess the sector, competition, obstacles generated by internal and external situations, cost analysis and administrative organization. Concomitantly, a questionary was sent to producers and general public to understand their preferences and the awareness of the importance of the deforestation impacts on ecosystem services, namely on pollination. In conclusion, meliponiculture reduces the insertion of polluting products in the regions where it is practiced. It is important for regional family farming. Contributes to pollination and high vegetative variability in the region. It has a high economic value, helping as extra income for family farming. There are few publications on the species *Melipona interrupta* and *Melipona seminigra*, which consequently demonstrates the importance of this work.

P 2. Peri-urban Forest Management: Enhancing Forest Stability and Resilience in the Face of Climate Change and Urban Expansion

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The adverse effects of climate change, such as rising global temperatures and disruption of global ecological ecosystems due to increasing carbon emissions, are a significant concern for human health, communities, and ecosystems. Forest ecosystems, particularly those in peri-urban areas, play a crucial role in mitigating these negative effects of climate change on society. They provide direct benefits to residents of large cities and surrounding areas, and their sustainable management is essential for protecting all the component ecosystems. This research took place in the forests of Lunca Muresului Natural Park and Bazos Arboretum, located in the Romanian sector of the Pannonian Plain near urban agglomerations. The methodological approach used focused on common oak stands, evaluating tree characteristics, wood quality, and volume calculation. Statistical analysis and theoretical functions were employed to assess forest stand stability. The results demonstrated high variability in the stands, with a strong Pearson correlation (ranging from 0.45 to 0.82) observed between the height-to-diameter ratio indicator and species diversity. These findings indicate the stability of these stands, which offer positive human-nature interactions, including recreational activities and attractive landscape views that indirectly contribute to their value. Preserving these ecosystems serves as an "insurance policy" against climate change for future generations.

P 3. Developing Criteria to Estimate Permaculture's Influence on Urban Resilience

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Urbanization can make cities vulnerable to disasters, especially in developing countries, where infrastructures and services are poorly developed. Additionally, rapid urbanization has high economic, social, and environmental costs. Some include access to essential services, unsustainable use of natural resources, air and water pollution, and increased greenhouse gas emissions. A city's resilience can be enhanced by employing strategies that will improve the urban environment, such as permaculture. In this study, we developed a measure based on expert opinions to estimate the influence of permaculture areas on urban resilience in Istanbul. Based on the literature, we determined all parameters and indicators of urban resilience and organized them towards three major threats: earthquakes, climate change, and epidemics, based on expert opinions. We then used a questionnaire for permaculture specialists to estimate the relative importance of each parameter by using an AHP procedure. The total number of criteria we decided and weighted has been 26 indicators under seven parameters. In the next phase of the study, we plan to apply the procedure to a real case in Istanbul.

P 4. Monumental Sweet Chestnuts (*Castanea sativa Mill.)* in Galicia's Cultural Landscape (NW Spain)

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Introduction

The cultural landscape of Galicia in NW Spain is a managed living landscape, characterized in many places by the cultivation of sweet chestnut (*Castanea sativa Mill*.) in groves known as soutos. In this soutos of Galicia there are many monumental chesnut trees.

Research Methodology

Study Area

The study area was the whole of Galicia (NW of the Iberian Peninsula).

Methodology

During the period 2006–2009, field and office work was carried out for the elaboration of the 'Galician Heritage Tree Catalogue' and during the period 2017–2019, we worked on the 'Revision of the Galician Heritage Tree Catalogue'. All the trees and tree formations included in the 'Galician Heritage Tree Catalogue' were assessed in the field, as well as other specimens and tree formations, with the aim of drawing up a list of possible candidates to join the Catalogue in the future.

Measured Parameters

All specimens and tree formations were georeferenced using GPS (Datum ETRS89), also noting the main descriptors of the site in the database. In addition, the following measurements were taken: trunk circumference (measured at 1.30 meters above the ground) and basal trunk circumference, using tape measure; total tree height and height up to the first canopy branches, using Vertex, performing two or more measurements to obtain an average; canopy spread in those specimens in which it was possible, and was considered a relevant measure (tape measure, two perpendicular measurements). Information was collected on the health status of each specimen, noting the recommended cultural and health treatments.

Conclusion

The presence of very large specimens of sweet chestnut with circumferences greater than seven meters is especially marked in areas with a long tradition of growing grafted sweet chestnut trees in 'soutos mansos'. The 51 specimens with these characteristics found in our research is much higher than the number found in previous catalogues.

P 5. Effect of Landscape Structure on Abundance of Native Honeybee in *Citrus tamurana* Orchards in Aya UNESCO Biosphere Reserve

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We examined the relationship between the pollination of hyuganatsu (*Citrus tamurana*) (as an ecosystem service) by native honeybees (*Apis cerana*) and landscape structure in the Aya UNESCO Biosphere Reserve located in Miyazaki Prefecture, Japan. A total of 24 hyuganatsu trees were selected from 16 orchards, and the number of honeybees visiting each tree was counted from 2016 to 2018. A land use map of the study area was developed by photo interpretation of the orthophoto to measure the area of each land use type around the target trees as an indicator of landscape structures. A stochastic model for predicting honeybee visits, regarded as an indicator of pollination service, was developed using the area of natural forests, total area of agricultural fields and grasslands, and distance from natural forests as explanatory variables. The difference in the bee-finding ability among the observers was also considered as an observation model. The estimated model parameters suggested that both the area of natural forest and the total area of agricultural fields and grasslands positively affected pollination services by native honeybees, and these effects varied with year. The results of this study also suggest that the distance to natural forests is an important landscape factor for evaluating pollination services by native honeybees.

P 6. Could Space Borne Multispectral Images Be Used to Assess Ecosystem Services Provided by Agroforestry Landscapes? - A Systematic Review

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Agroforestry (AF) is a relevant socio-ecological system in Mediterranean countries that plays a remarkable role in the provision of ecosystem services (ES). However, the rural exodus led to land abandonment or agriculture and forest intensification, which compromised part of the ES provided, namely wildfire regulation, i.e. the reduction in the incidence, intensity or speed of spread of fire usually promoted by smart-fire landscapes such the agrosilvopastoril mosaic. This situation led to the creation of recent Portuguese legislation, aiming at promoting landscape management to recovery to these traditional mosaics. The management strategy should consider ES enhancement and establish the payment for ecosystem services (PES) with no market value.

Consequently, in future, it will be essential to have clear ES long-term monitoring frameworks/protocols to guide managers and practitioners. Hence it is crucial to identify simple and cost-effective indicators to assess AF ecosystem services easily, freely and at long-term. This research aimed to understand the progress, emerging gaps, and opportunities on the use of remote sensing (RS) technologies, concretely space-borne multispectral satellites, to assess and monitor agroforestry ES. Although not many studies fit review research criteria (n=15), it was possible to identify RS biophysical data that could be used as proxy indicators to estimate and monitor some ES provided by AF. The analyzed studies assessed 3 indicators of provisioning ES (e.g. food and forage provisioning) and 8 regulation and maintenance ES (e.g. climate regulation or the regulation of the hydrological cycle). The Earth Observation medium spatial resolution satellite Sentinel-2, from Copernicus Programme, seems to be a good option to obtain data that could be used as cost-effective ES proxies due to its spatial resolution, continuity, affordability, and easy access.

P 7. A New Detection Tool for the Pinewood Nematode Based on Optimized Sensor Systems for Volatile Organic Compounds – The PURPEST Project

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Pine wilt disease (PWD) has ravaged pine forests in many Asian countries, rapidly spreading and ultimately evading established pest management strategies. The more recent outbreak occurred in Europe, in Portugal, in 1999. Since then, the pinewood nematode (PWN) has been detected throughout Portugal mainland, Madeira Island and in Spanish pine forests from Galicia and Estremadura provinces. In the last two decades, containment and mitigation of this priority pest has mobilized extensive investment. These efforts were partially inefficient, due also to the limited efficacy of the available detection and monitoring techniques. PURPEST (purpest.eu) proposes that volatile organic compound (VOC) profiles specific to the PWN can be used to construct a VOC-based system (Sensor System) for the detection of infected material. This system has the potential to revolutionize the current methodologies by offering an alternative to the traditional collection of wood samples and screening for PWN. To accomplish this task, VOC profiles of the PWN and infected pine material will be analysed through headspace GC-MS, and then used to fine-tune sensor components for the development of optimized sensor systems and, finally, a sensor system prototype will be validated in the field and at import control sites. Implementation of PURPEST advances pest management strategies by allowing an early detection of PWD and increasing the inspection rate in pine stands and woody material from coniferous importations with a non-invasive, reliable and high throughput methodology thus preventing entry into new forestry areas. Preliminary results allowed ranking the available PWN infection volatile signatures and pipelining VOC sensor miniaturization. PURPEST is co-funded by the EU through grant agreement 101060634.

P 8. Spatial Analysis of Changes in Vegetation Cover and Structural Connectivity of the Cloud Forest Landscape in Western Mexico

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The constant pressure of anthropogenic activities has generated that the fragments of the cloud forest (BN) have a pattern of islands surrounded by a matrix of socioeconomic activities. The conservation of this ecosystem is key because of the high biological diversity it represents in relation to its territorial extension in Mexico and globally. The objective of this work is to analyze the changes in vegetation cover and structural connectivity of the BN in the period 1995-2018 in the Transversal Volcanic System of the state of Michoacán from the visual interpretation of Orthophotos and SPOT satellite images. Landscape metrics were applied for subsequent comparative analysis. The results obtained show that the BN cover lost an area of 9,038 ha in 23 years, with an overall deforestation rate between 1995-2018 of -1.4%. Regarding the structural connectivity of the BN, an increase in the number of patches was observed, increasing from 628 in 1995 to 762 in 2018, as well as the density of patches from 2.1 to 3.6 ha for the same period. Which reflects that the BN has fragmented considerably, in addition to rapidly losing its original surface area. It is essential to generate data and information that contribute to the construction of strategies that increase landscape connectivity in BN fragments, guaranteeing the survival of wild species, through actions aimed at biodiversity conservation and reducing the fragmentation and isolation of ecosystems.

P 9. Intensive Phenological Monitoring through the Use of Multitemporal TLS Observations

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This paper presents a summary of the findings from a side study conducted as part of a broader project aimed at evaluating the potential application of active sensor-based remote sensing techniques in monitoring forest ecosystems. Field measurements were carried out in a mixed forest stand comprising Carpinus betulus, Acer campestre, Tilia cordata, and Quercus robur. The study focused on precisely identifying the patterns of early vegetation stages within the context of reduced precipitation.

Specifically, we analyzed phenological processes at an increased spatial resolution using terrestrial laser scanner data and constant reflectance panels. Daily scans were performed starting in March 2023, carefully considering the sensor position and time of day. With a density of 3 points/mm at 10m from the scanner, we were able to record detailed information about individuals from each species. Additionally, we applied supervised thresholds to separate the main vertical components of each tree (undergrowth vegetation / shoots, main trunk, crown spread region, mid-crown, top of canopy) and computed various spatial metrics such as coverage, density, gap fraction, and leaf area density. Furthermore, we examined the dynamics of beam reflectance intensity for each species as a proxy for water content, to further evaluate phenological processes. To ensure accuracy, ground truthing was conducted through photography, following the guidelines outlined in the ICP Forests manual.

Preliminary results reveal a sequential evolution of the forest ecosystem. For instance, the hornbeam displayed a daily increase in LAD for all layers up to the point when the development of epicormic branches overshadowed the upper canopy and reduced visibility. Interestingly, despite the expected similarity in phenological development based on previous years' observations, the small-leaved lime showed a 16-day delay compared to the oak. By the point the small-leaved lime reached a measurable change in density related metrics, the oak had already gone through four stages of bud flushing (18-20-23%). In conclusion, we consider that our study provides valuable insights into the potential use of close-range active sensor-based remote sensing techniques for forest ecosystem monitoring. The increased spatial resolution and specific methods employed have allowed us to observe and analyze various phenological processes within the forest, shedding light on the developmental differences among various tree species. Further research is ongoing to enhance our understanding and refine the results.

P 10. Using Soft Operational Research Methods to Advance SDGs Strategic Planning

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Important discussions related to the use of natural resources instead of fossil fuel materials have gained attention and opened up discussions. Countries and governments have agreed to more sustainable actions to stop climate change and support greener development. The design of new tools and frameworks to measure sustainable development has gained strength, and among many initiatives, in 2015 the United Nations created the Sustainable Development Goals (SDGs), a set of 17 objectives that aim to, among many other goals, to improve work conditions, to stimulate conscious production and consumption, and to guarantee life on earth. Forests provide sustainable forest materials and have huge potential to tackle climate change. To help addressing the complex relationship between SDGs and the forest sector, the use of Soft Operational Research (Soft OR) methods and more holistic approaches are very welcomed. Soft-OR methods carry the analysis further by adding a more formalized representation of the problem, particularly the development of structured models that provide a focus and language for discussion (Belton and Stewart, 2002). Rosenhead (1989) calls this alternative paradigm the ‘‘problem structuring’’ approach. This study will explore the methodology known as Strategic Options Development and Analysis (SODA), which has been developed to help with strategy formulation processes. SODA uses cognitive and causal mapping to express the thoughts and opinions of decision-making groups, engaged in a given subject in order to support strategic thinking. SODA can be used in a combination of steps, such as: Individual interviews; Modelling, and Analysis; Group workshops; Monitoring, and evaluation. The expected results will be a practical overview of how the forest sector can contribute to a positive impact toward SDGs, enabling the creation of roadmaps, guidelines, and frameworks for sustainable development in the forest environment.

P 11. Automatic Classification of Forest Cover Using Sentinel-2 Images and Google Earth Engine. A Case Study in North Spain

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The aim of this research was to carry out an automatic classification of forest cover at a spatial resolution of 10 m/pixel, in the region of Asturias (North Spain). Forestry is very important in the region, with large areas of plantations of *Pinus Pinaster*, *Pinus radiata* and *Eucalyptus globulus* providing 91% of the timber harvested annually. The classification therefore mainly involved these species. The classification was based on a series of multitemporal data provided by the Sentinel-2 satellite constellation and auxiliary (climate and topography) data. The following data sources were used: field plots included in the Spanish National Forest Inventory; land cover classification provided by the Corine Land Cover project; satellite images (Sentinel-2); and various sources of auxiliary variables. The code was implemented in Google Earth Engine®(GEE). We first applied a dimensionality reduction method and then implemented the Random Forest algorithm, using 70% of the data for fitting and 30% for model validation. The forest cover level classifies the territory into 30 large use classes. The Kappa value obtained for the forest cover level was 0.5723. Analysis of the confusion matrix revealed that confusion between classes arose as a consequence of the similarity of the spectral signatures of the different types of cover. Thus, e.g., eucalypt stands were classified as conifer stands and vice versa. In addition, classification of *P. pinaster* and *P. radiata* stands proved difficult when mixtures of species and shrubs were present, which may be due to the low density of trees in stands close to harvest age. In the coming years, improvements in the capture of more diverse data by remote sensors, further development of platforms such as GEE and the acquisition of new machine learning and deep learning algorithms will enable more accurate classification of land cover. Classification tools are therefore likely to become indispensable in natural resource management.

P 12. Predicting Future Suitable Environment for South East Madagascar Endemic Species for an Effective Protected Network

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Climate change is expected to cause shifts in species distributions worldwide, which should move towards higher elevations and latitudes as climate warms. In the South-East of Madagascar the rainforest belt is actually facing multiples threats such as deforestation due to subsistence agriculture and might be particularly vulnerable to climate changes. These blended threats for many taxa are making the identification of optimal habitat for the future a conservation priority. Between the National Parks of South Midongy and Andohahela, the Beampingaratsy massif acts as a forest corridor. In this study, we assessed the efficiency of implementing conservation measures in this area for two distinct vocations: 1) as an ecological corridor for two species located in the area, *Gephyromantis leucocephalus* (Anura, NT) and *Eulemur collaris* (Lemur, EN), 2) as an ecological haven for two species whose range are exclusively north of the area, *Mantella baroni* (Anura, LT) and *Hapalemur aureus* (Lemur, CR). These species are range-restricted and linked to the tropical forest. Using an ensemble of species distribution models (SDMs), we predicted their present and future (2070) environmental suitability with 19 bioclimatic variables (CHELSA) under current and two future climate scenarios: RCP 2.6 and RCP 8.5. We compared the differences between current and future by using two metrics of species range change: difference in overall suitability (SRC) and spatial overlap (Shoener's D overlap). All the species were predicted to shift southward, and projected to lose on average between 22% and 55% of their climate range suitability for the RCP 8.5. The climate range of the area is currently not suitable for the species located at the north of the area and the species currently located in the area are projected to lose their current range inside the area. This study provides new arguments for the conservation of the corridor, in a poorly studied area and with species showing low sample size.

P 13. Arboreal Camera Trapping Reveals Vertical and Diel Niche Differentiation of Frugivore Communities Feeding on *Ficus nota*

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Fig–frugivore mutualistic relationships in tropical forests are crucial in maintaining forest dynamics and biodiversity, yet important ecological aspects of these interactions are unknown. Philippine studies on these interactions are lacking, creating gaps in the understanding of how figs support frugivore diversity and how different frugivores can utilize figs as shared resources to promote coexistence. Arboreal camera trapping has emerged as a method to observe frugivores on long time scales in undersampled areas, leading to more robust knowledge on niche differentiation. In this study, we used arboreal camera trapping to observe vertical and diel niche differentiation in frugivores of *Ficus nota*, an understudied Philippine fig. We monitored one *F. nota* tree for 70 days using two camera traps to film terrestrial and arboreal frugivores. Our terrestrial camera filmed 238 videos comprising 1, 4, and 233 videos of rodent, civet, and bat activity, respectively. Our arboreal camera filmed 63 videos comprising 2, 7, 11, and 43 videos of rodent, bird, civet, and bat activity respectively. Non-parametric kernel density estimation and Watson's tests of homogeneity divide frugivore activity as diurnal in birds and nocturnal or crepuscular in mammals, but there were no significant differences in activity times among frugivorous mammals ($\alpha = 0.05$). Our results indicate that temporal niche differentiation prevents activity overlap between birds and mammals, while vertical niche differentiation may be the main mechanism preventing activity overlap between frugivorous mammals. This highlights the role of spatiotemporal complexity in maintaining frugivore diversity and has implications for forest management decisions such as the preservation of old–growth trees. Our study also underscores the role of arboreal camera trapping in capturing keystone forest species activity across large spatiotemporal scales which can aid in forest regeneration and animal conservation.

P 14. Use of RGB Imagery from UAVs to Enhancement Satellite Data in a Agroforestry Plantation

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Satellite imagery and drone imagery are two common forms of remote sensing to collect spatial data for various applications. Both methods have their advantages and limitations and the choice of which one to use depends on the specific requirements of the task at hand. When working at a scale that exceeds the plot, satellite images distributed free of charge on various websites are probably the best solution, especially when you consider value for money. At the parcel scale for continuous collection of remote sensing data over time, satellites offer data that may be sufficient, but could sometimes be supplemented with UAV flight imagery. Large UAVs equipped with Lidar, thermal or multispectral cameras as payloads improve satellite data, but it is an economic effort that not all farmers can make. Therefore, in this article we intend to evaluate the usefulness of a simple UAV equipped with a visible spectrum camera (RGB) to complement the data obtained from the travel of the Sentinel-2 satellites to know where cultivate the crops on the best location in a harvested after a fire forest. To do this, we will compare the data of a DJI Phantom 4 Advance drone flight with the satellite images of the previous day. In the comparison we will use QGIS 3.28 and Google Earth Engine Software. We will also carry out studies of spatial correlation between the bands and of these with the soil samples taken on the same surface in a near period. The use of small drones with RGB camera can be a help for small farmers who do not have the means to pay for big drone flights with fuller payloads.

P 15. Forest Microclimate: Measuring and Modelling this Unique Forest Property for Biodiversity Conservation

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The forest environment is unique, and its microclimate differs significantly from the climate measured by standard meteorological stations. Therefore, the data we usually use to monitor climate change and its effects on the biota is insufficient for understanding the forest microclimate. Canopy cover plays a crucial role in mitigating both cold and warm temperature extremes, and its buffering capacity is closely related to forest structure and tree species composition. This property is essential for many forest-dwelling organisms. Measuring and modelling forest microclimate is thus necessary to evaluate the effects of expected or observed forest changes on biodiversity in both natural and managed forests. Our team has co-developed a microclimatic logger, the TMS, designed for measuring conditions near the ground, including air and soil temperature and soil moisture. It has been widely used in the last decade, leading to standardized measurements across multiple studies and research groups. However, as the number of measurements increased, data processing became a bottleneck for ecologists. To address this issue, we developed an open-source library, myClim, for R software, which simplifies and standardizes calculations of biologically relevant microclimatic variables. This presentation aims to showcase how the forest microclimate can be measured and the data can be analyzed. We will provide several examples of recent studies that used microclimate data to deepen our understanding of forest ecology.

P 16. Characterization of Functional Traits of Old-Growth and Young Mediterranean Pines (*Pinus nigra* and *Pinus pinea*)

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Old-growth forests play an important role due to their ecological value, providing ecosystem services such as high biodiversity and long-term carbon storage capacity. In the Mediterranean basin, the intense effects of climate change and fires increment the vulnerability of such ecosystems. We characterize some functional traits of old and young tree cohorts of two Mediterranean old growth Pine forests in Spain looking for differences that could be related to their resilience. We selected two pilot areas of old-growth Mediterranean pine stands. One is a European black pine forest in the Navahondona forest in the southwest portion of the Cazorla Mountains (Jaén, Spain) where the oldest known living trees in the Iberian Peninsula are found. The second one is a stone pine stand in Hoyo de Pinares (Ávila, Spain), where the oldest trees dated for the species in Spain grow. Mean annual precipitation is 475 mm (Jaén) and 630 mm (Ávila). In each area, one-ha plot was installed, and all trees were positioned, and breast height diameter, total height and crown diameter was recorded. A pair sampling campaign of 15 young and 15 old trees were performed in both sites. Needle functional traits (LMA, chlorophyll-, carotenoid-, total polyphenol-, N contents) were analysed. In addition, increment cores were extracted to analyse the differential response to climate in basal area increment between old and young trees, by means of dendrochronological techniques. Old trees sampled in Navahonda are in the age range of 221-662 years while young are in the range 77-92. In Ávila age ranges are 140 – 220 years (old class) and 27 – 61 (young class). Our results indicated that there are no significant differences in pigment concentrations (Chlorophyll a+b, carotenoid, Ca/Cb and Ca+b/Ccarotenoids ratios) and total polyphenol concentrations between old-tree and young needles inside each site and for the two sites together. Besides pigment concentrations are significantly higher (P=0.0001) in *Pinus nigra* as in *Pinus pinea* trees. The authors acknowledge the support of the AGL2017-83828-C2-2-R and PID2019-108313RB-C32 research projects.

P 17. Seasonal Change of Edge Effects on Plant Species Diversity in a Teak Plantation in East Java, Indonesia

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Extensive monoculture plantation often causes the losses of biodiversity, forming a low-diversity spots in forest interior (“negative core”) which cannot get the benefit of edge effects. Therefore, appropriate edge formation or spatial arrangement of plantations and the other patches are desired to prevent the loss of biodiversity, especially in tropical regions where further expansion of plantation for carbon sequestration, such as facilitated by REDD+, is concerned. The edge effects can vary with various factors even in a same plantation patch. We aimed to clarify seasonal and edge-orientation variations of the edge effects on plant species diversity of understory vegetation in a teak planation in East Java, Indonesia. The data of plant species composition was collected in a 24-year-old teak plantation patch in the middle of rainy season (February) and dry season (August) in 2022. The results showed a clear edge effect in rainy season; higher species richness up to 20m from the forest edge, which inversely indicated the “negative core” at 20m or more distant from the edge. However, the edge effect was unclear in dry season with relatively low number of plant species. The unclear edge effects and limited species occurrence in dry season were attributed by less apparent gradient in of light environments because of defoliated teak canopy, and also by thick litter of teak trees covering the ground surface which might inhibited germination and growth of forest floor plants. The analysis by the additive partitioning method revealed that the species richness of the whole patch was contributed by species alteration with 1) edge/interior habitats and 2) edge orientations, rather than that with rainy/dry seasons, indicating the importance of decision support for appropriate spatial arrangement of patch mosaics for conservation of species diversity in the region.

P 18. Soil P Dynamics after Wildfires and Prescribed Fires and Subsequent Recovery: A Case Study in the Southern Iberian Peninsula

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Soil phosphorus (P) is a limiting element, essential for the ecosystem functioning and the long-term plant nutrition. The changes in the availability of P forms in different post-fire scenarios is still scarce. Our main objective was to assess the effects of prescribed fires and wildfires in the dynamics of soil P forms in Mediterranean forests (Southern Iberian Peninsula). Both wildfires (Sierra Bermeja) and prescribed fires (Cartaya, Doñana) were selected, and the surface organic layer and the uppermost mineral soil (0-2 cm) were sampled in unburned (pre-fire) and burned (post-fire) sites immediately after fire and one year after. Besides the strong increase in pH (>2 pH units) and the loss of SOM, extractable P increased immediately after fire. 31P-NMR spectroscopy indicated that both prescribed and wildfires led to the transformation of the different P fractions, especially at the organic layer.

The low severity burning on the organic layer produced a short-term peak of orthophosphate, reducing the organic P (P mono- and diesters) in both prescribed and wildfires. However, fire affected more severely the P pool in the organic than the mineral fraction. P forms were almost completely mineralized, the effect decreasing with decreasing fire severity: Sierra Bermeja (high severity) > Sierra Bermeja (low severity) ~ Cartaya fire > Doñana fire. As fire severity decreased, different P forms and the organic:inorganic P ratios (Po:Pi) dramatically increased. The profile of P compounds was markedly dependent on the origin of fire. Despite both wildfires and prescribed burns affected the mineral fraction (0-2 cm), clear differences were observed in the organic layer. After one year, the composition of the different soil P forms in prescribed fires was similar to prefire conditions, but this was not the case of the wildfires, even the low severity burning.

P 19. Silvoarable Systems: Shade Adaptation of Rye Varieties

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One of the challenges facing European agri-food systems is climate change and plant species that constitute the basis of the food chain, such as cereals, which production and quality are under threat. Therefore, the present study aims to analyse which rye varieties (that were previously designed to be exploited as monocultures) are the most suitable for cultivation in silvoarable systems. For this purpose, 11 varieties of rye (Secale cereale L.), planted in December 2017 in pots, were studied under greenhouse conditions through a randomised complete block design with eight replications per variety and three shade treatments: no shade (NS), intermediate shade (IS) and a high shade (HS). Shade was applied through meshes of different dimensions (0.0075 cm^2 and 0.0026 cm^2 for IS and HS, respectively) in May, coinciding with the budding season of Atlantic deciduous trees such as Castanea sativa Mill.) Plants were harvested after seven months of growth, and plant productivity (dry rye matter) was measured. The results obtained were treated by analysis of variance (ANOVA) with Duncan's post hoc tests ($p<0.05$). The joint interaction of varieties and shade factors significantly affected ($p<0.05$) plant biomass, and in general, plant productivity decreased with increasing shade intensity. However, some varieties, such as Petkus, showed higher biomass in HS than others, suggesting that this variety could be a potential candidate for its establishment in silvoarable systems.

P 20. Variation of Quality and Production of Forage Maize in an Agroforestry System

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European agri-food systems face climate stress and resource depletion. Therefore, sustainable agri-food practices require new strategies, such as farm-to-table and the Common Agricultural Policy (CAP). This study explores how intercropping practices based on silvoarable systems can contribute to developing some of the Green Deal's climate change adaptation and mitigation objectives. In this study, three maize (*Zea mays L*.) varieties ('DS0747', 'HUXXTOR' and 'SIMPATICO'), combined with 10-year-old chestnut (*Castanea sativa Mill*.) plantations, were studied, compared with their cultivation under open field conditions, to analyse the variation in maise yield and nutrient quality under shaded conditions. The yield of the three maize varieties varied significantly under shaded conditions, and there was a clear influence of the maize variety factor ($p < 0.05$). Variety DS0747 showed the lowest yield under shaded conditions, with a 66% reduction compared to unshaded conditions. However, 'SIMPATICO' stood out as the highest-yielding variety in the 10-year-old chestnut plantation. There was an increase in protein content in some types, such as SIMPATICO, and an increase in *Fe* content in all varieties intercropped with *Castanea sativa Mill*.

P 21. Tree Species Selections to Improve Air Pollution Removal Capacity in Urban Ecosystems within a Framework of the AIRFRESH Project

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Urban air pollution is a threatening problem around the world especially in industrialized countries. Among atmospheric pollutants, tropospheric ozone (O_3), nitrogen dioxide (NO_2) and particulate matter (PM2.5 and PM10), are the most dangerous affecting citizens' health. Urban trees can reduce the concentrations of these pollutants thanks to stomatal absorption and dry deposition on their canopies. However, some tree species emit volatile organic compounds (VOCs) such as isoprene and monoterpenes that are O_3-precursors resulting in air quality deterioration. In the European LIFE AIRFRESH project (LIFE19 ENV/FR/000086), we developed an innovative single-tree model (FlorTree) to estimate the air pollutant removal capacity by trees and select the best species for urban greening. FlorTree considers species-specific parameters such as tree morphology (height and crown leaf area), leaf/shoot structure, leaf habit (deciduous or evergreen) and physiological responses (stomatal conductance and VOCs emissions) to environmental factors. Hourly concentration data for air pollutants (O_3, NO_2, and PM10) and meteorological parameters (temperature, solar radiation, relative humidity and wind speed) were used as model input. Here, we will present our approach for the selection of suitable urban tree species at Florence. Several promising species (e.g. *Tilia platyphyllos*) were selected on the basis of their high absorption and removal capacity of atmospheric pollutants and low VOC emissions.

P 22. Soil Organic Carbon Balance in Broadleaf Forest Plantations on Abandoned Agricultural Lands in Hemiboreal Vegetation Zone

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The new European Union (EU) forest strategy targets to improve carbon sinks and biodiversity by expanding the forest area under the "3 Billion Trees Pledge" program. In Northern Europe, the potential way to fulfil the EU program would be the restoration of abandoned agricultural soils with new forest plantations. Afforestation of former agricultural lands with broadleaf tree plantations is a novel silvicultural system in Northern Europe to produce industrial woody biomass and mitigate climate change on marginal lands. Before the large-scale afforestation, yet, there is a need for knowledge how broadleaf tree plantation affects soil organic carbon (SOC) over a longer period and after regeneration. We studied SOC changes in hybrid aspen (*Populus tremula* × *P. tremuloides Michx*.) and silver birch (Betula pendula Roth) plantations two decades after their establishment on former agricultural soils. In addition, we clarified the early change of SOC for hybrid aspen coppice generation aimed for bioenergy production. Two decades of afforestation did not reduce SOC concentrations in the upper 30 cm soil layer for hybrid aspen (+10.4%) and silver birch (+4.3%). However, we found some vertical shifts in SOC allocation where the SOC decreased in deeper soil layers and increased in the upper soil layers. SOC-exhausted former croplands (+8.3 Mg C ha^{-1}) tended to improve their SOC stock more than former grasslands (+1.3 Mg C ha^{-1}) after afforestation with hybrid aspen. The second-generation hybrid aspen bioenergy coppice showed a decrease of SOC (-3.6 Mg C ha^{-1}), but it was compensated with the aboveground carbon gain (+17.9 Mg C ha^{-1}). Plantations with a higher productivity tended to improve the SOC stocks because of higher litter input. All the studied plantations are carbon sinks at the ecosystem level as the C outputs are compensated by the C inputs with the high productivity in aboveground biomass. To conclude, two decades (passing 2/3 of the expected 30 year rotation cycle) after the afforestation of former agricultural lands with broadleaf tree plantations does not jeopardize SOC stocks. Such ecosystem restoration method can offer a sustainable land-use system to achieve the climate targets of EU.

P 23. The Effects of Forest Cover on Aquatic Carbon Transport

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Key question: How does land use, and particularly forestry, affect aquatic carbon transport? There is considerable interest and debate on the amount, sources and pathways of carbon transport (inorganic, organic and particulate) from terrestrial environments to surface waters and oceans. Riverine export is a relatively small component of total terrestrial carbon flux compared to transfers between land, atmosphere and the oceans but it makes important contributions to the global carbon cycle through CO_2 release from inland waters, deposition of carbon to sediments and transport to the oceans, all of which is of significance to current concerns over global warming and climate change. Moreover, dissolved organic carbon (DOC) plays an important role in supporting aquatic ecosystems and in many environmental processes and biogeochemical cycles. Of particular interest to drinking water suppliers is the link between DOC concentrations and the formation of carcinogenic trihalomethanes following water disinfection by chlorination; the issue is a cause of growing concern, with a number of studies reporting increasing DOC trends in surface waters across Europe and North America. Many factors can affect DOC transport including land use, with urbanization, agriculture and forestry all shown to impact upon carbon dynamics. Some studies have indicated that aquatic carbon transport may be higher from forestry compared to other land uses, but others have found no difference highlighting a clear knowledge gap. In this presentation we consider the sources and origin of DOC to surface waters, present data from studies investigating the effects of forest operations on DOC transport and finish by introducing new research aiming to improve our understanding of the effects of land use on aquatic carbon transport.

P 24. Foliar Water Uptake Capacity of Cork Oak Depends on Leaf Water Status

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Foliar water uptake (FWU), the absorption of water directly into leaves, is a mechanism observed in various species across different ecosystems. However, the information regarding FWU in Mediterranean ecosystems is limited and, to our knowledge, non-existent for cork oak (Quercus suber). In Mediterranean ecosystems, FWU may hold greater importance than previously recognized, particularly during droughts when water stress is highest and even more with the forecasted increase in aridity. The uptake of water through leaves, whether from small precipitation events, dew, or fog, can significantly enhance plant water status and, at the very least, prevent further water deficits during the dry season. Nevertheless, the functional significance of FWU in these contexts remains poorly understood. The objective of this study was to assess the leaf water uptake capacity of cork oak and examine its contribution to leaf water status and daily carbon assimilation. We conducted a controlled experiment with cork oak seedlings from two origins (Companhia das Lezírias and Vila Viçosa) subjected to varying water availabilities to evaluate the FWU capacity. By monitoring leaf water potential and gas exchange, we quantified the extent to which FWU influenced water status and carbon assimilation. Preliminary results indicate that FWU occurred in cork oak leaves and exhibited an upward trend as leaf water status decreased. This pattern was consistent across different seedling origins. Moreover, FWU played a significant role in enhancing the leaf's relative water content, resulting in an average increase of 5%. Gaining a better understanding of FWU's contribution to the carbon and water balance of cork oak holds significant implications for the conservation and restoration of ecosystems. Furthermore, it is essential to promote increasingly sustainable water use, and this can be partially achieved by exploring alternative water sources beyond solely relying on rainfall and/or irrigation.

P 25. Effect of the Hydrogel (Polyter) and Mycorrhizae on Resilience to Hydric Stress in Eucalyptus Plantation

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Under nursery conditions, different treatments were tested and compared with the control. To improve plant survival were tested: organic and fertilized hydrogel (Polyter, kindly supplied by Green Tech Novation), ectomycorrhiza (Micofora) and a liquid spore mix of the mycorrhizal fungi *Pisolithus tinctorius* (harvested from eucalyptus stands). As control a controlled release fertilizer at the bottom of the pit (Agroblen) and P2O5 mixed into the substrate was used. Dry polyter was added (2g/plant) to the bottom of the pit vs hydrated and mixed into the substrate. Six treatments were tested: 1) dry Polyter+P2O5; 2) hydrated Polyter+P2O5; 3) ectomycorrhizae; 4) hydrated Polyter+ectomycorrhizae; 5) plant immersion in the liquid spore mix; 6) hydrated Polyter+plant immersion in the liquid spore mix. Two types of soil texture were tested (medium vs coarse, respectively with 17.2% and 2% clay). To reduce the genotypic response the same clone was used. Plants were placed in a pot (2.8L). The trial was set up in a randomized block design, during summer (no watering or shade net). The results showed that treatment “dry Polyter + P_2O_5” showed the best results ($P<5\%$) on survival rate, physiological parameters (plant turgidity; leaf development), chlorophyll and flavonoid content and, particularly, in coarse-textured soil. Under these unfavourable conditions, due to lower water retention, the treatment “hydrated Polyter + plant immersion in the liquid spore mix” gave the following best response. Dry Polyter showed to improve the root system development, reducing the effect of hydric stress, ensuring the plant survival. This study shows that the use of dry Polyter applied to the bottom of the pit added to the usual localized fertilization with P_2O_5 is easily operationalized in the field and improves the plant survival. New trials were established in field and nursery to test the effect of Polyter, endo/ectomycorrhiza and plant immersion in liquid spore mix of *P. tinctorius*.

P 26. Living in the Mountains: Vulnerability and Adaptation to Wildfires in Rural Inner Communities of Algarve (South of Portugal)

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This paper presents the main results of a research (financed by Foundation for Science and Technology, PCIF/AGT/0072/2019) aimed at characterizing vulnerability and adaptation of rural communities of Monchique, Southern Portugal. These communities have been subject to cyclical wildfires, at least since the 1990s. Between 1990 and 2022, this municipality has been affected by eight major rural fires, with the total area burnt fluctuating between 6,129 hectares (1991) and 27,154 hectares (2018) (PRGP Monchique, 2020). It is common an area to be affected more than once. It is the case the last major fire in 2018, which, according with technical studies pursued in the aftermath of the disaster, was through an area that had already been the subject of a fire in 2003. Which factors do explain this persistent vulnerability towards wildfire? What kind of adaptive strategies inhabitants adopt to cope with wildfires? Methodologically, this research follows a case-study design, with Monchique's municipality as empirical field. The above-mentioned research questions were a tackled through a multi-method approach, based in secondary data analysis and interviewing methods. Fieldwork and interviewing followed a two-stage strategy: an exploratory approach, based in interviews with local leaders; and a structured interviewing approach to a sample of population at risk (60 subjects) of Alferce, Monchique Research findings indicate that Monchique's persistent vulnerability towards wildfires results from a complex combination environmental alterations, i.e. climate change, and social processes. Monchique faces a process of demographic regression since the mid-twentieth century. Demographic regression remounts to the 1960s. According to Census, Monchique had 14,779 inhabitants in that year, decreasing to 12,000 inhabitants in 1970. Presently, Monchique has 5,465 inhabitants, which, in relative terms, represents a loss of population of around 63% compared to the situation in 1960. This demographic regression, in parallel with public policies stimulating the productivism in forestry, emptied Monchique's mountains of people and stimulated land abandonment. The traditional multifunctional model of land-use, based on an interchange between agriculture, livestock farming and forestry, gave way to productive forestry. We posit that these two interrelated processes are the root causes of Monchique's vulnerability towards wildfire, which, jointly with dynamic pressures, increased people's exposure to fire hazard. The survey pursued in Alferce, currently undergoing data analysis, revealed a high level of awareness and recognition of rural fire hazard among the interviewees and the existence of experiential knowledge of fire behavior and fire safety measures. Such knowledge is product of ancestral coping with fire and cyclical disaster experience. Most interviewees revealed to undertake some form of preparation. Safety measures were mainly concerned with the creation-maintenance of a defensible space around dwellings and, in the case of rural property, periodical cleaning. Among some households, the level of activity did not match with their stated intention of investing in safety. Lack of resources, jointly with inherent fragilities related with

age, seem to be at the basis of such difficulty of implementation. Although there are gaps, informal knowledge and adaptive capacity appear to be under-utilized by a wildfire management system based on a command-and-control model in which local people play a largely passive role.

P 27. Mixed Plantations of Cork Oak (*Quercus suber*) and Stone Pine (*Pinus pinea*): Characterization and Management of the Areas

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The aim of this work is to research the ecological and productive sustainability of mixed forests of cork oak (*Quercus suber*) and stone pine (*Pinus pinea*), by creating practical knowledge for the owner and forest manager. It is intended to be a starting point for the compilation of the main management problems reported by owners related to the management of these mixed systems. It is also intended to contribute to the establishment of effective ways of managing this mixture. This work is considered the first stage of the establishment of a network to a continuous monitoring plots in the project "Mixed Quercus suber and Pinus pinea forests: management for products valorisation, biodiversity and forest fires prevention". Six farms located between the municipalities of Ponte-Sôr and Ferreira do Alentejo are collaborating in this study, representing different areas of incidence of the two species.

The work was organised in two stages, a qualitative stage using interviews with owners and a quantitative stage where a forest inventory was carried out in each plantation. Information was collected and compiled from forest owners and managers in the field who, individually, had the initiative to implement mixed plantations of cork oak and stone pine. The interviews were based on open questions and followed a pre-defined script with key questions, ensuring that the views and opinions of the interviewees were considered. As a conclusion, the results analysed so far refer that managers´ motivations for mixing cork oak and stone pine were: diversification and profitability of forest areas with two species with good productive potential, problems with aged and/or decrepit cork oak forests with low tree density, management of more resistant and resilient forests in the future and preservation of biodiversity in the forest.

P 28. Preserving the Link: Exploring the Relationship between Swedish Urban Forests and Uneven-Aged Forestry

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The Swedish forestry model has traditionally used even-aged methods, which have been supported by Swedish forestry law since the 1900s. However, opinions about forest management have evolved now considering sustainability and biodiversity, spurred by the need to meet sustainable development and biodiversity goals, and climate change mitigation strategies. Uneven-aged forestry is emerging as a potential solution to managing forests while protecting biodiversity and preserving recreational values in forests around cities. Given the high number of visitors to urban forests, our research aims to provide updated information on uneven-aged forest management methods in Sweden, focusing on their application around urban areas and understanding the behavior of forest owners and visitors. The project aims to provide updated information on the methods used in Swedish urban forests and to gather insights from both forest owners and visitors to transition to an uneven-aged forestry model. In its first stage, the research intends to show the unique forest ownership dynamics observed across the country and to identify challenges in creating a common understanding of urban forests in a country-specific context. Results emphasize the need for a new definition of "Urban Forest" that reflects Sweden's deep relationship between forests and cities. In this conference, we show the methods used for identifying urban forests in Sweden while highlighting the identification issues that arise when following the standard definitions of what an urban forest is when applied to the Swedish context. Results from implementing a national-scale survey pretend to explore differences in attitudes towards non-rotation forestry in relation to proximity to urban settlements.

P 29. How Real Estate Cadastre Data Can Help in Forest Management?

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The current forest ownership structure in the Czech Republic (CZ) has evolved through the restitution of previously nationalized forestland to former private owners, in addition to being influenced by demographic and legal processes. Official data regarding forest ownership are recorded in the Real Estate Cadastre. Analyzing this data can provide valuable insights into the factors that impact forest management practices. Within the projects NAZV QK21020371, QK23020008 and QK23020008 we have analyzed all data that are marked as forest parcels in the cadastre (about 2.5 million records). We found that there are almost 385 thousand forest (co-)owners in the CZ, the most diverse of which is the group of individuals comprising 344 thousand owners. The average size of owned forests for this group is only 1.34 ha, while 77% of these owners have properties smaller than one hectare.

Anonymized data we analyzed using ArcGIS 10.5 and R statistical software. Here we present the basic explorative analyses of spatial relationship between forest parcels and their owners. The selected data were specifically analyzed for locations where a large bark beetle calamity has occurred in recent years. Our findings indicate a prevalence of shorter distances between owners and their forestland. Local owners account for approximately 74% of the total forestland owned by private individuals. On average, the distance between an owner's residence and their forest is 23.8 km. The majority of owners (81%) reside outside larger cities (e.g. cities with population exceeding 40,000 inhabitants), and they possess nearly 80% of the forestland owned by private individuals. By employing spatial data, we were able to visualize the distribution of the ownership structure, thus enhancing our understanding of this phenomenon. Accurate knowledge of the actual ownership structure and its spatial patterns is crucial for effectively targeting forest policies.

P 30. Future Pathways of Forest Ecosystem Services – A Stakeholder Analysis in Four European Regions

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Forests provide a wide array of services, and a sustainable use of forest ecosystem services (FES) is essential for achievement of sustainable development goals. However, as humans face climate change, societal and environmental challenges, fundamental changes are needed to ensure future prosperity in the growing bioeconomy and circular economy transformation. This transformation depends on both technical and social innovations together with societies adapting to a bio-based sustainable future. In policymaking, synergies need to be realised and trade-offs evaluated and addressed in forest management in general to support continuous provision of FES. In this study, organisations that have an interest in FES were approached within ONEforest research case study regions; Catalonia (Spain), Estonia, Grisons (Switzerland), and Hesse/Thuringia (Germany). The purpose of the study was to identify key determinants of the use of forest ecosystem services and the effect of these factors on the provision of FES, and the downstream wood value chain. Interacting with stakeholders in a collaborative learning approach, a scenario-based technique further used PESTEL frame to identify key determinants to discuss future pathways for the societal benefits of forest ecosystem services. The results indicate that forest stakeholders identify different conflicts between FES, e.g., between timber production and recreation, or between timber production and carbon storage. However, the identified conflicts are context dependent. Stakeholders further identified decision-making and management challenges regarding FES. Finally, the study notes that prioritization of FES provision may become necessary due to increasing demand and potential conflicts. Overall, the results of stakeholder analysis FES help to inform more effective and inclusive forest management and governance including the needs and interests of stakeholders, which will contribute to a more successful policy implementation.

P 31. How Did the Forest Landscape Change in Japan? - Analysis using the 1960 and 1970 World Census of Agriculture and Forestry

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The forest landscape on the earth has changed totally in the Anthropocene when human activities have influenced the earth's environment. The Japanese archipelago is an example that has undergone dramatic landscape changes after World War II. The study will identify forest landscape changes in 11 Japanese regions: Hokkaido, Tohoku, Kanto, Hokuriku, Tosan, Tokai, Kansai, San'in, Sanyou, Shikoku, and Kyushu. Nowadays, natural regeneration is chosen as land use after harvesting planted forests in Japan. It is implied that the amount of residual buried seeds affects whether natural regeneration will succeed. The amount depends on the vegetation history of the planted forest. Thus, natural regeneration needs to understand its history. The study will be able to contribute to the field by providing useful information for forest management in each region. The study utilises data from the 1960 and 1970 World Census of Agriculture and Forestry. They classify land of pre-afforestation uses into three categories: (i) natural forests, (ⅱ) planted forests, and (ⅲ) non-forest. The afforestation rate in each land was calculated for regions based on the digitised data. As a result, landscape changes are indicated as follows. Firstly, in the 10 years, the planted rate of non-forest kept higher in Hokkaido and Kyushu, where logging activities are currently intense, although the rate was lower in Kanto and Kansai including the megapolis. Secondly, the afforestation rate in natural forest harvest sites was over 60 percent in all regions. In the 10 years, the afforestation rate in natural forest harvest sites rose although the afforestation rate in non-forest areas decreased. The result indicates that the major change was planted forests from natural forests. The afforestation in non-forest was also obvious in Hokkaido and Kyushu.

P 32. Conceptual Model of Protected Area Management in Serbia

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Protected area (PA) management includes interaction of different actors, institutions and processes and is carried out on different levels, from global to local. In Serbia, forest areas are mostly present within PA and forest management is directly connected with PA management (NFI, 2008; Đorđević, 2018). The management of a PA can be delegated to an organization, an individual or to a community which functions according to a set of laws, rules and/or traditions (Borrini-Feyerabend et al., 2013; Stanciu, Ionita, 2014). Also, the main feature of the modern PA management system is the existence of different types of managers. The governance of PA is carried out through the participation of the public and to a larger extent of the local communities and it has become a widely accepted principle of work. Conceptual model of PA management includes interaction between nature protection and forest management frameworks (strategic, legislative and institutional), structural characteristics of PA management (management and protection, monitoring of species and visitor monitoring) and mechanisms of financing. The aim of this research is to assess the main elements of conceptual model of PA management in Serbia and purpose elements of improvement. Results are showing that conceptual model of PA management in Serbia includes relevant frameworks (nature protection and forest management), structural characteristic and mechanisms of financing, but it needs improvement. Concerning frameworks, additional organizational capacities for establishing PA and its management from government level is needed as well as sustainable mechanisms of financing. The main weakness of structural characteristic of PA management is connected with overlapping of different responsibilities, insufficient organizational capacities and inadequate cooperation with local communities within the PA managers. On this level, diversified mechanisms of financing are lacking, since managers are mostly relaying on governmental financing. Regarding the directions for future research studies activities on identifying and analyzing organizational needs of PA managers are suggested as well as analysis of the financial needs of PA.

P 33. Forest Species Diversity in Alto Alentejo, Portugal

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The spatial distribution pattern of five forest species in Alto Alentejo, Portugal was the goal of this study. Sentinel-2 images with random forest and bands, vegetation and texture indices as explanatory variables were used to produce a land cover land use map. This map with six classes (*Quercus suber*, *Quercus rotundifolia*, *Pinus pinea*, *Pinus pinaster* and *Eucaliptus spp* and non-forest) was used to evaluate beta diversity with eleven diversity metrics of composition and configuration. The analysis was done for Alto Alentejo and four sub-regions defined according to their topographic, edaphic and climatic homogeneity. The results highlighted the high variability in composition and configuration and the differences in diversity amongst sub-regions. Overall, the analysis at Alto Alentejo and sub-regions levels enabled to provide insights of the spatial arrangement dynamics at landscape level.

P 34. A GIS-Based Network Analysis of Urban Green Spaces Accessibility and Greenness: A Case Study in Portugal

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Urban green spaces are an integral part of any urban area, and their benefits and importance are very well known. Usually, urbanization results in a high level of biodiversity loss. Living in an urban environment with easy access to green areas is very important for most people. The aim of this study was evaluating the amount of urban green spaces and the connectivity and accessibility (walking distances) of urban green spaces to the population. Urban green spaces were identified, georeferenced and digitalized using ArcGIS software. Population census data were used to explore its accessibility to the population. The analysis of the existing network of green corridors in the city was performed using the roads network and urban green spaces as nodes by the Network Analyst extension in ArcGIS software. Twelve green areas of the city were recognized as network nodes, and the pedestrian distances between them were measured, as well as different coverage areas that allowed analysing the density of existing green spaces.

The results showed that the index of green areas obtained for the main green structure (urban green spaces 5, 6 10 and 12) has found to be below the recommend (17 m^2 per inhabitant) while for the secondary green structure (the remaining urban green spaces) the value is in accordance with the recommended (10 m^2 per inhabitant). The total length of the network is approximately 266 km, and the green corridors occupy approximately 117 km (44%). So, more than half the road network does not have green corridors. The resulting walking route for the shortest path, considering all the selected urban green spaces, has a total length of approximately 11.4 km considering its ends the nodes 9 and 3 (initial and final or vice-versa). Regarding the presence of green corridors in this route only 33% has no vegetation (3.8 km).

This study can serve as a tool to support green areas planning throughout the city. In areas with less green density, restoration actions could be promoted, maintaining the pre-existing vegetation, and improving the index of green areas per inhabitant. The green corridors maintenance and planning can also be a part of the strategy to improve biodiversity in urban areas.

P 35. The Influence of Grazing on Small Shrub and Forest Communities in the Montado Ecosystem

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The Montado is a traditional and multifunctional production system predominant in southern Portugal, based on agricultural, livestock, and forestry activities that characterize its spatial and temporal habitat heterogeneity, hosting high levels of biodiversity. Thus it is recognized as a High Nature Value (HNV) system. However, is under threat by land-use changes such as grazing, and agriculture intensification, resulting in habitat loss and fragmentation, and consequently, loss of biodiversity. Grazing is one of the determining factors for the sustainability of the Montado and its recognized associated biodiversity value, including the presence and conservation of natural remnant habitats in the Montado. The objective of this study was to analyze the influence of grazing on small shrub and forest communities in the Montado areas. The study was conducted in two plots at “Herdade da Mitra”, Central Alentejo (southern Portugal), one with cattle grazing and the other with no grazing. Twenty-two patches of vegetation were sampled (12 grazed and 10 not grazed) in the spring of 2021 and 2022 for eight parameters such as vegetation strata, plant species, and *Quercineas* natural regeneration around the vegetation patches as a proxy of cattle grazing. The plant community's species were identified and also their ecological preferences such as preference for shadow or nitrophily. Our results show that grazing, together with the presence of rock clusters in the grazed area influences the composition of plant communities. Inversely, the absence of grazing allows the development of heliophilic scrub communities. The co-existence of distinct areas in terms of management (mosaic of ungrazed areas with extensive grazing) can be beneficial for plant-specific and functional biodiversity improving the High Natural Value of the Montado ecosystem. This work is funded by National Funds through FCT under the Ph.D. scholarship 2020.07109.BD. and Project UIDB/05183/2020.

P 36. Using the Natural Vegetation for Restoration of Degraded Areas - The Concept

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The period from 2021 to 2030 has been declared as a Decade on Ecosystem Restoration, by the United Nations and The Food and Agriculture Organization, together with the world's leading organizations in the field of environmental protection, in order to combat the evident climate change consequences, pollution, loss of biodiversity, and to contribute to overall societal well-being. Forest tree cover of Serbia makes up 37.1% of the total country area, with only 9% cover in Vojvodina (Pannonian part of Serbia)- area recognized as the least forested in Europe. By performing spatial analyses, modelling and spatial statistics, Potential Landscape Units for Restoration at urban fringe zones will be identified. By geospatial aggregation of data about Natural Potential Vegetation major zones/ macro units will be created. In order to select suitable species for the restoration, the list of dominant and most common species for the macro units, will be generated. VSD+PROPS and Maxent models, will be used to predict the influence of future climate changes and air pollution scenarios on the habitat suitability for selected species. After the analyses, scalable conceptual designs for the restoration will be created, consisting of trees, shrubs and perennial species in a way that they can be planted together and form self-sustainable communities in determined environmental conditions. The designs are intended to be independent of scale, therefore widely applicable within the macro unit, visually appealing, multifunctional parts of the green infrastructure. Advocating the use of native species, and forcing the idea of restoration of degraded and neglected areas of urban fringe zones, in a scientifically designed way, it is expected that this concept will propel the decision making process at multiple levels. Furthermore, the idea is expected to echo within practitioners, decision makers and producers, through nature base solutions that are “ready to use”.

P 37. Conservation of *Acer ibericum Bieb.* in Georgian (the South Caucasus) Forest

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The forest ecosystem in Georgia is distinguished by plant biodiversity. Among them, many species are under anthropogenic pressure, and as a result, their ranges are reduced. It becomes necessary to study the area of such a species, investigate locations and plan conservation measures. The Georgian maple *Acer ibericum Bieb.,* one of the species of Georgian light forest in the international literature mentioned as *Acer monspessulanum var. ibericum*. It is distributed in eastern Georgia in a form of individual trees or small groups, and is included in the Red List of Georgia as vulnerable VU, B1c (iv). The purpose of the present research was to study the Georgian maple population genetic diversity and choose the best location for conservation. The forest inventory was conducted by recording of slope inclination, exposure, GPS coordinates, forest type, stand density, understory, tree height, and diameter of target species. According to our inventory, it was found that the range of the species has been significantly reduced. Based on these data a distribution map for the target species was prepared and six populations were recorded. In total, 91 individuals representing six populations were investigated. Molecular analysis was carried out for leaf samples taken from each tree. The internal transcribed spacer region of the ribosomal DNA (ITS) was used as a barcoding and population genetic marker. MegaBLAST searches of studied samples against the GenBank database revealed that all studied accessions could be considered A. ibericum. Populations from Vashlovani National Park revealed the presence of unique ribotypes, and together with the population from Shavi Mountain, they were identified as the most genetically diverse ones. Furthermore, based on the obtained data the Shavi Mountain population, as the largest population with favorable local climatic and soil conditions should be protected in situ.

P 38. Old Conifer Plantation as a Conservation Site for the Endangered Orchid, *Apostasia wallichii var. nipponica*

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Apostasia wallichii var. nipponica is a terrestrial orchid classified in the genus Apostasia. This species is endemic to Japan and is distributed only in the forest floor of evergreen broad-leaved forests in southern Japan. Due to population decline associated with the deterioration of the habitat environment, this orchid has been designated as a species Endangered species (a high risk of extinction in the near future) in Japan. In recent years, however, it has been confirmed that this orchid inhabits in an old conifer plantation in southern Kyushu. This suggests a possibility that conifer plantations can become ex situ conservation areas for OECM (Other effective area-based conservation measures). In this study, we aimed to clarify whether plantation of hinoki (Japanese cypress; *Chamaecyparis obtusa*) and sugi (Japanese cedar; *Cryptomeria japonica*), major plantation species in Japan, can function as a habitat for *A. wallichii var. nipponica* around their natural habitats. Field survey was conducted in the experimental forest of University of Miyazaki located in southern Kyusyu. We investigated the individual density of *A. wallichii var. nipponica* in 10 hinoki plantations and 4 sugi plantations with different ages. The results revealed that *A. wallichii var. nipponica* inhabited old hinoki plantations, while no individual was found in young hinoki plantations. This difference was attributed by the presence/absence of broad-leaved trees in the sub-canopy or canopy layers of the plantations. In contrast, we could not find *A. wallichii var. nipponica* in old sugi plantations in spite of many broad-leaved trees growing in the sub-canopy layer. For the conservation of *A. wallichii var. nipponica* it was found that the old hinoki plantation, rather than the sugi plantation, can play an important role as an alternative habitat for the conservation of rare plant species in forested landscapes for timber production.

P 39. Biodiversity of Oaks in Georgian forest

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In Georgia Genus Quercus is presented by 7 species, among them Pedunculatae oaks presented by *Q. hartwissiana* Steven, *Q. robur subsp. imeretina* (Steven ex Woronow) Menitsky, *Q. robur subsp. pedunculifllora* (K. Koch) Menitsky), and sessiliflorae oaks with *Q. petraea subsp. dshorochensis* (K. Koch) Menitsky, *Q. macranthera* Fisch & C. A. Mey, ex Hohen, *Q. petraea subsp. Iberica* (Steven ex M. Bieb) Krasilln. and *Q. pontica* K. Koch. In economical and ecological point of view oak in the Georgian forest is considered as one of the most significant species. Oak stands are the most diverse and rich in terms of the floristic composition.

Nowadays, they cover 10.5% of the forest area. Hybridization and the presence of hybrid zones is a common fact among the oak species, which often makes difficult to distinguish between species and subspecies. The aim of the present study was to determine the range of 4 oak species(*Q. Pontica*; *Q. robur subsp. Imeretina*; *Q. robur subsp. Pedunculifllora* and *Q. petraea subsp. Iberica*) in natural forests of Georgia, create GIS maps, compare leaf morphological characteristics and al location of conservation areas. In this purpose, inventory was carried out in oak ranges by forestry inventory methods: slope inclination, exposure, GPS coordinates, forest type, stand density, understory and tree height and diameter of target species were recorded. Leaf samples were digitized, morphometric parameters were measured by the program ImageJ1.47v. Morphometric characteristics of oak leaves were studied by international descriptors. As a result of the conducted research, maps of locations for four oak species were made, the degree of degradation was determined, leaf samples were compared and conservation areas were identified.

P 40. Seed Dispersal by Water, Wind, Birds, and Bats in the Caliraya Watershed, Laguna

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Seed dispersal supports community structure, maintains genetic connectivity across fragmented landscapes, and influences vegetation assemblages. In the Philippines, only two seed dispersal studies have compared different dispersal agents. We examined the seed dispersal patterns of water, wind, birds, and bats in the Caliraya Watershed, Philippines. We aimed to determine the floral species that were dispersed and how the forest characteristics influenced seed dispersal. By running seed rain traps and drift litter collection from March to June 2022, we analyzed 14,090 seeds in a privately owned study site within the watershed. Water did not exclusively disperse any species and acted as a secondary disperser. Seed density (seeds/trap) was significantly higher for bird-dispersed (n=166) and bat-dispersed (n=145) seeds than for wind-dispersed (n=79) seeds (One-way analysis of variance [ANOVA]: $2,87=16.21$, $P<0.0001$). Species number (species/trap) was significantly higher for bird-dispersed (n=3.7) and bat-dispersed (n=3.9) seeds than for wind-dispersed (n=0.2) seeds (One-way ANOVA: $F2,87=16.67$, $P<0.0001$).

Birds dispersed more species because they are more diverse and access a wider variety of fruits, unlike bats. Birds and bats target different fruits and provide separate seed dispersal services. Generalized linear model analyses revealed that the number and basal area of fleshy fruit trees most strongly influenced the bird seed dispersal patterns. Therefore, we recommend a three-way approach to restoration efforts in the Caliraya Watershed: (1) ensure the presence of fleshy fruit trees in restoration zones, (2) assist the establishment of mid-successional and wind-dispersed trees, and (3) intensify the conservation efforts for both flora and faunal diversity.

P 41. Zambujo reCover – A Forest Rehabilitation and Soil Protection Project

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Zambujo reCover aims to increase the ecological value and ecosystem services of forest, natural and semi-natural habitats in Zambujo estate, located in Rosmaninhal (Idanha-a-Nova), enclosed in the Tejo International Natural Park and in the Tejo International, Erges and Ponsul Special Protection Areas' while preventing desertification. Thus, *Eucalyptus* plantations are being converted to *Quercus rotundifolia* (holm oak) forests, and the current holm oak areas will be densified, totalizing around 110 hectares (recovery of the conservation status of natural habitats by 2030, and fully recovering of native ecosystems by 2050). Land use is characterized by *Eucalyptus globulus* managed plantations, holm oak native forests, pastures and sclerophyllous bushes. The most sloping area close to the Erges river has a slope greater than 35% and soils prone to erosion. Within intervention area for converting *Eucalyptus* plantations into holm oaks forest, a trial was set up during March 2023 to assess the influence of post-harvesting residues management and different tillage practices on soil conservation and fertility, and on holm oak survival rate. Four treatments were established considering also residues placing or removal, counting up to 88 plants/treatment (around 300 plants in the trial), with a spacing of 4 x 4 m: T1 – localized soil tillage between the stumps after stumps shattering + planting; T2 – ripping after stumps shattering and place harvest residues between planting rows + planting; T3 – ripping after stumps shattering and residues removal + planting; T4 – stumps shattering + harrowing + ripping + planting. Tree survival and soil fertility by treatment are being assessed (e.g. organic matter, macro and micronutrients, cation exchange capacity and moisture). The intervention area is also being monitored using multiespectral and RGB imagery acquired by unmanned aerial vehicle. Results available so far reveal a high tree survival rate in all treatments.

P 42. Competition and Competitors Location Effect on Growth and Survival in Middle-Aged Betula pendula Plantations

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Silver birch plantations established on former agricultural lands exhibit higher growth and yield than the native birch stands growing on forest lands in Northern Europe indicating the need to clarify whether current silvicultural recommendations for forest stands are applicable to plantations. Consequently, this study aimed to identify the most appropriate competition index (CI) and competitor selection method for predicting the competition effect on the periodic annual increment (PAI) and mortality during the agespan of 16-21 years in silver birch plantations. Additionally, the study assessed whether considering the competitor trees cardinal direction from the target tree would improve the growth prediction of CIs. The research involved mapping the tree locations in 0.1 ha sample plots in 11 silver birch plantations, and measuring their growth parameters. In the end of the study period, birch forests on forest land in similar site types demonstrated about 60% lower mean annual increment (5.6 m^3 ha^{-1} yr^{-1}) compared to the same aged silver birch plantations on previous agricultural lands (14.1 m^3 ha^{-1} yr^{-1}). The best CI for predicting basal area increment for all tree sizes was the sum of DBH ratios combined with the reverse search cone approach for competitor selection. Furthermore, the addition of a weight to competitor trees based on their cardinal direction from the target tree improved the performance of CIs for dominant trees. The comparison of the performance of CIs expressing asymmetric and symmetric competition suggested that, at given fertile sites and plantation ages, asymmetric competition was the prevailing mode of competition that affected the growth of silver birches. Also, all asymmetric CIs performed as better predictors of tree mortality than symmetric indices, which failed to explain mortality significantly. However, mortality was predicted most accurately when considering the increment of the tree during the preceding 3 years.

P 43. Seedballs: An Ancestral Idea or a New Opportunity in Mediterranean Ecological Restoration?

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Seedballs are a seed coating technique developed to improve germination success, constituted by clay, water, and seeds. Seed coating is an ancient technique; however, its application to native seeds remains limited and is scarce under Mediterranean climate. Developing seedballs with native seeds could benefit the success of seed-based restoration plans by overpassing specific challenges that limit plant recruitment, like seed predators, sloping terrains, or difficulties in the native seeds' mechanical sowing. In Mediterranean habitats, where the dry periods are increasing, seedballs could safeguard the seeds from predators and desiccation until suitable germination conditions occur. Seedballs are also appealing for involving citizens in environmental conservation since they are easy to make and apply. We are developing seedballs using ceramic industry by-products (clay with a high organic matter content) and domestic waste (fireplace ash as P supply). Using these by-products to produce seedballs would promote a circular economy, contributing to their valuation and helping to solve the problem of their destination. Our work aims to determine the best seedball composition for the Mediterranean climate and to assess the seedball capacity against seed predation. In October 2022, we sowed 12 native species using 2 seedball compositions (with/without fireplace ash) and direct sowing (control) in outside plots (3 plots/modality/species). The germination and survival rate were assessed weekly until May 2023. We also assessed seed predation for each modality. The germination and survival rate differed between species and seedball composition. Germination was higher in seedballs that included fireplace ash. Seedballs decreased seed predation by 39%. Developing seedballs using industrial and domestic by-products in the ecological restoration decade has exceptional potential to involve people in the ecological restoration and improve its success in Mediterranean forests.

P 44. Restoring Degraded Areas and Enhancing Resilience to Desertification: the REACT MORE Project in Portugal

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Desertification, characterized by soil degradation in arid, semi-arid, and dry sub-humid regions, has been on the rise in Portugal. Approximately 58% of the mainland territory is susceptible to this phenomenon, leading to adverse impacts at several levels. The REACT MORE project aims to restore an area of 290 ha degraded and cyclically affected by rural fires in the municipality of Figueira de Castelo Rodrigo (Portugal). The restoration strategy focuses on reforesting the area with native tree species, including Quercus suber, Arbutus unedo, and Quercus ilex, known for their adaptation to the local climate. The primary objectives of the project are to restore soil productive capacity, enhance resilience to wildfires, and promote long-term sustainability in the region. To assess the impact of this intervention, six pilot test plots were established, comprising three control plots and three intervention plots, each containing seven georeferenced sampling points, where various indicators will be monitored. Floristic inventories within quadrats and entomological inventories using pitfall and sweeping collection methods will be conducted at different stages of the project. These inventories will provide valuable insights into the existing vegetation and entomological fauna. Temperature and relative humidity sensors placed in the plots will enable the study of potential relationships between different quantified variables. Soil samples collected will undergo analysis to evaluate changes in organic matter content, moisture levels, and other relevant variables. Additionally, a communication strategy will be implemented to inform and raise societal awareness about the urgent need to intervene in these territories to mitigate desertification and reverse the observed global trend. By disseminating knowledge and fostering understanding, we aim to engage stakeholders and promote collective action towards combating desertification and fostering resilience.

P 45. Learning from the Past: Analysis of the Restoration Projects in Europe

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Restoration is the key to halt and reverse ecosystem degradation and biodiversity loss. The global change and the increasing disturbances intensities reinforce the importance of the restoration projects that are carried out in the different ecosystems so that they are able to be adapted to the new conditions. However, large-scale restoration is frequently prevented or constrained by socio-economic interests opposing it, inconsistent policies, or a lack of capacities/knowledge of land managers and stakeholders. Ecosystems are very complex, and despite well-planned restoration approaches, there are many factors out of control. In addition to these obstacles, when a restoration is planned, there is no database to look up if similar works to the one proposed that have been previously carried out, how they have been developed, if they have been successful or unsuccessful, etc. Sometimes the problem is the lack of connection between the practical knowledge of stakeholders and land owners with scientists. On other occasions, the problem is directly the lack of previous information. With this base line, within the SUPERB project we have linked practical and scientific knowledge to learn from restoration and adaptation projects carried out in the past in Europe. Based on an online questionnaire specifically design for these purposes, we have collected information of practical and real experiences from restoration projects comprising four main categories: ecological, economic, social and political aspects.

P 46. Forest-Based Solutions Increase Ecosystem Services Provision in the Cávado River Basin (NW Portugal)

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Europe's nature is at great threat with more than 80% of the habitats in poor condition, with a consequent decline in biodiversity and ecosystem services. However, efforts are being made to revert the loss, for instance, the recent European Commission's Nature Restoration Law foresees that at least 20% of degraded ecosystems must be restored until 2030. In Europe, 60% of surface water is classified with less than good ecological status according to the Water Framework Directive standards and forests have been historically used as a green solution to reduce the diffuse pollutants present in water. So, while using forests to achieve good quality water targets, other economic valuable co-benefits may arise such as timber, edible mushrooms and carbon sequestration. The main goal of this study was to create an opportunity map for the Cávado River Basin region (NW Portugal), identifying priority areas for targeting forest-based solutions to improve water quality, and to monetarily value the ecosystem services provided by this green solution by means of forest area increase scenarization. To achieve our goals, QGIS software was used to make the opportunity mapping using several spatial environmental variables. Subsequently, InVEST ecosystem services model was used to map the provision of several ecosystem services, including carbon sequestration, water purification in a forestation scenario compared to the actual land-cover. Finally, a monetary value was applied to each ecosystem service to evaluate total economic added value of having forest area increase, using several methods such as market prices or exchange value. Expected results indicate that forestation scenario increases the provision of ecosystem services, in particular carbon sequestration and water purification, compared to actual land-cover. The outcomes of this project will be important to understand the critical role of forests on providing non marketed ecosystem services.

P 47. Learning from the Past: Failures and Successes in European Restoration Projects

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Restoration is the action of recover, repair or put something back in the state or estimate that it had before. Talking about restoration projects, immediately leads us to think about restorations directly or indirectly related to nature, in the form of ecological, forestry or hydrological restoration, for example. However, there are many other types of restoration such as those derived from human activities of those related to cultural heritage. The currently global climate change and the increasing disturbances intensities reinforce the importance of all types of restoration projects in the different ecosystems to be adapted to the new conditions. No matter the objective of the restoration, there is no database to look out on previous restoration projects when planning a new one. LIFE, Interreg and Horizon are the main European foundation for research projects. Based on the online questionnaire implemented by SUPERB project, we analyzed the information to contrast the failures and success indicators of the different compiled projects, belonging to these research programs, to establish possible connections to improve the process of create a restoration project independently of the type of restoration layed out.

P 48. Finding Resilient Strategies to Deal with Climate Change: FoRES Collaborative Approach

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Agriculture and forestry were, for a long time, the main economic activities of Portuguese rural areas. However, these sectors have suffered major changes during the last century, boosted by a continuous process of rural out-migration and land abandonment. Finding and implementing solutions to deal with climate change and increase fire resilience is urgently needed. This is the purpose of FoRES project, in the case study of the Integrated Area of Landscape Management da Baixa Lombada in northeastern Portugal. FoRES project targets forests as key areas to investigate resilience and adaptation strategies to climate change and its impacts. The FoRES project approach focuses on developing alternative scenarios for land use, considering climatic conditions and fire regimes, and discussing them with the stakeholders (e.g., forest owners, common lands, forest technicians from governmental and non-governmental organizations, etc.). This approach is based on the premise that forest owners and other actors engaged in forest management can reject policy and behavioral changes that do not reflect their values, interests, and motivations and will more easily adopt forest policies supporting their management activities. The conservation of habitats, soil protection, and carbon sequestration were used as the three core objectives in the design of forest management scenarios. These scenarios were presented to the stakeholders in a participatory workshop. The discussions held highlight the need to find an equilibrium between the objectives proposed and other socio-economic objectives, such as generate economic return, attract, and maintain inhabitants, promote traditional activities (e.g., hunt, fishery) and prevent wildfires and other risks.

P 49. Can Biochar-Engineered Soils Sustainably Improve Multiple Ecosystem Services in Portuguese Sown Biodiverse Pasture Soils?

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Desertification is a growing concern in Portuguese pastoral systems, as climate models predict decreasing annual precipitation & increased potential evapotranspiration and intensity events especially in the winter season. At the same time, unsustainable soil management leads to well-documented declines in abundance and diversity of flora and soil compaction, leading to a global loss of pollinator habitat. Through sustainable application of selected biochars to pasture soils, projects SOILCOMBAT & TRUESOIL aim to engineer the sponge and climate regulation functions, while POLLINATE & PASTURE+ aim to promote and restore the habitat use by pollinators and soil macroinvertebrates. To this aim, they integrate biochar research and production technologies, with soil science and hydrology, environmental engineering and chemistry, plant and insect ecology and ecotoxicology, greenhouse gas fluxes, life cycle thinking tools and stakeholder participatory studies, in a truly interdisciplinary approach. Their approaches are complementary and combine laboratory, lysimeter and field trials with meta-analysis and modelling. Combined, they fill current knowledge gaps and mechanistic understanding of biochar's potential to improve multiple ecosystem services in pastures with minimal trade-offs, thus contributing to sustainable food production, as well as improved climate adaptation and resilience of pastoral ecosystems, while combating desertification.