SER EUROPE

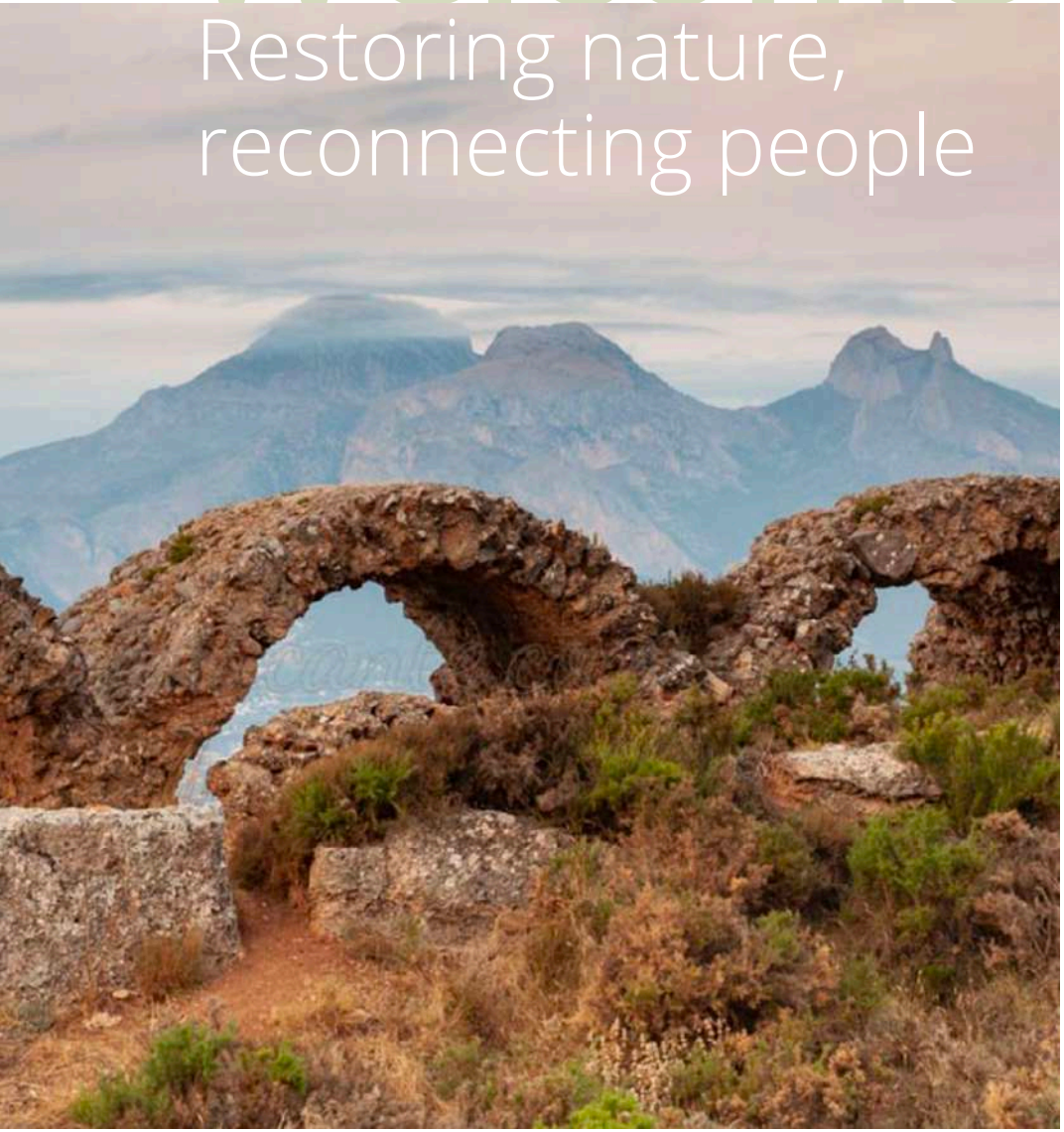
13th SERE CONFERENCE
5th – 9th SEP 2022
ALICANTE, SPAIN

Universitat d'Alacant
Universidad de Alicante

Restoring Nature, Reconecting People

Welcome

Restoring nature, reconnecting people



SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Universitat d'Alacant
Universidad de Alicante

Welcome to the 13th European Conference on Ecological Restoration! Welcome to SER Europe 2022!

The Society for Ecological Restoration (SER) is the professional Society of reference in the field of ecological restoration. It promotes the science, practice, and policy of ecological restoration to protect biodiversity, improve adaptation to climate change, mitigate its effects, and restore a healthy relationship between nature and society. For three decades, SER has given voice to this discipline and provided leadership in all aspects of its development. The European Chapter of the Society, acquaints hundreds of experts and organizational members in 37 countries, and has affiliated organizations in 6 of them.

These are crucial times for ecological restoration in Europe and globally. Ecological restoration is essential to combat climate change, protect biodiversity and reverse desertification, and thus contribute to human wellbeing. Under the UN Decade of Ecosystem Restoration (2021-2030) and the EU Biodiversity Strategy for 2030, we can reverse the global environmental crisis, and give Anthropocene a chance. Yet, to obtain all the benefits that ecological restoration can provide and ensure a fair distribution of wealth, we must promote its practice and strive to increase the quality of restoration programs. Bridges between science, practice and policy must be built, based on scientific excellence, to better understand socio-ecological systems and their management.

SERE2022 represents an excellent opportunity to foster efficient reciprocal exchanges between managers, decision and policymakers and the academia across Europe. It is also the place where experts from different restoration sectors (forests, wetlands, rivers, agroecosystems, marine areas, urban environments, extractive industries, etc.) have the unusual chance to sit together and learn from each other.

There are many reasons to meet in Alicante, including high levels of biodiversity, long history of interactions between humans and nature, nice examples of socio-ecological co-evolution, the combination of land and sea, and the long history of actions to combat degradation and desertification. Last, but not least, the strong commitment of the government of the Region of Valencia and the Spanish government with ecological transition and ecological restoration.

For one week, we will gather in Alicante to assess recent advances in the theory and practice of ecological restoration and discuss future priorities. We invite you to take full advantage of the many events that will be organized under the umbrella of SERE 2022 and contribute to build the European leadership in ecological restoration.

JORDI CORTINA-SEGARRA
Chair SER Europe
University of Alicante

2
- Organizing Comittee

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3
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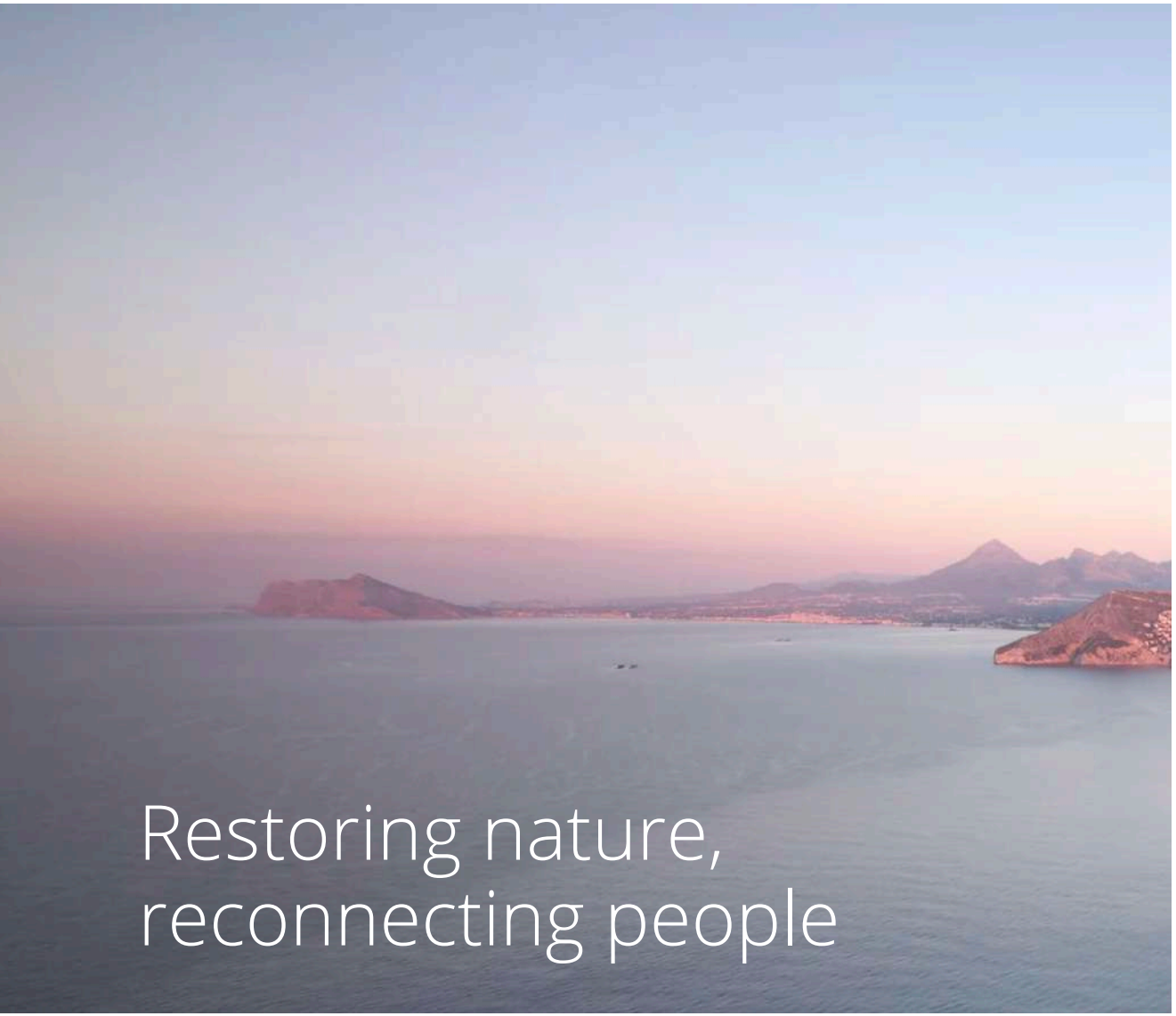
Portugal

Richard Scott
UK Urban Ecology Forum. Eden Project
United Kingdom

Kristin Svavarsdottir
Soil Conservation Service of Iceland (SCSI)
Island

4 - Scientific Programme detail

Monday, 5th September 2022
Programme



8.30-17.00 | Pre-Conference Courses

(Aulari II - General Lecture Hall II, University of Alicante)
Room: Seminar of Ecology (Sciences Faculty II, UA)

8.30-13.30 - 15.00-17.00 Introduction to Soil and Water Bioengineering for ecological restoration. *Sangalli P., Arizpe D. & Pirrera G.*

Room: A2/E22 (Aulari II - General Lecture Hall II)

8.30-11.30 - 13.30-16.30 Prioritizing restoration areas using Spatial Multicriteria Analysis. *Mchich Derak & Jordi Cortina-Segarra*

17.00-18.00 | Restoring nature, reconnecting people: the 13th European Conference on Ecological Restoration for beginners

(Room: Rafael Altamira - Seu Ciutat d'Alacant, Alicante city centre)

17.00 | Registration and delivery of documentation (Panoramis Terrace, Alicante city centre)

19.00-21.00 | Welcome party (Panoramis Terrace, Alicante city centre)

Welcome addresses by:
Dr. Jordi Cortina, Chair European Chapter, Society for Ecological Restoration and SERE 2022 Conference organizer.

Dr. James Hallett, Chair of the Board of Directors, Society for Ecological Restoration.

Dr. Cara Nelson, Leader Ecosystem Restoration Thematic Group, Commission on Ecosystem Management, IUCN.

Mr. Stefan Leiner, Head of Unit Natural Capital & Ecosystem Health (ENV.D.2) Directorate-General for Environment, European Commission.

Mr. Manuel Villar, Deputy Mayor and Councilor for the Environment, City Council of Alicante.
Dr. Amparo Navarro, President of the University of Alicante.

Cocktail

Exhibition of traditional Alicante music, folk dances, and costumes.

Tuesday, 6th September 2022
Programme

Main Hall Aulari II - General Lecture Hall II, University of Alicante

08.30 | Registration and delivery of documentation

Sala d'actes

Aulari II -Auditorium General Lecture Hall II, University of Alicante

9.15-10.00 | Opening ceremony

9.15 | Salutation. Juan Mora, Vicerrector de la Universidad de Alicante (Deputy President of the University of Alicante).

9.20 | Welcome address. Jordi Cortina-Segarra, Chair of SER Europe

9.30 | Introducting online speakers. Juan Mora, Vicerrector de la Universidad de Alicante (Deputy President of the University of Alicante).

9.35 | Welcome address. Mireia Mollà, Consellera d'Agricultura, Desenvolupament Rural, Emergència Climàtica i Transició Ecològica de la Generalitat Valenciana (Secretary of Agriculture, Rural Development, Climate Emergency and Ecological Transition of the Regional Government of Valencia)

9.40 | Welcome address. Hugo Morán, Ministerio para la Transición Ecológica y el Reto Demográfico del Gobierno de España (Secretary of State for the Environment, Ministry for the Ecological Transition and the Demographic Challenge, Government of Spain)

9.45 | Welcome address. Virginijus Sinkevičius (online) (Commissioner D.G. Environment, Oceans and Fisheries)

9.50 | Official inauguration. Juan Mora, Vicerrector de la Universidad de Alicante (Deputy President of the University of Alicante).

10.00-10.30 | Stefan Leiner (EC) *- Chair: Anne Tolvanen*

10.30-11.15 | Plenary 1. Towards a Decade of Social-Ecological Restoration. *Fischer, Joern - Chair: Anne Tolvanen*

11.15-11.45 | Coffee

11.45-14.00 | W4. Rewilding: challenges and opportunities. *Chair: José M. Rey Benayas*

11.45-12.00 | Rewilding agricultural landscapes.- *Rey Benayas, José M.*

12.00-12.15 | Exploring the potential for rewilding in Spain.- *Palau-Puigvert, Jordi*

12.15-12.30 | Scaling up rewilding. Nature as our ally in socio-economic challenges.- *Helmer, Wouter*

12.30-12.45 | Psychological and ecological potential of rewilding in different continents.- *Jiménez, Ignacio*

12.45-13.00 | Restoration of wild reindeer (Rangifer tarandus tarandus) ranges in Norway.- *Gundersen, Vegard*

13.00-13.15 | Evaluation of the habitat of Lynx rufus (Schreber, 1777) in two windfarms of Tamaulipas, Mexico.- *Sarmiento-Muñoz, Tania*

13.15-13.30 | Assessing the ecological suitability of the Irish landscape for the Eurasian lynx (Lynx lynx).- *Guilfoyle, Colin*

13.30-13.45 | Using a Restoration Diagnostic tool to assess barriers and opportunities to restoration: Experience of the Endangered Landscapes Programme .- *Thomas, David*

13.45-14.00 | Large-scale rewilding of European landscapes: concepts, monitoring and scenarios.- *Nestor Fernández*

13.45-15.00 | Lunch

15.00-15.45 | Plenary 2. The United Nations Decade on Ecosystem Restoration: an opportunity to upscale restoration and to share good practices in Europe by 2030.- *Besacier, Christophe - Chair: Kristín Svavarsdóttir*

15.45-17.45 | S5. Restoration Monitoring. *Chair: Susana Bautista*

15.45-16.00 | Evaluation of the restoration of formerly dyked marshes, using the recovery wheel 2.0..- *Gallet, Sébastien*

16.00-16.15 | Vegetation succession in abandoned fields: chronosequence data verified by permanent plots.- *Rehounkova, Klara*

16.15-16.30 | Social-ecological post hoc assessment of ecosystem restoration from a system archetype perspective.- *Pacheco-Romero, Manuel*

16.30-16.45 | Ecosystem composition, structure and function of afforested areas in Portuguese drylands.- *Köbel Batista, Melanie*

16.45-17.00 | Gathering knowledge on ecological restoration practices in European forest ecosystems.- *Rubio Cuadrado, Álvaro*

17.00-17.15 | Challenges in Monitoring Tree Survival and Development.- *Dwyer, Edward*

17.15-17.30 | Assessing the impact of post-fire restoration interventions using spectral vegetation indices: A case study in El Bruc, Spain.- *Dorado Guerrero, Bernat*

17.30-17.45 | How remote sensing choices influence monitoring and evaluation results of ecological restoration.- *WIllemen, Louise*

Tuesday, 6th September 2022
Programme

A2/SOTANO room,
Aulari II - General Lecture Hall II, University of Alicante

11.45-13.45 | W1. Enhancing capacities for effective ecosystem restoration throughout the UN Decade and beyond. *Facilitators: James G. Hallett (SER) & Cara R. Nelson (IUCN CEM & University of Montana)*

11.45-11.53 | Opening: Key gaps and capacity priorities for restoration to support the United Nations Decade on Ecosystem Restoration – *Besacier, Christophe (FAO)*

11.53-12:00 | Development of a Capacity, Knowledge and Learning Action Plan for the UN Decade –*Chazdon, Robin (Forestoration International)*

12.00-12:20 | Proposed flagship products that could be elaborated in the context of the UN Decade –C*hazdon, Robin (Forestoration International) and Andrea Romero (FAO)*

12:20-13.20 | Small group discussions on proposed flagship products

13.20-13.40 |Participants comments

13.40-13.45 | Closing remarks. *Besacier, Christophe (FAO)*

13.45-15.00 | Lunch

15.45-17.45 | W3. Developing Guidance for Effective Ecosystem Restoration. *Facilitators: Boze Hancock (TNC), Emanuela Weidlich (Leuphana University), George Gann (SER & Institute for Regional Conservation), Robin Chazdon (Forestoration International) & Victoria Gutierrez (Commonland)*

15.45-16.10 | Opening plenary

- **Welcome and goals of the session -** *Andrea Romero (FAO)*
- **Background and development of Standards of Practice for Ecosystem Restoration -** *James G. Hallett (SER)*
- **Introduction to participant exercise** - *Cara R. Nelson (IUCN CEM & University of Montana)*

16.10-17.20| Small group discussions

17.20-17.45 | Closing plenary

- **Participant comments**
- **Closing remarks,** *Christophe Besacier (FAO)*

A2/D02 room,
Aulari II - General Lecture Hall II, University of Alicante

11.45-13.45 | W8. Ecosystem health, ecological restoration, and human health: let's identify and strengthen the linkages. *Chair: Aronson, James*

Prof. Ása Aradóttir

Dr. Katalin Török

Dr. Melinda Halassy

Dr. Þórunn Wolfram Pétursdóttir

Dr. Eric Bourguignon

13.45-15.00 | Lunch

15.45-17.45 | W11. Mind Your Language! Restoration, Regeneration or Rewilding? What is the best way to communicate conservation strategies to the public? *Chair: Woodworth, Paddy*

Woodworth, Paddy

Aronson, James

Peláez, Sara

17.45-19.15 | Coffee + posters

Tuesday, 6th September 2022
Programme

A2/C4 room,
Aulari II - General Lecture Hall II, University of Alicante

11.45-13.00 | W6.1 Education and Training in Ecological Restoration: Restoring hope – opportunities for international and inter-generational knowledge exchange. *Chair: Rodríguez González, Patricia María*

11.45-11.50 | Introduction

11.50-12.10 | Wanted! Chief Ecosystem Orchestrators. - *Moolenaar, Simon Willem*

12.10-12.25 | WWF Spain experience on participation in ecological restoration. - *Melero de Blas, María*

12.25-12.40 | Facing-Fire: service learning for education and training in wildfires.- *Peña Molina, Esther*

12.40-13.00 | Knowledge transfer among sectors to improve good practices in European riparian restoration.- *Rodríguez González, Patricia María*

13.45-15.00 | Lunch

15.45-16.45 | W6.2 Education and Training in Ecological Restoration: Restoring hope – opportunities for international and inter-generational knowledge exchange. *Chair: Rodríguez González, Patricia María*

15.45-16.00 | Challenges and opportunities for international collaboration in ecological restoration learning from experiences in Puerto Rico. – Kaufman, Breanna

16.00-16.15 | YoungER's on the road for restoring ecosystems.- *Poalinelli Reis, Bruna*

16.15-16.30 | Experiences sharing: How YoungER's are contributing to education and training in ecological restoration.- *Poalinelli Reis, Bruna*

16.30-16.45 | YoungER Opportunity Board.- *Fraga Dornellas Cysneiros, Luísa*

16.45-17.15 | Disscussion- opportunities for international and inter-generational knowledge exchange.- Maria Nolan & YOUNG#ER

17.45-19.15 | Coffee + posters

A2/D03 room,
Aulari II - General Lecture Hall II, University of Alicante

11.45-12.15 | E4. MITECO. The Spanish National Restoration Plan within the framework of the National Strategy on Green Infrastructure. *Manuel Oñorbe*

12.15-12.45 **| E11. European Investment Bank initiatives on ecological restoration.** *Stephen Hart*

12.45-13.15 | E2. Living Building Challenge: A Visionary Path to Regenerative Buildings. Júlia Perez Torres

13.15-13.45 | E13. The International Network for Seed-based Restoration (INSR): A SER Section. Emma Ladouceur

13.45-15.00 | Lunch

15.45-16.15 | E9. Presentation of SERIAC, the new Iberoamerican and Caribbean chapter of the SER. *Pilar Andrés*

16.15-16.45 | E12. Struggling for climate neutrality in Europe: carbon sequestration as an opportunity for large scale restoration of agricultural soils. *Pilar Andrés*

Wednesday, 7th September 2022

Programme

Main Hall Aulari II - General Lecture Hall II, University of Alicante

08.30 | Registration and delivery of documentation

Sala d'actes - Aulari II - Auditorium

General Lecture Hall II, University of Alicante

8.30-9.15 | Plenary 3. The European Green Deal and Systemic approaches to Nature Restoration. *Bruyninckx, Hans*
Chair: Aveliina Helm

9.15-11.15 | S1.1 Restoration measures for landscape connectivity and implementation of Green Infrastructure. *Chairs: Jiménez Franco, María Victoria and Rodríguez-Caro, Roberto C.*

9.15-9.30 | Learning from secondary succession to assist in the restoration of semi-arid oldfields in SE Spain.- *Robledano Aymerich, Francisco*

9.30-9.45 | Amphibian road mortality in Spain: SAFE Project and other initiatives of AHE.- *Caballero Díaz, Carlos*

9.45-10.00 | Rehabilitation of bog woodlands and alluvial forests – best practice and lessons learned.- *Willecke, Inga*

10.00-10.15 | Managing stress-inducing factors for better restoration outcomes, the case of low-lying Mediterranean Iberian coast.- *Lascurain Golferichs, José*

10.15-10.30 | The Role of Green Roofs in Urban Ecological Restoration.- *Liberalesso, Tiago*

10.30-10.45 | Do lowland semi-improved grasslands have a natural restorative capacity to revert to semi-natural grassland vegetation?.- *O'Rourke-Griffin, Sally*

10.45-11.00 | Recovering landscapes and its functionality. The holistic LIFE RIBERMINE project (Guadalajara, Spain).- *Martín Moreno, Cristina*

11.00-11.15 | Early drought prevents annual species to persist on a Mediterranean extensive green roof.- *Vidaller, Christel*

11.15-11.45 | Coffee

11.45-13.15 | S1.2 Restoration measures for landscape connectivity and implementation of Green Infrastructure. *Chair: Jiménez Franco, María Victoria*

11.45-12.00 | Identification of plant indicators for high pollinator diversity when prioritizing roadside restoration.- *Skrindo, Astrid Brekke*

12.00-12.15 | LIFE PRIMED (LIFE17NAT/GR/000511): promoting interdisciplinarity and ecosystem-based approach when restoring declined Mediterranean forest.- *Cambria, Vito Emanuele*

12.15-12.30 | A proposal for classifying nature-based solutions.- *Mayor Farguell, Xavier*

12.30-12.45 | Assessing limiting factors for natural regeneration in Mediterranean hedgerows.- *García de León, David*

12.45-13.00 | Composition and diversity of arbuscular mycorrhizal fungal communities associated with planted Mediterranean hedgerows.- *García de León, David*

13.00-13.15 | Designing diverse and functional green areas: a toolkit for decision makers.- *Magro, Sandra*

13.15-14.30 | Lunch

14.30-15.15 | Plenary 4. Scaling up action for resilient wetland landscapes. *Madgwick, Jane - Chair: Kris Decleer*

15.15-16.45 | S15. Management and Policy in Restoration. *Chair: Sabine Tischew*

15.15-15.30 | Is it a Man's world? Gender bias in Ecosystem Restoration.- *Rohrer Rodriguez, Zoe*

15.30-15.45 | Identifying Training needs in Ecological Restoration at European scale.- *Corrià, Robin*

15.45-16.00 | Knowledge needs of restoration practitioners in southeastern Spain.- *Cortina-Segarra, Jordi*

16.00-16.15 | Management Prioritisation of Czech Natura 2000 Sites.- *Ivana, Jongepierova*

16.15-16.30 | Fifty Shades of Restoration in Italy: Analysis of Legal Tools and Drivers for Transformative Change.- *Ciscato, Eleonora*

16.30-16.45 | Is the proposed EU Nature Restoration Regulation 'fit for purpose'?.- *Decleer, Kris*

16.45-17.15 | Coffee

17.15-19.15 | S13. Dryland Restoration. *Chair: Fernando T. Maestre Gil*

17.15-17.30 | Land Degradation Neutrality, addressing land degradation beyond drylands and restoration.- *Martínez Valderrama, Jaime*

17.30-17.45 | Priority effects in dry grasslands: insights from a field experiment and implications for restoration.- *Alonso-Crespo, Inés María*

17.45-18.00 | Livestock grazing and ecosystem service delivery in global drylands.- *Maestre Gil, Fernando Tomás*

18.00-18.15 | Overgrazing reduces the ability of soil microbes to sustain dryland functioning: implications for ecosystem restoration.- *Neuenkamp, Lena*

18.15-18.30 | Maximizing runoff capture by vegetation by spatial modelling as a tool to enhance dryland restoration.- *Maggioli, Lisa*

18.30-18.45 | Establishing resource-conserving species-diverse patchy vegetation: a nature-based path forward to restore drylands.- *Bautista, Susana*

18.45-19.00 | Effect of seed biopriming with biocrust-forming cyanobacteria on radicle growth and germination of semiarid native plants.- *Alameda Martín, Aitor*

19.00-19.15 | Forest restoration in drylands is conditioned by climatic legacies.- *Guirado, Emilio*

Wednesday, 7th September 2022
Programme

A2/D01 room - Aulari II
General Lecture Hall II, University of Alicante

9.15-11.15 | S2.1 Forest regrowth after land abandonment in Europe: extent, threats, and opportunities. *Chairs: Espelta Morral, Josep Maria & Hampe, Arndt*

9.15-9.30 | What can ecosystem change over 30,000 years tell us about future ecological restoration options? Some hints from NE Portugal.- *Beja, Pedro (Invited keynote)*

9.30-9.45 | Outcomes and drivers of forest recovery.- *Cruz-Alonso, Verónica (Invited keynote)*

9.45-10.00 | Tree species diversity increase in Catalan forests is associated to forest history, connectivity, and management.- *Selwyn Alvarez, Miriam*

10.00-10.15 | Degree of ecological specialization in vegetation succession in Central European disturbed sites.- *Ballesteros, Miguel*

10.15-10.30 | The role of remnant trees differs among oak species in the colonization of pine plantations.- *Lorente Casalini, Olivia*

10.30-10.45 | Being in or out the climatic niche influences the performance of Pinus plantations in Spain.- *Perez Navarro, Maria Angeles*

10.45-11.00 | Recovering soil fungal communities in abandoned mined sites; how should we act?.- *Alday, Josu G*

11.00-11.15 | Plant-animal seed dispersal interactions as key drivers of ecological restoration in a changing world.- *Silveira Bueno, Rafael*

11.15-11.45 | Coffee

11.45-13.15 | S2.2 Forest regrowth after land abandonment in Europe: extent, threats, and opportunities. *Chair: Espelta Morral, Josep Maria & Hampe, Arndt*

11.45-12.00 | When nature concludes the forest transition – natural forest regrowth in the eyes of society.- *Winkel, Georg (Invited keynote)*

12.00-12.15 | Ten golden rules for reforestation – and when natural regeneration has a need for seed.- *Hardwick, Kate (Invited keynote)*

12.15-12.30 | Carbon offsetting through reforestation: how can society enable a great opportunity for sparsely populated areas.- *Martínez Sanz, Francisco Manuel*

12.30-12.45 | Mixed forest establishment in a degraded area in northern Spain – an experimental approach.- *Uzquiano, Sara*

12.45-13.00 | Long-term shrub encroachment of Mediterranean mountain grasslands in relation to climate and rewilding.- *Rincón Madroñero, Marina*

13.00-13.15 | Conclusions and perspectives

13.15-14.30 | Lunch

15.15-16.45 | S10. Restoring Agricultural Land and Other Heavily Transformed Landscapes. *Chair: Pilar Andrés Pastor*

15.15-15.30 | Restoration in the agricultural landscape as key to regenerative agriculture: summary of the EASAC report.- *Valkó, Orsolya*

15.30-15.45 | Assessing farm biodiversity in orchards to identify good management practices using a global online tool.- *Arellano, Eduardo*

15.45-16.00 | Using complementary diversity metrics to promote the resilience of agroforestry systems to climate change.- *Nunes, Alice*

16.00-16.15 | Soil c sequestration and p dynamics after restoration of arable croplands into grasslands in humid temperate areas.- *Merino, Agustin*

16.15-16.30 | Valle Salado Botanic Site: to restore the halophilic vegetation.- *Sangalli, Paola*

16:30-16.45 | Hydrological management of Castellet basin for taking control of avenues, forest fires, and improve biodiversity.- *Sorolla, Gina*

16.45-17.15 | Coffee

17.15-18.45 | S17. Forest Restoration. *Chair: Alejandro Valdecantos*

17.15-17.30 | Deciphering the performance of holm oak saplings to improve restoration success of Mediterranean forests.- *Juan-Ovejero, Raquel*

17.30-17.45 | Potential impacts of afforestation/deforestation scenarios on regional precipitation recycling in a Mediterranean area in SE Spain.- *Moutahir, Hassane*

17.45-18.00 | Plant functional diversity affects the macroinvertebrate community in a Hawaiian wet forest restoration.- *Sebastián González, Esther*

18.00-18.15 | Conservation and Restoration of Mediterranean Taxus baccata woods in southeastern Spain.- *Arizpe Ochoa, Daniel*

18.15-18.30 | Rehabilitation of cork oak forests through the involvement of the local population from Northwestern Tunisia.- *STITI, Boutheina*

18.30-18.45 | Five years\' experience of Natura2000 oak forest habitat restoration in Hungary.- *Aszalós, Réka*

Wednesday, 7th September 2022
Programme

A2/D02 room - Aulari II
General Lecture Hall II, University of Alicante

9.15-11.00 | S8. Mine Restoration. *Chair: Klara Rehounkova*

9.15-9.30 | "La Chanta" quarry: a study case of restoration and reconnecting people with nature.- *Gegúndez Cámara, Pilar*

9.30-9.45 |Using various artificial soil mixtures to restore dry grasslands in quarries.- *Buisson, Elise*

9.45-10.00 | Understanding biodiversity threats from mining construction minerals for conservation and restoration.- *Torres, Aurora*

10.00-10.15 | The effect of tree foliage traits on soil carbon storage depends on soil development.- *Frouz, Jan*

10.15-10.30 | Monitoring Quercus seedlings' survival and growth beneath nurse shrubs in coal mines reclaimed to grasslands.- *Martínez-Ruiz, Carolina*

10.30-10.45 | Comparison between active and passive restoration in extractive activities.- *Montero, Pau*

10.45-11.00 | Meso and macro-fauna ecosystem engineers as indicators of restoration success in a rehabilitated mine tailings chronosequence. *Pelaez Sanchez, Sara*

11.15-11.45 | Coffee

11.45-13.15 | W9. Soil and Water Bioengineering, a Nature based discipline between grey and green Infrastructures. *Chair: Sangalli, Paola*

11.45-12.00 | Soil and Water Bioengineering (SWB) is and has always been a Nature-Based Solution (NBS): a reasoned comparison of terms and definitions.- *Sangalli, Paola*

12.00-12.15 | Soil Substitutes for Sustainable Land Reclamation of Coal Mining-Affected Areas.- *Krzemien, Alicja*

12.15-12.30 | Solutions to the flooding of the Estepona river in the urban area of Bakio (Vizkaya) with Soil and Water Bioengineering.- *Sangalli, Sergio*

12.30-12.45 | Technosols for slope stabilization and ecosystem services maximization: pilot experiences and long-term results.- *Carabassa Closa, Vicenç*

12.45-13.00 | Functional biodiversity associated to soil bioengineering cribwalls.- *Mota, Bet*

13.00-13.15 | Using soil and germination models to predict seed germination in geomorphic restoration in mines.- *Tormo, Jaume*

13.15-14.30 | Lunch

15.15-16.45 | W2. Flagship program in the Mediterranean Region UN Decade on Ecosystem Restoration. *Chair: de Dato, Giovanbattista*

15.15-15.30 | Assessing the restoration activities in the Mediterranean for the Restoration Flagship Initiatives.- *de Dato, Giovanbattista*

15.30-15.45 | Forest and Landscape restoration in Lebanon A case study on post fire restoration.- *Mohanna, Chadi*

15.45-16.00 | Participatory forest restoration in the Talassemtane National Park, North Morocco.- Derak, Mchich

16.00-16.15 | *The co-management of forest landscapes: An innovative approach for climate change adaptation and mitigation measures.- Boufaroua, Mohamed*

16.15-16.30 | Restoration/Rehablitation activies in Turkiye and its Carbon Benefits.- Ozdemir, Eray

16.45-17.15 | Coffee

17.15-19.00 | S6. Restoration Planning. *Chair: Johannes Kollmann*

17.15-17.30 | Contrasting vegetation, soil, and climatic drivers determine plant contribution to soil carbon stocks globally.- *Dacal, Marina*

17.30-17.45 | Ecosystem multifunctionality in Mediterranean-type ecosystems – a matter of species composition and environmental conditions.- *Fiedler, Sebastian*

17.45-18.00 | Spatial restoration design: insights from theory.- Gawecka, Klementyna

18.00-18.15 | BirkiVist: Trans-disciplinary research to support scaling-up of woodland restoration.- *Aradottir, Asa Lovisa*

18.15-18.30 | Forest Restoration Productive Chain: Challenges And Opportunities In The Involvement Of Local Communities.- *Ferreira Abrahão, Leandro Luiz*

18.30-18.45 | Planning for landscape-scale restoration: which tools do we need?.- *Helm, Aveliina*

18.45-19.00 | Assessing restoration suitability and regeneration potential for reforestation success in Panamá Canal Area.- *Bardino, Giulia*

19.00-19.15 | The importance of investing in human resources to achieve large-scale forest restoration goals in south-eastern Brazil.- *Barbosa, Karina Cavalheiro*

Wednesday, 7th September 2022
Programme

A2/C04 room - Aulari II
General Lecture Hall II, University of Alicante

9.15-11.15 | S11. Response to Risks and Disturbances. *Chair: Víctor Santana*

9.15-9.30 | The role of invasive species control and assembly on restoration.- *Weidlich, Emanuela W. A.*

9.30-9.45 | Vegetation degradation promotes the invasion potential of Impatiens glandulifera in an oligotrophic mountain habitat.- *Nikolic, Nina*

9.45-10.00 | Return of a native Mediterranean ant community after Carpobrotus removal on a small island.- *Blaya, Romane*

10.00-10.15 | How do native species compete against the reproductive success of exotic pines after fires? A restoring approach.- *Ovalle, Juan*

10.15-10.30 | Post-fire management: restoration tools in semiarid aleppo pine forests (se spain).- *Moya, Daniel*

10.30-10.45 | Multifunctionality of Mediterranean landscapes is increased by the application of different post-fire management actions.- *Moghli, Aymen*

10.45-11.00 | Climate impacts on radial growth of Quercus suber growing in the Northwest of Tunisia.- *Stiti, Boutheina*

11.00-11.15 | Root properties relevant for erosion control, and vegetation morphometry using LIDAR in a field experiment.- *Virgil Alexandru, Iordache*

11.15-11.45 | Coffee

11.45-13.00 | S12.1 Grassland Restoration I. *Chair: Elise Buisson*

11.45-12.00 | The long-term effect of restoration practices and landscape composition on the success of sand grasslands restoration.- *Poalinelli Reis, Bruna*

12.00-12.15 | No mid-term detrimental effects of soil disturbance linked to grassland restoration on established ground-dwelling invertebrates.- *Slodowicz, Daniel*

12.15-12.30 | Restoration of dry and sandy habitats in Brandenburg, Germany by LIFE projects.- *Ruffer, Janine*

12.30-12.45 | Dry Grassland Restoration Activities in the Dinara back to LIFE project – experiences and challenge.- *Skunca, Luka*

12.45-13.00 | Application of regeneration potential trajectories to prioritize ecological restoration interventions in the Hungarian sand regions. - *Csákvári, Edina*

13.15-14.30 | Lunch

15.15-16.45 | S12.2 Grassland Restoration II. *Chair: Melinda Halassy*

15.15-15.30 | Costs and benefits of grassland reconstruction in an industrial area.- *Halassy, Melinda*

15.30-15.45 | Spontaneous grassland recovery in an open alkali landscape - restoration of a former military area.- *Deák, Balázs*

15.45-16.00 | Reintroduction of mowing on steep slopes increases species diversity of a grassland after abandonment.- *Yamada, Susumu*

16.00-16.15 | Recovery of plant-bumblebee interactions in restored semi-natural grasslands.- *Reitalu, Triin*

16.15-16.30 | Plant establishment during the restoration of species rich grasslands.- *Mudrák, Ondrej*

16.30-16.45 | Long-term assessment of restored species-rich grassland in Germany.- *Kirmer, Anita*

16.45-17.15 | Coffee

17.15-19.15 | W10. The LIFE programme: Practical examples of EU funding supporting Nature Restoration. *Chair: Ana Nava; Sylvia Barova*

LIFE success stories on ecological restoration - LIFE N2K revisited.- Broumova, Radka

LIFE success stories on ecological restoration - LIFE TECMINE.- Olmo, Beatriz

LIFE success stories on ecological restoration - LIFE to Alvars.- Helm, Aveliina

Wednesday, 7th September 2022
Programme

A2/C03 room - Aulari II
General Lecture Hall II, University of Alicante

9.15-10.15 | E1. Commonland. Landscape Restoration as a means of delivering the EU Green Deal: Recommendations. *Victoria Gutiérrez; Amanda del Rio; Yurena Lorenzo; Jordi Cortina.*

10.30-11.00 | E5. Land Life: examples and challenges in nature restoration through Voluntary Carbon Markets. *Francisco Purroy*

11.15-11.45 | Coffee

11.45-12.15 | E6. Ecoembes. "Los Sistemas Colectivos de Responsabilidad Ampliada del Productor (SCRAP) y las experiencias de restauración ecológica". *Esperanza Alvarez Garcia*

12.15-12.45 | E7. CEMBUREAU's vision for biodiversity in and around quarries over the coming decades. *Alexandra Silva*

13.15-14.30 | Lunch

Thursday, 8th September 2022
Programme

Mid conference field tours

09.00-18.30 | #1 Restoration of a highly transformed semiarid landscape. – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

09-00-17.00| #2. Promoting resilience through restoration actions in Mediterranean fire-prone areas. – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

08.30-17.15 | #4. Coastal restoration. – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

09.00-16.00 | #5. Restoration of Mediterranean rivers and flood management. – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

09.00-18.00 | #6. Wetland restoration for birds – Birdwatching – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

10.30-17.30 | #7. The restoration of coastal shores and marine habitats-Snorkeling. – Meeting point: Alicante port: Kontiki boats dock, Alicante

09.00-18.00 | #8. Restoration of metalliferous mining sites in the Cartagena-La Unión mining district. - Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

08.00-18.00 | #9. Quarry restoration. – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

08.00-18.30 | #10. The environmental crisis of the Mar Menor coastal lagoon: The great challenge of ecological restoration in the coming decades. – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

09.00-17.30 | #11. Experimental restoration of semiarid degraded lands. – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

09.00-17.30 | #12. Conservation and restoration of Mediterranean landscapes. – Meeting point: University of Alicante Campus, Sant Vicent del Raspeig

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20.30 - 24.30 | Gala dinner at Hotel Melià Alicante

Friday, 9th September
Programme

Main Hall Aulari II - General Lecture Hall II, University of Alicante

08.30 | Registration and delivery of documentation

Sala d'actes Aulari II -Auditorium
General Lecture Hall II, University of Alicante

8.30-9.15 | Plenary 5. Past, present and future directions in marine restoration. *Linares, Cristina- Chair: Cristina Gambi*

9.15-11.15 | S9. Large-scale rewilding across Europe – Can we overcome challenges to achieve a historic opportunity? *Chair: Aykroyd, Toby*

9.15-9.20 | Introduction to the session, *Toby Aykroyd Director Wild Europe Foundation*

9.20-9.40 |Underlying principles for a strategy – drawing solutions from past challenges. *Ladislav Miko, Lead Environmental Advisor to the 2022 EU Presidency and EU representative at COP15 in Montreal, former Head of Natural Environment at the European Commission, Wild Europe Trustee*

9.40-9.50 | Large scale natural process restoration – planning for the benefits & challenges - *Kris Decleer, Board Member, Society for Ecological Restoration, Senior Researcher INBO*

9.50-10.00 | A supporting framework for successful rewilding strategy (video) - *Erika Stanciu, Chair of World Council for Protected Areas (WCPA) Europe, former Secretary of State for Forests in Romanian government, Chair of Wild Europe*

10.00 – 10.10 | EU & wider European restoration strategy - insights from a global perspective - *Cara Nelson, Chair of the Ecosystem Thematic Group for IUCN CEM*

10.10 – 10.20 Funding the strategy, the need for extensive reforms- *Toby Aykroyd, Director of Wild Europe Foundation*

10-20-11.15 Open Session: building a successful restoration strategy, the session will hear opinions from the audience.- *Led by Ladislav Miko, with Toby Aykroyd moderating, Kris Decleer and Cara Nelson.*

11.15-11.45 | Coffee

11.45-12.00 | Introduction to the WWF-SER Standards for the Certification of Forest Ecosystem Restoration Projects *(Forest Programme Coordinator, WWF Spain)*

12.00-12.15 | Restoration of the fire degraded area of Las Peñuelas and practical considerations in the application of the WWF-SER Standards for the Certification of Forest Ecosystem Restoration Projects.- *Miguel Ángel Maneiro Márquez (Regional Governmental Representative, Junta de Andalucía)*

12.15-12.30 | Restoration plan of public forests affected by the forest fire in "Las Peñuelas", in 2017: western sector of the Doñana Natural Park, Coto Mazagón and Ordenados de Moguer.- *Juan Gorostidi (Technical project auditor, SER-E)*

12.30-12.45 | Evolution and Future of the WWF-SER Standards for the Certification of Forest Ecosystem Restoration Projects.- *George Gann (International Policy Lead, SER)*

12.45-13.00 | Professional Roundtable: 3-4 international subject matter experts in European forestry restoration projects and use of standards.

13.15-14.30 | Lunch

14.30-15.15 | Plenary 6. Closing plenary. Ecological Connectivity in the Spotlight of the Restoration Agenda. *Andrea Meza, Amy Fraenkel and Barron J. Orr - Chair: Susana Bautista*

15:15-16.00 | E10. UNCCD: Ecological connectivity: an essential component of ecosystem restoration. *Barron J. Orr, Vittoria Semplici*

16.00-17.30 | SERE Membership Meeting

17.30-18.00 | Coffee

18.00-18.45 | Closure

A2/D01 room - Aulari II
General Lecture Hall II, University of Alicante

9.15-11.30 | S4. Restoration in the Mediterranean Sea: are we ready for scaling up? *Chair: Bianchelli, Silvia*

9.15-9.30 | The challenge of marine ecosystems' restoration in a changing ocean.- *Gambi, Cristina*

9.30-9.45 | Setting restoration targets under climate changes: the case study of Mediterranean macroalgal forests.- *Fabbrizzi, Erika*

9.45-10.00 |Following the roadmap for Mediterranean Macroalgal forests restoration: a case study from the Adriatic Sea.- *Bianchelli, Silvia*

10.00-10.15 | AFRIMED and algal forest restoration in the Mediterranean: stakeholder beliefs on feasibility, acceptance and barriers.- *Papadopoulou, Konstantia*

10.15-10.30 | The LIFE SEPOSSO proposal for the planning, implementation, and monitoring of Posidonia oceanica transplantations.- *La Porta, Barbara*

10.30-10.45 | Exploring the timescales needed to recover the functioning of Mediterranean coralligenous assemblages through active restoration.- *Zentner Murlans, Yanis*

10.45-11.00 | Quantifying the ecosystem service benefits of Mediterranean Cystoseira macroalgal forests.- *Critchley, Megan*

11.00-11.15 | Towards the restoration of macroalgal forests in the mediterranean sea: major challenges and wins.- *Chiantore, Mariachiara*

11.15-11.30 | Posidonia oceanica transplantation: insights and lessons from Italy.- *Bacci, Tiziano*

11.15-11.45 | Coffee

11.45-13.15 | S14. Hydrological Restoration. *Chair: Patricia Rodríguez*

11.45-12.00 | Estimating the value of newly restored riparian and tidal marsh areas to recreational hunters.- *Matzek, Virginia*

12.00-12.15 | Global assessment of the biological condition of rivers via fish and macroinvertebrate assemblages.- F*eio, Maria João*

12.15-12.30 | River-human connections and affinity for nature of local populations to regulated rivers.- *Aguiar, Francisca C.*

12.30-12.45 | River regulation induces functional alterations in the aquatic communities.- *Feio, Maria João*

Friday, 9th September
Programme

A2/D02 room - Aulari II
General Lecture Hall II, University of Alicante

9.15-11.05 | W7. Addressing the climate emergency through citizen-driven forest restoration projects. *Chair: Moore, Chrystal; Sabate, Santiago*

9.15-9.25 | The 4 Returns Approach to Landscape Restoration: opportunities & challenges.- *Moolenaar, Simon Willem*

9.25-9.35 | Building environmental awareness and addressing climate change through forest restoration in a fire-prone landscape (North-eastern Spain).- *Duguy Pedra, Beatriz*

9.35-9.45 | Restor. A Science Based Platform to Enable and Accelerate the Restoration of Earth's Ecosystems.- *Max, Simeon*

9.45-9.55 | Species selection for sustainable tree planting under a rapidly changing climate.- *Allasia Grau, Samuel*

9.55-10.05 | How to support educators from different countries with teaching sustainability, and evaluate the programme's success.- *Gregori Montaner, Aroa*

10.05-10.15 | Empowering individuals and organisations to lead climate action through tree planting: Terra Leaders.- *Gregori Montaner, Aroa*

10.15-10.25 | Engage citizens to take positive climate action by developing tools for measuring their climate impact.- *Moore, Chrystal*

10.25-10.35 | Engaging citizens to gather useful data regarding tree plantings.- *de Santana, Tiago*

10.35-10.45 | Estimation of live carbon storage in a continental-scale plantation.- *Sauras-Yera, Teresa*

10.45-10.55 | SUPERB - Systemic solutions for upscaling of urgent ecosystem restoration for forest-related biodiversity and ecosystem services.- *Alberdi, Iciar*

10.55-11.05 | LIFE TECMINE Project. Innovative Techniques for Landscape Recovery after Clay Mining under Mediterranean Conditions.- *Morcillo, Luna*

11.15-11.45 | Coffee

11.45-13.00 | S16. Society and Restoration. *Chair: Alice Nunes*

11.45-12.00 | The potential socioeconomic impact of the forest restoration chain in a basin of high social vulnerability in South-eastern Brazil.- *Tieppo, Felipe Maraue Marques*

12.00-12.15 | Implications of social preferences in restoration planning based on cost-effectiveness.- *Silva, Elysa*

12.15-12.30 | What influences public attitudes toward river restorations?.- Junker-Koehler, Berit

12.30-12.45 | Theatre to promote public awareness for the rehabilitation of urban streams.- *Montenegro, Mário*

12.45-13.00 | Management towards multiple ecological and socio-economic functions in rainforest transformation systems: An agent-based modelling approach.- *Fiedler, Sebastian*

A2/C04 room - Aulari II
General Lecture Hall II, University of Alicante

9.15-11.15 | S7. Restoration in Wetlands. *Chair: Sébastien Gallet*

9.15-9.30 | Wetlands, a key ecosystem to tackle climate change.- *Aguirre, Ernesto*

9.30-9.45 | Restoration of formerly extracted raised bogs – vegetation succession and recovery of other trophic groups.- *Prach, Karel*

9.45-10.00 | Peatlands under pressure? Hidden side-effects of aeolian dust dispersal in Iceland.- *Möckel, Susanne Claudia*

10.00-10.15 | Restoring mediterranean wetlands in corsica: methodology, field results and challenges.- *Emmanouilidou, Pantelina*

10.15-10.30 | Restoring mediterranean wetlands part II: methodology, field results and future challenges.- *Emmanouilidou, Pantelina*

10.30-10.45 | A network for wetland restoration in Brittany (France).- *Armel, Dausse*

10.45-11.00 | Characteristics of vegetation of formerly dyked marshes. Analysis of composition and spatial organization in comparison to reference sites.- *Salgueiro-Simon, Manuel*

11.15-11.45 | Coffee

11.45-13.15 | S3. Ecological integration and restoration of solar parks. *Chair: Armin, Bischoff*

11.45-12.00 | A decision support tool to improve solar park management for ecosystem services.- *Armstrong, Alona*

12.00-12.15 | Photovoltaic power station : an opportunity to restore semi-naturel European grassland.- *Quentin, Lambert*

12.15-12.30 | Ecosystem responses to solar park development in the UK.- *Carvalho Gomes da Silva, Fabio*

12.30-12.45 | Solar park construction - evaluation of ecological impact, compensation and restoration strategies.- *Armin, Bischoff*

12.45-13.00 | Study of ecosystem services generated in an experimental design combining green roofs and photovoltaic panels.- *Belin, Marie*

13.00-13.15 | Assessing the impact of solar parks on vegetation, microclimate and soil properties.- *Obriejetan, Michael*

Friday, 9th September
Programme

A2/C03 room - Aulari II
General Lecture Hall II, University of Alicante

9.15.10.15 | E3. Sylvestris: Carbon offsetting through reforestation. How can society enable a great opportunity for sparsely populated areas. *Francisco Manuel Martínez Sanz*

10.30-11.00 | E8. SER: International Principles and Standards for the Ecological Restoration and Recovery of Mine Sites. *George Gann*

Pre-conference Courses

Coordinator(s):
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Introduction to Soil and Water Bioengineering for ecological restoration

Soil and Water Bioengineering (SWB): is a discipline that combines technology with Oil and Water Bioengineering (SWB): is a discipline that combines technology with biology, making use of native plants and plant communities as construction material and erosion control in degraded environments. It pursues technological, ecological, economic and landscape regeneration goals.The fields of application are very large, including the restoration of the naturalenvironment of extractive activities (mining, quarrying ...), infrastructure (motorways, railways...) riverbeds, dunes and coastal areas, urban areas…Although these techniques have a potential combined with other techniques of ecological restoration there is still a deficit in knowledge and training of technicians and professionals, both in projects and in the implementation. The proposal that we present is to organize a practical course in soil bioengineering coinciding with the celebration of the 13th SER Europe Conference of EcologicalRestoration.

The aim of this course is to introduce the audience in the techniques of soil Bioengineering with a duration of 8 hours divided in two parts: The first part is devoted to theory while in second part will be held a practical workshop in which the participants will construct 1:20 scale models of the following techniques: living wattle fence, living brush mattress, fascine, vegetated log crib wall and living grid.

The practical section will be used as teaching aids: video, pptThe practical workshop will need a list of material, that will be provided by the AEIP(Spanish association)

This proposal has been prepared by the Spanish Association of Landscape Engineering(AEIP), the Italian Association of Naturalistic Engineering (AIPIN) and has the support ofthe European Federation of Soil Bioengineering.

Coordinator(s):
DERAK Mchich, Regional Forest Directory, Tétouan, Morocco
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Prioritizing restoration areas using Spatial Multicriteria Analysis

Course on practical application of Spatial Multicriteria Analysis in natural resource management, with a special emphasis on the identification of critical areas for restoration.

Ecological restoration is a suitable tool to revert land degradation and enhance human well-being. A major challenge in systematic restoration planning is the identification of critical areas where restoration should be prioritized to optimize the use of time and resources. The identification of critical areas is a complex decision-making problem that requires the integration of multiple criteria from different disciplines. Spatial multicriteria analysis (SMCA) allows dealing with such complexity, given its ability to combine different types of spatial data, and incorporate the opinion of different social groups in the decision-making process.

Practical application of SMCA requires a special attention to a number of issues: construction of the decision matrix, use of weighting methods appropriate for a wide range of social groups, computation of global maps, aggregation and interpretation of collective preferences, among others. The Integrated Land and Water Information System (ILWIS), a PC-based GIS and remote sensing software, has been widely used to implement SMCA in an easy and comprehensive way. Handling this software allows practitioners to deal with SMCA problems in an efficient way.

During the course, participants will be given an overview on restoration prioritizing tools as well as on SMCA applied to natural resource management. Participants will perform SMCA exercises using ILWIS. Furthermore, participants will be given practical advices to interpret SMCA outputs and the way to validate them taking into consideration social needs and interests.

At the end of the course, participants will have acquired practical abilities:

- To use suitable SMCA methods to prioritize restoration interventions.
- To avoid typical errors when performing successive SMCA steps.
- To compute and compare global priority maps for individuals and different societal groups.
- To collectively interpret and validate SMCA outputs.

Coordinator(s):
Martínez Valderrama, Jaime (Instituto Multidisciplinar para el Estudio del Medio (IMEM), University of Alicante)

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Restoring nature, reconnecting people: the 13th European Conference on Ecological Restoration for beginners

Desertification, water and aridity: understanding their relationships to ensure the sustainability of drylands

This course will clarify conceptual misconceptions and topics linked to desertification, one of the most important global problems, and will present initiatives to address it.

Draft program: Ten-hour course (8 lectures, one workshop, one round table) spread over three mornings. The importance of drylands, desertification and various initiatives to tackle it will be discussed. Artificial intelligence, LDN, the Spanish national action programme and xxx will be discussed. Special attention will be given to the issue of water. There will be academic speakers (three professors, one scientist from the Spanish National Research Council (CSIC), two postdoctoral researchers) and representatives of the central administration (Secretary General for the Environment, Ministry for Ecological Transition), an environmental foundation and an NGO.

The course is conceived as an opportunity to transfer knowledge from science and public institutions to the general public and is therefore of an informative nature. Some technical aspects will be covered, but the aim is that anyone can understand the content of the course.

Some of the conferences are focused on ecological restoration and how to involve local populations. In general, the aim is to present desertification from the point of view of the solutions that are being provided.

The course is part of the Summer courses of the University of Alicante.

5 - Presentations & Workshops

Towards a decade of social-ecological restoration

The United Nations declared 2021 to 2030 the Decade on Ecosystem Restoration. In my keynote presentation, I argue that ecosystem restoration will be most effective if it is routinely approached as "social-ecological restoration" – because especially in landscapes requiring restoration, social systems and ecosystems are intimately connected. Reviewing recent social-ecological systems research, I summarize six key themes that could help to improve restoration. These themes relate to resilience and adaptability, ecosystem stewardship and navigating change, relational values, the co-evolution of human and ecological systems, social-ecological telecoupling, and finding leverage points for transformative change. I recommend two cross-cutting new research foci, namely (1) post-hoc cross-sectional assessments of social-ecological restoration projects; and (2) transdisciplinary, social-ecological "living labs" that accompany new restoration projects as they unfold. With global sustainability initiatives increasingly taking a social-ecological perspective, recasting restoration as a social-ecological endeavour offers exciting new opportunities for both research and practice.

Acknowledgements: I appreciate the input of all co-authors of the paper this talk is based on[1].

References

1) Joern Fischer, Maraja Riechers, Jacqueline Loos, Berta Martin-Lopez, Vicky Temperton, Trends Ecol. Evol. **2021,** *36*, 20-28.

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W4

Tuesday, 6th September 2022 (Sala d'actes Aulari II -Auditorium General Lecture Hall II, University of Alicante)

Coordinator(s):
Rey Benayas,
José M. (University of Alcalá)

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Rewilding: challenges and opportunities

Rewilding is a form of ecological restoration that is gaining momentum in Europe. Challenges and opportunities about rewilding will be presented by invited speakers that belong to both academic institutions and practitioner organizations. On top of an exchange of experiences, we expect an exciting discussion with the audience about usefulness and effectiveness of rewilding and how to scale it up. The recently created Rewilding Spain Foundation will be presented to the public.

The expected outcomes are (1) an overview of challenges and opportunities around rewilding in Europe, particularly its usefulness and effectiveness and how to scale it up; (2) an exchange of experiences among scientists and practitioners; (3) a public presentation of the recently created Rewilding Spain Foundation; and (4) possibly a special issue to be published in a scientific restoration and/or conservation oriented journal.

Rewilding is clearly connected to the main Conference theme as it is a form of nature restoration which connects people to nature and offers nature-based solutions and economic opportunities.
Session supported by Fundación Internacional para la Restauración de Ecosistemas, Fundación Española de Renaturalización and Rewilding Europe

Rewilding agricultural landscapes

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ABSTRACT

Three major processes that rewilding aims to restore are species dispersal (connectivity), trophic complexity, and stochastic disturbances, which lead to enhanced environmental heterogeneity in space and time. Agricultural landscapes, which harbour many characteristic wildlife species, can be rewilded through land separation or land sharing; these two strategies are complementary rather than opposing. Application of good agricultural practices is the most extensive and straightforward way to substantially increase biodiversity in agricultural landscapes, whereas recovery of extensive husbandry contributes to restore the three major processes simultaneously. The landscapes should retain or restore at least 20% of unutilized or very low utilized natural vegetation, which can be mostly aggregated in core areas; these core areas can be connected by networks of hedgerows and tree islands. Other small species-rich landscape elements such as restored or created ponds function also as steppingstones and contribute to species dispersal. Restoring trophic complexity must document the lost or decimated species and implement strategic actions that trigger their recolonization and abundance, including feasible (i.e., low intensity wildlife-human conflicts) translocations of relevant guilds such as herbivores, predators, and scavengers. Stochastic disturbances such as flooding and fire are usually the most difficult processes to restore due to lack of social acceptance. Restoring the highly degraded riparian systems in dry environments such as the Mediterranean is a priority. I illustrate actions and outcomes of rewilding in central Spain at the landscape (the *Campo de Montiel más Natural* Initiative) and farmland state (the *Nava del Conejo* Field Lab of Agroecological and Forest Restoration) levels. For instance, the Strategic Plan 2021-2026 of this last project includes 17 actions and 90 expected results associated with measurable indicators that are being monitored. Both the Initiative and the Field Lab are implementing actions related to agrotourism, local economy and commercialization, and education and capacity building.

Keywords: dispersal, land sharing, land sparing, stochastic disturbances, trophic complexity.

Fig. 1. A drone view of the *Nava del Conejo* Field Lab of Agroecological and Forest Restoration (Valdepeñas, central Spain). The management scheme follows the principles of organic and conservation agriculture and includes five crops and two fallow types that are rapidly enhancing biodiversity and its contributions to people.

Exploring the potential for rewilding in Spain

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ABSTRACT

Rewilding is a relatively new nature conservation strategy, especially in Europe, where there are very few experiences put into full practice. This approach is based on the ecological restoration of natural processes as the main drivers of ecosystem dynamics. When developing this concept in Spain, it would be important to analyse why it is interesting and where it is possible. In this communication we provide six main arguments that make rewilding an interesting option in the Spanish context. We also analyse the factors that make an area more or less suitable for rewilding, grouping them into four main categories. With all those factors we propose an index to assess the suitability of an area for rewilding, defining which typology of areas is more suitable for those projects and providing some examples. Finally, we discuss some practical measures that could be applied to enhance the rewilding potential of the Spanish national parks (IUCN category II areas), and we draw some key ideas for a Spanish strategy of rewilding. In all those considerations, the point of view of a protected area manager, working for a regional government and living in a depopulated rural area, is providing a more pragmatic approach. This communication summarizes and updates some of the main ideas provided in the book “Rewilding Iberia. Explorando el potencial de la renaturalización en España” (Lynx Edicions, 2020), which is the first one that covers this topic in the Spanish context.

Keywords: Rewilding, Spain, shifting baseline syndrome, suitability index

Scaling up rewilding. Nature as our ally in socio-economic challenges

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ABSTRACT

Starting 35 years ago with some first pioneering projects in the Netherlands, rewilding has developed over the past decades into a new dimension within the European nature movement. In addition to protecting nature, the realization dawned that nature can also be an important ally in the design of our modern society.

Flood risk can be reduced with new wetlands along rivers. Drinking water sources can be secured in nature. The risk of forest fires can be reduced through natural grazing. New nature reserves can play a key role in carbon sequestration, etc. And all these new natural areas at the same time are an attractive target for visitors, increase the values of real estate in the area and thus contribute in various ways to the economy of rural regions.

Using a series of projects from different parts of Europe, the presentation makes clear how important it is to give ecological processes a central role again in the design of our landscapes. Not only for reasons of cost-effectiveness, but also because of the resulting biodiversity. After all, biodiversity does not originate in human management, but in the million-year-old interplay of river dynamics, natural grazing, the circle of life and other important natural processes.

Showing a steep learning curve, always confronting vision and practice, the presentation provides an overview of the success and failure factors of rewilding so far. Once starting on some dozens of hectares, now implemented on a landscape scale throughout Europe, with millions of hectares in prospect.

Keywords: rewilding, nature based solutions, ecological processes, climate adaptation, rural development

Fig. 1 The Maas on the border of the Netherlands and Belgium. From a narrow channel turned into a braiding gravel river. Gravel extraction, water safety, nature and recreation go hand in hand here (photo Avisum)

Fig.2 A grazing fire brigade at work in Spain (photo Rewilding Europe)

Psychological and ecological potential of rewilding in different continents.

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ABSTRACT

I present the concept of ecological and psychological potential for rewilding in different regions. Ecological rewilding potential relates to the physical availability of habitats to engage in effective rewilding activities. Psychological rewilding potential refers to the disposition of relevant stakeholders (e.g. authorities, local communities, public opinion, businesses, and conservationists) to support or undermine these activities. Ecological and psychological potential were measured qualitatively through onsite observations, interviews with stakeholders, scientists and conservationists, and literature review. I use examples from different continents to show how both potentials can vary depending on the context, and how they can determine the success of rewilding programs. I also argue that psychological potential tends to be more flexible than ecological potential. This framework provides guidance to rewilding practitioners to be aware of how both potentials can affect their work and also on how to manage their projects to increase psychological potential through their activities.

Keywords: rewilding, ecology, social issues, conflict

Restoration of wild reindeer (Rangifer tarandus tarandus) ranges in Norway

Author(s): Vegard Gundersen

ABSTRACT

Norway is a mountain country, and more than half of the land area is alpine. The mountains of Southern-Norway host the last population of wild mountain reindeer in Euroasia. The herds are very shy and lived in remote areas with minor human activity all year around. The human use of these areas has changed from herding, hunting and fishing subsistence activities, to intensive recreational activity and tourism. In the last century, and in particular the last decades, there has been an explosive development of soft and heavy infrastructure for outdoor recreation and tourism in the ranges. At the same time, humans have become more urbanized and use infrastructure as roads, marked trails and tourist cabins to a larger extend than before. All these processes have resulted in a tremendously increased disturbance pressure to the herds, and it is today urgent to implement mitigation measures to provide more space to the reindeer. Here, we present the main principles for habitat restoration for the herds, which primarily involves pushing people out of the area by removing infrastructure and facilitation in the core areas and at same time pulling people to new tourism attractions in the fringe of the ranges. The effects of removing tourist cabins and marked trails in core areas will be presented with examples from the Rondane wild reindeer range. Our analyses are based on data from GPS collared wild reindeer individual (n=41) that are representing similar number of large herds, and human data from automatic counters (n=46), crowdsourced Strava app and also qualitative interviews of local users, in the period 2009-2021. The conclusion is that the removal of infrastructure to restore wild reindeer habitats has positive effects by reducing human traffic in the most cases. However, some prerequisites must be taken to be successful.

Image: Norwegian Institute for Nature Research

Evaluation of the habitat of *Lynx rufus* (Schreber, 1777) in two windfarms of Tamaulipas, Mexico

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ABSTRACT

Wind farms represent an alternative in the energy sector to reduce the effects of climate change, however, due to their large size, they often occupy farmland, livestock, local communities, and natural ecosystems. These are often a composition of patches, fragments, and corridors of vegetation, which can provide habitat for wildlife with sufficient connectivity to support predator populations. *Lynx rufus* is a wild cat that controls lagomorph and rodent populations, widely distributed in North America, and commonly found in arid scrub and temperate forest. From March 2021 to March 2022, we monitored the population and habitat of *L. rufus* in two wind farms of Reynosa, Tamaulipas, Mexico. 30 permanent photo-trapping stations were installed in an area of 14,031.97 hectares, which were maintained and reviewed monthly. While in October 2022, the evaluation of the floristic composition of the monitoring stations was carried out. With the photographic material, the individuals of L. rufus were identified, based on the distinctive pattern of bands or spots of each animal, as well as the distinguishable characters in the fur of the body and tail. Population density was estimated with the CAPTURE program using the capture and recapture model. Finally, to estimate the probability of the presence of the species by climatic season, the records of the presence of animals and the vegetation and landscape variables were related to the maximum entropy modeling. A population of 16 individuals with a potential distribution of 8.76 km^2 per individual was projected. A higher population density was observed in the park with larger areas and greater vegetation cover. The seasons with the highest mobility of individuals were autumn and winter. It is concluded that the corridors of native vegetation in wind farms are of great importance for the conservation of the habitat of *L. rufus*.

Keywords: windfarms, wildcat habitat, fragmentation, connectivity, monitoring

Fig. 1. Photo capture of an individual of *Lynx rufus* in a vegetation corridor of the windfarms.

Assessing the ecological suitability of the Irish landscape for the Eurasian lynx (*Lynx lynx*)

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ABSTRACT

Restoration of natural processes via the reintroduction of locally extinct species is a key component of the rewilding process. In Ireland, the Eurasian lynx (Lynx lynx), an indigenous medium-sized felid, was likely driven to extinction on the island by a combination of woodland habitat loss and human persecution. With increased afforestation in Ireland occurring during the 20th century, and a subsequent rise in the populations of both native and exotic deer species, the potential for the Irish landscape to ecologically support a viable lynx population was examined. Four main approaches were undertaken: (1) identifying the extent of available habitat using GIS software; (2) assessing the connectivity between habitat patches using a least-cost path analysis; (3) quantifying the number of lynx which could be supported by the available habitat and prey; and (4) investigating the long-term viability of a reintroduced lynx population under differing scenarios, using RangeShifter individual-based modelling software. Overall, a total of 4,488 km2 of suitable habitat was identified, spread between 4 habitat networks and 3 isolated patches. Estimated deer densities found that a total population of 84 lynx could be supported by this cumulative network of habitat nationally. Varying the size of the founder population, the location of release, or the number of release sites used, had little effect on the overall outcome of a modelled lynx reintroduction, with there being a 100% extinction probability within 100 years, for all modelled scenarios. For Ireland to be capable of sustaining a viable population of lynx, there must be enhancement of both habitat availability and connectivity, through coherent landscape-scale, prioritized and targeted woodland restoration. The results also highlight the importance of an evidence-based approach in species reintroduction planning, allowing for the likelihood of success to be rapidly quantified, and for potential complications to be foreseen.

Keywords: Species reintroduction, rewilding, population viability, habitat connectivity, individual-based model

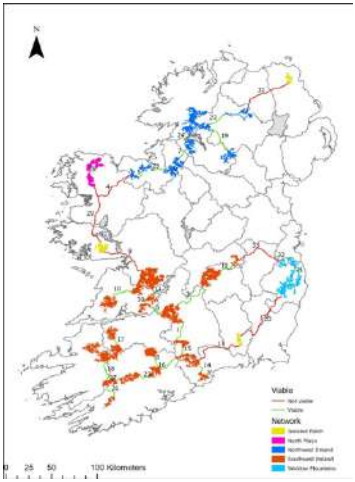

Fig. 1 Habitat networks and least cost pathways identified during the connectivity analysis.

Using a Restoration Diagnostic tool to assess barriers and opportunities to restoration: Experience of the Endangered Landscapes Programme

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ABSTRACT

Global environmental conventions include ambitious targets on restoring degraded ecosystems. These are taken up in the EU's proposed new Nature Restoration Law (NRL). To achieve these targets requires going beyond restoration of individual sites, to undertake restoration at landscape scale.

The relative importance of enabling factors for restoration at landscape scale is likely to differ from factors importance for sites. They relate for example to economy, policy, legislation, political will, culture, institutional coordination and land tenure.

The Endangered Landscapes Programme (ELP) provides grants to projects (in Europe) that share its vision of restoring healthy ecosystems with flourishing populations of plants and animals, where there is space for the natural functioning of ecological processes, and that support and respect the cultural, social and economic values of nature.

As part of a co-development stage, ELP grantees complete a 'Restoration Diagnostic' that supports a systematic analysis (and monitoring) of the presence or absence of key enabling factors. The tool provides a checklist that helps implementing organisations to understand the challenges and opportunities for restoration in their landscape, and design strategies to address them.

Results from the ELP's current eight landscapes show that enabling factors commonly present include: the potential to generate economic, social and environmental benefits from restoration, the availability of native seeds, seedlings, or source populations, legal restrictions on altering remaining natural habitat, and the existence of restoration "know how". On the other hand, enabling factors that are often weak or absent include: the existence of laws requiring restoration, the absence of plants and animals that can impede restoration, the reduction of competing demands (e.g., food, fuel) from the degraded landscape, and having policies which affect restoration that are aligned and streamlined. The ELP's experience shows where policy might need to focus if the ambitions of the NRL are to be delivered.

Keywords: Landscape, Restoration, Diagnostic, Enabling, Barriers

Large-scale rewilding of European landscapes: concepts, monitoring and scenarios

Authors: Néstor Fernández[1,2], Henrique M. Pereira, Laura C. Quintero-Uribe, & Josiane Segar.

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ABSTRACT

Concepts of rewilding are increasingly promoted as large-scale restoration solutions while, at the same time, debates are growing around the societal and ecological convenience and implications of such approaches. Much of the debate has been shaped by: contrasting perspectives around what specific actions should contribute to rewilding; the use of reference ecological conditions for defining rewilding targets; and the interference with traditional and cultural uses of the landscape. In this talk, I will discuss how rewilding concepts that pursue the recovery of ecosystem complexity and resilience can be translated into specific implementation and monitoring actions at different spatial scales. Using European-scale and local-scale case studies I will describe progress and challenges in quantifying baseline conditions and outputs of rewilding. At local rewilding sites, restoration progress has often been constrained by regulations and policies that enable competing practices such as the removal of carrion and deadwood, while incentivizing agriculture to the detriment of ongoing passive restoration. I argue that rewilding priorities and projects need to be re-framed according to their potential contribution to meeting the EU-level biodiversity and restoration targets, to which large-scale rewilding has much to offer. For this, I will illustrate the development of a “wildness” indicator aimed at supporting ecological status and rewilding progress assessments. Furthermore, the development of quantitative scenarios for the future of nature that include rewilding indicators emerges as an important research priority.

The United Nations decade on Ecosystem Restoration: an opportunity to upscale restoration and to share good practices in europe by 2030

Chair: Kristín Svavarsdóttir

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ABSTRACT

Unsustainable land use and destruction of natural ecosystems have contributed to global land degradation, climate change and biodiversity loss. To prevent, halt and reverse the degradation of ecosystems worldwide, the United Nations General Assembly proclaimed 2021–2030 as the Decade on Ecosystem Restoration. All ecosystems, terrestrial and aquatic, have the potential to be restored.

For the Decade, ecosystem restoration encompasses a wide continuum of activities that contribute to protecting intact ecosystems, avoid further degradation and repairing degraded ones. It means that restoration can happen in many ways and that it is not always possible – or desirable – to return an ecosystem to its original state. In that case, the goal is to optimize ecosystem functions and services, and to improve management practices and governance.

To support the implementation of the UN Decade and help achieve its goals, there is a need for a shared vision of ecosystem restoration, defined as "the process of halting and reversing degradation, resulting in improved ecosystem services and recovered biodiversity. Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choice" (UNEP, 2021, p. 7).

A key step in creating a shared vision of ecosystem restoration is to adopt principles that underpin the full set of ecosystem restoration activities in support of the UN Decade Strategy. Although principles for specific types of restorative activities – such as ecological restoration and forest and landscape restoration already have been published, there is a need for principles to underpin all of the restorative activities that are part of the continuum of ecosystem restoration defined by the UN Decade, and which are applicable across all sectors, biomes, and regions.

The keynote speaker will highlight briefly all recent key achievements of the United Nations Decade on Ecosystem Restoration: Strategy, Action Plan, Flagships, Multi-Donor-Trust-Fund, Framework for Ecosystem Restoration Monitoring, Principles and Standards of Practices, Capacity Need Assessment and future Knowledge and Learning Action Plan and the Framework for collection / dissemination of Good Practices to be launched officially in September 2022.

Restoration Monitoring

Chair: Susana Bautista

Evaluation of the restoration of formerly dyked marshes, using the recovery wheel 2.0.

Authors : Gallet, S.[1];, Dauvergne, X.[1];, Pétillon, J.[2];, Carpentier, A.[3];, Gallet, L., Salgueiro-Simon M.[1];

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ABSTRACT

In restoration ecology, evaluation is essential both at site and global scales. Indeed, evaluation is needed by site managers in order to adapt their practice or further project, and to share their feedback. When this evaluation is based on scientific surveys It can also allow to develop the knowledge on restoration processes and, thus, improve practices.

Unfortunately formal assesment is rarely implemented. Many factors can explain this fact : lack of time, lack of money, lack of competence, lack of definition of restoration aims and maybe the most important, the apparent complexity of this evaluation process. However, the framework of this evaluation is clearly proposed by SER in its “standards” and the “Five stars evaluation / recovery wheel” tools appear to be a very useful tool for global evaluation of restoration. One difficulty is that indicators that have to be integrated in this process appear sometimes complex and hardly applicable.

Research programs on ecological restoration are opportunities to test and adapt restoration evaluation and pertinent indicators. Thus, in the framework of the PEPPS research program on restoration of salt marshes, different ecological indicators were used to analyze the restoration success : vegetation, fauna (arthropods), functionalities , topography,... Available data were quite heterogeneous both in nature and representation, and a collective reflection has been conducted on the way to include them in a five-star evaluation process. Then, a 2.0 version of the recovery wheel has been developed and proposed to potential users, in order to simplify its use and its adaptation to different contexts.

Keywords: Evaluation Recovery wheel, indicators, salt-marshes

Vegetation succession in abandoned fields: chronosequence data verified by permanent plots

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ABSTRACT

We asked if there is a correspondence between the general successional pattern in abandoned fields based on similar sites of different age examined at one- point in time (chronosequence) and that derived from a limited number of permanent plots. Dry and mesic successional subseres of abandoned fields were identified between 1975 and 2019 in Bohemian Karst, Czech Republic, Europe. In total, we collected 129 phytosociological relevés for the chronosequence approach and 26 relevés in six permanent plots using the percentage cover scale. The age (years since abandonment) varied from 1 to 99 years for permanent plots and up to 91 years for chronosequences.

The successional patterns on abandoned fields were consistent between the chronosequence and permanent plots. On dry and mesic sites, succession followed similar pathways from open annual to perennial vegetation at the beginning. On mesic sites, the succession led to woodland stands in about 20–30 years, while the succession on dry sites slowed down and persisted for several decades in a stage dominated by perennial graminoids with scattered shrubs and trees. Thus, abandoned fields with extremely dry conditions exhibited slower successional development than those on mesic sites.

A chronosequence approach composed of a high number of sites can be as reliable as repeated sampling of a limited number of individual sites over time to show a general successional pattern. Moreover, a higher number of sites observed at one moment in time may better reveal the variability of succession at the landscape scale than a detailed, long-lasting study of a lower number of semi-permanent plots.

Keywords, abandoned fields, ecological restoration, permanent plots, space-for-time substitution, vegetation development

Social-ecological post hoc assessment of ecosystem restoration from a system archetype perspective

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ABSTRACT

Ecosystem restoration has traditionally considered only ecological criteria to assess the performance of restoration actions. This may fall short of understanding the factors that lead to the success or failure of restoration because the dynamics of landscapes cannot be understood without considering the complexity of human-nature interactions operating on them. Thus, ecosystem restoration should be approached from a social-ecological perspective. In this ongoing research, we propose a comprehensive approach for the social-ecological post hoc assessment of ecosystem restoration. Based on a literature review, we have developed a conceptual framework and a hierarchical list of attributes to assess restoration performance from a social-ecological perspective. Drawing on this framework and list, we are surveying key stakeholder perceptions about the success of restoration actions undertaken in grassland ecosystems across Germany, as well as Mediterranean ecosystems in Southern Spain. Finally, by applying a system archetype approach, we seek to identify recurrent social-ecological patterns across restoration actions and develop a nested archetype classification that integrates top-down and bottom-up analyses. For the top-down analysis, we are characterizing and classifying restoration actions based on: (i) contextual social-ecological conditions, (ii) objectives and methods applied in the restoration process, and (iii) restoration success according to stakeholder perceptions. For bottom-up analysis, we will conduct interviews with key stakeholders in representative restoration actions of the diversity of archetypes identified to derive typical causal mechanisms that explain restoration performance. The proposed archetype-based method gives holistic insights into social-ecological patterns and mechanisms driving the success or failure of ecosystem restoration actions, which will be useful to guide future restoration efforts.

Keywords: archetype analysis, post hoc assessment, restoration performance, social-ecological systems, stakeholder perceptions

Ecosystem composition, structure and function of afforested areas in Portuguese drylands

Author(s): Köbel, M.[1]; Nunes, A.[1]; Príncipe, A. [1]; Vizinho, A. [1]; Serrano, H. [1]; Soares, C.[2]; Pinho, P[1]; Branquinho, C. [1]

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ABSTRACT

Afforestation efforts are one of the most commonly applied restoration actions worldwide. In drylands in particular, planted forests play an important role in preventing further desertification and land degradation. Despite the long-term investment in afforestations over the past decades in Portugal, plantations often follow a one-fits-all recipe and its assessment rarely goes beyond tree survival, leaving largely unknown the outcome at the ecosystem level over the medium or long-term.

In this work, we evaluated ca. 45 afforested areas with umbrella pine (*Pinus pinea*), holm oak *(Quercus ilex*) and cork oak (*Q. suber*) over Alentejo region, a mostly semi-arid area in southern Portugal. We measured tree size and indicators of ecosystem composition, structure and function, and assessed how these were related with climate, micro-climate and plantation management choices, such as the species planted, tree density or shrub cover.

Overall, the results suggest that tree species influences tree growth, but its role in modelling other ecosystem parameters is limited. Rather, it is mostly climatic conditions and structural diversity that model indicators such as species richness, tree regeneration soil C/N and ecosystem multifunctionality.

Keywords: active restoration, Mediterranean, ecological indicators, multifunctionality, woodland

Gathering knowledge on ecological restoration practices in European forest ecosystems

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ABSTRACT

SUPERB (Systemic solutions for upscaling of urgent ecosystem restoration for forest-related biodiversity and ecosystem services) is a European research project, funded under Horizon 2020 European Green Deal, which aims to enable and demonstrate large-scale restoration of forests and forest landscapes across Europe. One of the main specific objectives of SUPERB is to deliver evidence-based practical knowledge. To achieve this, experiences from restoration and adaptation projects across Europe will be compiled, fostering insights into the ecological, technical, social, economic and political dimensions of restoration, including success metrics and reasons for failure. To obtain a complete picture of ecosystem restoration practices, information will be collected using two different approaches: the collection of site-level restoration activities and the development of national-level restoration narratives. At site-level, information will be collected on specific past and ongoing restoration projects carried out with European, national, regional or local funding. These data will be compiled following different methods such as personal interviews; gathering information available in databases of the EU funding programs Life and INTERREG, as well as information provided by national agencies; and through the creation of an on-line platform for surveys, aimed at project managers who have carried out projects financed at local, regional or national level. For the national-level narratives, information will be collected for European countries, encompassing the key current and historical restoration and adaptation practices through national-expert assessments. In this study, the methods to gather data and information throughout Europe (both documented and unpublished) will be described, as well as the expected outputs focused on identifying the success or failure indicators of restoration and adaptation activities, enabling derivation of lessons-learned when combined with scientific information.

Keywords: forest, restoration, practical knowledge, narrative, survey

Challenges in Monitoring Tree Survival and Development

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ABSTRACT

Monitoring of trees in the first years after planting is important to determine early survival rates and tree health. Once trees are established, monitoring can move to the plot level in order to track growth rates and tree health and to make estimates of biomass, and hence of carbon captured. Field-level monitoring is a robust and reliable approach; however, it is hard to scale-up. As the number of planting sites for a restoration project increase, it is resource intensive to conduct regularly and only a sample of trees and plots may be monitored.

Remote sensing methods include drones, aircraft and satellite platforms. Drones/aircraft can provide high-resolution imagery and may also fly LiDAR sensors, which allow the retrieval of 3-D information on forests including biomass estimates. Nonetheless, these approaches are resource intensive, require careful planning and may be difficult to conduct regularly over many years. Satellites fly very high-resolution (VHR) sensors that provide imagery with up to 30cm spatial resolution. However, this imagery cannot detect trees during early years of growth, has low observation frequency, and has significant financial costs. Medium-resolution optical and radar sensors (~10m – 30m) provide frequent imagery that is generally free to obtain, for monitoring forest health at plot level, especially once crown closure occurs. Radar imagery has been used for biomass retrieval, but substantial ground reference data is required for its calibration.

The effective monitoring of individual trees and forest stands therefore requires a careful determination of the goals of the monitoring plan and a trade-off in terms of frequency, cost and parameters to be retrieved. This presentation will outline the approaches taken so far in the Life Terra project towards the monitoring of planted plots and will provide background information for further discussion on this topic

Keywords: tree monitoring, remote sensing, biomass retrieval, forest health, Life Terra

Assessing the impact of post-fire restoration interventions using spectral vegetation indices

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ABSTRACT

Ecological restoration has become an increasingly used practice to revert degraded land and mitigate the effects of extreme events in vulnerable biomes such as drylands. Methods to improve the assessment of these restoration interventions are essential to ensure their success, optimize resources and identify improvement aspects for future interventions. This study develops a method to assess the performance of post-fire restoration interventions on a pixel level when access to pre- and post- fire field data is limited, therefore depending on remote sensing data. The approach takes into account restoration intervention objectives, the state of the area before the intervention efforts began and key terrain variables. This method was applied to a restoration intervention made in a burnt forest in north-east Spain, where an agro-silvopastoral mosaic has been conceived under the frame of a Life 2020 program. To assess the restoration performance, different spectral vegetation indices (SVIs) linked to the objectives were used. By using the Before-After-Control-Impact (BACI) statistical method, the study isolates the impact of the interventions from temporal variability and natural regrowth. The study explored the effects of the interventions by comparing restoration types (active or passive), terrain variables and the post-fire recovery levels before the intervention efforts began. The study also showed that the sole use of one SVI to assess the impact of restoration interventions may lead to limited conclusions as the three selected indices were outputting different levels of performance for the comparisons undertaken. The pixel level analysis also allowed to map the detailed variation in performance across areas. The core of this method can be applied to other restoration intervention scenarios other than post-fire and its affordability could allow for its integration in monitoring protocols in large-scale endeavours such as the current UN Decade on Ecological Restoration program.

Keywords: restoration intervention, drylands, monitoring, BACI, spectral vegetation indices.

How remote sensing choices influence monitoring and evaluation results of ecological restoration

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ABSTRACT

Ecological restoration has been recognized worldwide as an effective strategy for combating environmental problems and promoting sustainability. Remote sensing imagery such as obtained from Landsat and Sentinel-2 satellites can provide valuable spatial, spectral, and temporal information to support large-scale monitoring, evaluation and learning of restoration activities. However, choices need to be made when monitoring and evaluating restoration interventions through remote sensing, because of the abundance of data, and diverse methodological analysis options. This study aimed to explore the effect of remote sensing choices related to i) the image reference period, ii) size and distribution of the control sample, and iii) satellite sensor type in a before-after-control-impact (BACI) analysis of ecosystem service provision on restoration evaluation outcomes. We explored the effect of these choices in areas with different vegetation degradation classes. Results showed that different moments of the year for comparison lead to the highest percentage of opposite BACI results, meaning that conclusions of the restoration could change depending on when the evaluation is done. Another choice that showed opposite BACI results where different distribution of controls. There were only small differences when using 20 or 100 controls. All the different results obtained with the evaluated remote sensing-related choices were greater in less degraded areas. However, these areas showed a more stable responses on time. Although the choice of different satellite sensors produced similar trajectories of ecosystem service supply, the estimated supply was higher using Sentinel-2 than with Landsat-8 OLI, denoting the need of harmonizing results using ground data when using more than one image source for the evaluation. Common knowledge and documentation of the effect of key remote sensing-related choices on restoration evaluation results is essential to properly understand, manage and adapt restoration initiatives.

Keywords: BACI, land degradation, impact assessment, sensitivity analysis, South Africa

W1

Tuesday, 6th September 2022 (A2/SOTANO room, Aulari II - General Lecture Hall II, University of Alicante)

Coordinator(s):
Romero Montoya, Andrea (FAO)

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Enhancing capacities for effective ecosystem restoration throughout the UN Decade and beyond

To boost action for the implementation of the United Nations Decade on Ecosystem Restoration (hereafter "UN Decade"), an FAO-led Task Force on Best Practices was established to enhance knowledge dissemination and capacity development efforts.

In 2021, the Task Force implemented a global survey of capacity needs for restoration and based on this assessment has published a summary report that identifies key gaps and capacity development priorities to support the UN Decade.

The survey received 1331 responses from all around the world across sectors and regions. Overall, 50% of respondents had no capacity development opportunities to enhance their restoration work.

This year, the survey information will be combined with a stock-taking effort to document existing (current and recent) knowledge products and capacity development initiatives with the goal of identifying: i) ways to replicate or extend existing programs; and ii) gaps where knowledge products or capacity development initiatives are needed.

The final product will be a Capacity, Knowledge, and Learning Action Plan for the UN Decade. Its scope includes all types of ecosystems, sectors and the four major categories of the restorative continuum. During this workshop, participants will have the opportunity to review and provide inputs into the draft Action Plan, and to identify opportunities for collaboration throughout its implementation.

Key gaps and capacity priorities for restoration to support the United Nations Decade on Ecosystem Restoration – *Besacier, Christophe (FAO)*

Development of a Capacity, Knowledge and Learning Action Plan for the UN Decade –

Chazdon, Robin (Forestoration International)

Proposed flagship products that could be elaborated in the context of the UN Decade –

Chazdon, Robin (Forestoration International) and Andrea Romero (FAO)

W3

Tuesday, 6th September 2022

(A2/SOTANO room, Aulari II - General Lecture Hall II, University of Alicante)

Developing Guidance for Effective Ecosystem Restoration

To support the implementation of the United Nations Decade on Ecosystem Restoration (hereafter the "UN Decade") and help achieve its goals, there is a need for a shared vision of ecosystem restoration.

A key step in creating this shared vision is adoption of principles that underpin the full set of ecosystem restoration activities. In 2021, the FAO-led Task Force on Best Practices, the Society for Ecological Restoration (SER), and IUCN's Commission on Ecosystem Management (IUCN CEM) partnered to develop ten principles to guide the UN Decade.

These principles detail the essential tenets of ecosystem restoration that should be followed to maximize net gain for native biodiversity, ecosystem health and integrity, and human health and well-being, across all biomes, sectors, and regions. Following publication of the principles, development of standards of practice was initiated to provide guidance on the application of the principles to the planning, implementation, monitoring, and maintenance of ecosystem restoration projects.

Engagement of SERE members in the development of the Standards of Practice is an important step in the process. During this workshop, participants will have the opportunity to review and provide inputs into the draft Standards of Practice. This feedback will be used to improve the final version.

Session supported by Food and Agriculture Organization of the United Nations (FAO), Society for Ecological Restoration (SER) and IUCN's Commission on Ecosystem Management (IUCN CEM).

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W8

Tuesday, 6th September 2022

(A2/D02 room, Aulari II - General Lecture Hall II, University of Alicante)

Ecosystem health, ecological restoration, and human health: let's identify and strengthen the linkages

Ecosystem (or ecological) health and human health are intimately linked, and by recognizing this we can move towards a more holistic approach to ecological restoration and allied activities than is possible by focussing only on standard ecosystem services and biodiversity related objectives. Ecological restoration can bring very significant health and well-being benefits for people, locally, regionally, and globally, through recovering the vital ecosystem services we have lost through degrading biodiversity, and indeed the biosphere on which our lives depend. In this workshop, we will discuss how to advance the development and integration of an holistic approach to the science, practice, and policy of ecological restoration, and related activities, based on the emerging evidence of the links between restoration and human health. We will also discuss how ecological restoration could in theory be more fully integrated in all the existing intiatives linking Health and Environment.

Key words: Ecological health, human health, holistic restoration, reciprocal restoration

Supported by
EcoHealth Network (www.ecohealthglobal.org)

Coordinator:
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Dr. Katalin Török
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W11

Tuesday, 6th September 2022

(A2/D02 room, Aulari II - General Lecture Hall II, University of Alicante)

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Mind Your Language! Restoration, Regeneration or Rewilding?
What is the best way to communicate conservation strategies to the public?

In Ireland, and in many parts of Europe, and boosted in the English-speaking world by very successful books like Isabella Tree's 'Wilding' and George Monbiot's 'Feral', rewilding has become a popular catchphrase. However, it's used often in an emotional way, showing little understanding of restoration ecology, stakeholder engagement, or the SER Principles and Standards.

Rewilders fail to recognise that simply 'giving landscapes back to wild nature', without considering ecological baselines, necessary interventions, and ongoing management, often results in less biodiversity, not more, due to invasive species and other factors.

It is important to acknowledge that some promoters of rewilding, including SER members, do recognise these issues. But then it often seems that what they are really talking about are the optimal outcomes on the SER Principles Continuum of Restorative Activities: "Fully Recovering Native Ecosystems". And of course, as the SER Principles make clear, in cases where natural regeneration alone can restore an ecosystem, it is the preferred option. But why use the term 'rewilding' to describe this process?

Some argue that raising the 'rewilding' banner attracts support among some environmentalists. That is true. But the term also provokes a lot more hostility than support in the general public, especially in rural communities. Since rewilders often talk about top predators -- bears and wolves, for example -- regardless of the current state of the ecosystems and society where they want to reintroduce them, this hostility is not always unreasonable; it is certainly not helpful to promoting the recovery of biodiversity. .

Restoration is a much more appropriate word, and strategy, for contemporary conservation.

While this workshop's coordinators will put forward these views, we very much welcome robust challenges from those who may disagree with us, in an atmosphere of collegial goodwill and shared values. That is how policy, and science, advances!

W6.1

Tuesday, 6th September 2022

(A2/D02 room, Aulari II - General Lecture Hall II, University of Alicante)

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Education and Training in Ecological Restoration

Restoring hope - opportunities for international and inter-generational knowledge exchange

Knowledge sharing in Ecological Restoration (ER) imust be improved to better facilitate global ER aims. Education and training requires multidisciplinarity, best practice exchange between science and practitioners and societal involvement and through this can contribute to better restoration outcomes while promoting professional opportunities for future generations.

The objectives of this workshop are to:

a) inspire hope for future restoration and opportunities for personal development, employment, and research
b) create an opportunity for Young#ERs to present their work and share experiences between early career and experienced restoration researchers / practitioners
c) discuss how to overcome barriers to international collaboration and knowledge exchange - and why we must

This workshop will serve for the discussion and the dissemination of the Education and Training working group within SERE and for the Young#ER Network

Wanted!
Chief Ecosystem Orchestrators

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ABSTRACT

We will introduce the 4 Returns Framework as a means for large-scale and business-supported landscape restoration. To us, landscape restoration means restoring both ecosystems and communities with 4 Returns: the return of Hope & Inspiration, Natural, Social and Financial returns.

We will discuss barriers and ways forward to ecological and landscape restoration in general and to knowledge exchange and learning specifically.

In addition, and most excitingly, we will ask your input and feedback on developing an interdisciplinary curriculum for (landscape restoration) professionals, helping them to become “chief ecosystem orchestrators”.

Keywords: landscape, education, restoration, business.

WWF Spain experience on participation in ecological restoration

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ABSTRACT

One of the priorities of WWF Spain is restoration of degraded forest areas, in which it has been working since 1989 with more than 30 field projects. The organization defends that it is necessary to promote public participation strategies in all phases of restoration to bring this discipline closer to society and make them participant and responsible in decision-making. For this reason, participation is one of the key elements included in the WWF-SER Standards for the Certification of Forest Ecosystem Restoration Projects. This tool brings together good ecological and socioeconomic practices in the design and execution of restoration processes, and has been developed by a multidisciplinary working group made up of Spanish experts and aligned with the SER International Principles on ecological restoration.

The participation of different stakeholders in WWF field restoration projects is one of our hallmarks: collecting opinions and seeking synergies between different social actors and promoting awareness and participation of thousands of schoolchildren, local population, volunteers and company employees.

In addition, WWF collaborates in other innovative participatory projects such as 'Terecova' (https://recuperandonuestrospaisajes.org/), which has developed a method to identify priority areas for ecological restoration in Comunidad Valenciana through the incorporation of the opinion of people that are linked to the territory. Or 'Plantando Cara al Fuego' (https://www.plantandocaraalfuego.org/), which aims to involve citizens in the problem of forest fires, transferring scientific-technical knowledge and civic values to the population, especially youth, through pedagogical strategies.

Keywords: Local population, opinions, participation, restoration, stakeholders.

Fig. 1 A 'Terecova' workshop organized in Alicante (2018)

Facing-Fire: service learning for education and training in wildfires

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ABSTRACT

The Iberian Peninsula, like other regions of Europe, faces the problem of wildfires every year. This complex phenomenon endangers the lives of rural populations, damages the environment and affects the economy. The post-fire environmental consequences (flooding, soil erosion, ecosystems degradation…) are considered the most costly and irreversible impacts. Moreover, as a result of climate change among other factors (depopulation and changes in traditional land uses) the problem is likely to become even greater in the future. Although there are different education programs on wildfires in Spain, there is a need for greater involvement of the different social agents. In recent years, useful techniques have been developed to reduce the incidence and impact of wildfires (early detection, prevention and extinction of forest fires, rehabilitation of degraded burned areas, etc.). However, the implementation of these techniques is limited due, in part, to the lack of knowledge transfer to forest communities and the general population. The aim of the project “Facing-Fire” is to involve citizens in the problem of wildfires, transferring scientific-technical knowledge and civic values to the population, especially to young people, through pedagogical strategies, such as Service-Learning (S-L) and collaboration between educational centers (universities, secondary education, training courses) and social agents (administrations, NGOs, companies, landowners, associations, etc.). During the development of this project, student-tutors were trained so that they, in turn, were trainers of other students on issues related to fire prevention and post-fire restoration techniques.

Keywords: ecological restoration, pedagogical strategies, prescribed burns, wildfires.

Knowledge transfer among sectors to improve good practices in European riparian restoration

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ABSTRACT

Riparian vegetation is a key element of the landscape, modulating biological and physical processes and constituting ecological corridors that provide multiple ecosystem services while subject to intense use and pressures. Widespread riparian degradation has motivated restoration efforts but the scarce consideration of vegetation-mediated processes has hampered the effective improvement of the riparian ecosystems across Europe. Therefore, the status of riparian corridors remains generally poor. CONVERGES Cost Action (CA 16208, 2017-2022) aimed to improve knowledge conversion from science to practitioners and to integrate practitioners experiences and interests in the scientific community, by coordinating research, capacity building and training efforts across Europe (39 countries). The driving force of CONVERGES has been to contribute to bridge a misalignment of 'frames' which often challenges the multiple socioecological targets faced by riparian restoration. Misalignment refers to the ways in which individuals or organizations with different backgrounds, geographical origin, cultural contexts, or purpose, know and conceive such complex riparian systems and how their management should be implemented. Knowledge transfer activities promoted by CONVERGES included an effort in the production of technical documents (Reports, Policy Brief) and their translation into 18 European languages, 16 networking meetings, 2 Training Schools, 26 Short Term Scientific Missions for young researchers, and dedicated funding for conferences participation of Inclusiveness Target Countries. Among the key deliverables in Education and Training, the Action developed a Policy Brief with Key Actionable Recommendations, a Best Practices Guidance and a Teaching Manifesto on early start learning and life-long learning to meet sustainable riparian zone and human well-being. In this workshop, we will discuss how education and training activities can be used as a mean to bridge the gap among sectors that embrace a diversity of disciplines, actors and regions.

Keywords: Capacity Building; Education and training; European Network; riparian vegetation;

W6.2

Tuesday, 6th September 2022

(A2/D02 room, Aulari II - General Lecture Hall II, University of Alicante)

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Education and Training in Ecological Restoration

Restoring hope - opportunities for international and inter-generational knowledge exchange

Knowledge sharing in Ecological Restoration (ER) imust be improved to better facilitate global ER aims. Education and training requires multidisciplinarity, best practice exchange between science and practitioners and societal involvement and through this can contribute to better restoration outcomes while promoting professional opportunities for future generations.

The objectives of this workshop are to:

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b) create an opportunity for Young#ERs to present their work and share experiences between early career and experienced restoration researchers / practitioners
c) discuss how to overcome barriers to international collaboration and knowledge exchange - and why we must

This workshop will serve for the discussion and the dissemination of the Education and Training working group within SERE and for the Young#ER Network

Challenges and opportunities for international collaboration in ecological restoration - learning from experiences in Puerto Rico

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ABSTRACT

During the SER2021 conference, staff from Eden Project Learning (EPL) and University of Puerto Rico Aguadilla (UPRAg) met virtually and created a partnership which entails a passion for restoration that is actioned through knowledge exchange, best practice planning, hands-on land and ecological restoration projects, sustainable monitoring, and interdisciplinary research collaboration.

In Spring of 2022, staff and students from these academic institutions were finally able to meet and collaborate in-person. 2 EPL staff and 13 MSc Land and Ecological Restoration students were graciously hosted by a multitude of UPRAg Vida Marina associates.

This trip included site visits to a range of habitats (rainforest, dry forest, salt flats, dunes, mangroves, and coral reefs), expert lectures (bird and coral reef conservation and restoration projects), practical restoration (planting red and black mangroves in the 'Secret Spot'), witness of unique ecological processes (leatherback sea turtle nesting and seas sparkling with bioluminescent microorganisms), and cultural experiences (political history discussions, Spanish vocabulary, salsa dancing, and eating mofongo). EPL and UPRAg both have SER Student Associations which were also able to collaborate during this trip and share ideas for restoration initiatives and international partnership.

Through accounts of staff and student experiences on this trip, we aim to discuss the opportunities and practicalities of university-led in-person collaboration. While executing overseas visits has challenges, it has been an opportunity for ecological restoration students to learn from international practitioners, to understand about how geo-political and social aspects influence restoration efforts, and to build lasting partnerships that strengthen the global community of practitioners and researchers.

Keywords: international collaboration, environmental education, student experience, practical restoration, interdisciplinary research

YoungER's on the road for restoring ecosystems

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ABSTRACT

The SERE Young#ER networking group evolved from a session facilitated by students and researchers across Europe at the 12th European Conference on Ecological Restoration, 2021. It became clear that students, early career researchers, and restoration practitioners wanted more opportunities to come together to learn from each other and to gain more information about careers within ecological restoration.

The main aim of this network is to connect individuals at an early stage of their careers in ecological restoration around Europe, support individuals to take action to restore nature, share experiences and exchange knowledge about ecological restoration in an informal setting.

The SERE Young#ER network meets virtually every month and discusses technical and career-related topics. In October 2021, we held an introductory call with all the members to agree on topics for the structure of the sessions, topics for discussion, and how we can share our experiences and knowledge. Since then, we have held journal club-style meetings with topics selected and facilitated by the network members. Discussion topics have included: novel ecosystems, mycoremediation, and rewilding. We also use these meetings to share information about possible job opportunities with the SERE. Our meetings usually have attendees from different institutions and organizations across Europe, varying from masters, early Ph.D. students, and young practitioners.

Going forward, events will be a mix of journal clubs and external speakers. We will invite speakers to discuss their technical restoration experience and aspects of their role, such as successful grant applications and working with stakeholders. We will cover topics such as restoration techniques, methodologies, and analysis for different ecosystems, the social aspects of restoration, and their importance for successful projects. We also intend to extend the YOUNG#ER network within SER Europe and beyond.

Fig. 1 The last YoungER's meeting- Topic rewilding.

Keywords: education and training, ecological restoration, youngers

Experiences sharing: How YoungER's are contributing to education & training in ecological restoration

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ABSTRACT

To improve the successful application of restoration techniques, knowledge transfer to future generations of professionals is crucial. After a session about education & ecological restoration held at the 12th European Conference on Ecological Restoration, it became evident that students, early career/experienced researchers, and restoration practitioners needed more opportunities to share their experiences and learn from each other. In this overview, students and early career professionals from different countries, members of the YoungEr's network, present case studies in which they are involved, focused on ecological restoration and knowledge transfer. In Spain, students are investigating the efficacy of two revegetation methods for oaks, seeding, and planting. This knowledge is transferred to people through volunteer programs such as "Operación Encina", where people learn first-hand from scientists and help to reforest Mediterranean forests. In Portugal, the Generation Earth group will introduce the role of youth and diversity in ecological restoration, by working with youth engagement, organizing action projects, and coordinating a youth-led capacitation program. In the UK, students from the Eden Project Learning SER student chapter want to encourage others to start a student chapter at their university, as a platform to create opportunities to gain practical restoration experience and connect with like-minded colleagues and organizations that interest them in ecological restoration career development. Still in the UK, a Ph.D. student will provide his personal perspective as a young professional starting his career in ecosystem restoration research. He will share his experiences of the rewards and challenges of his research on the social aspects driving the uptake of native woodland creation interventions. Finally in Chile, young researchers will share a story about a local community who started a wetland restoration project and how they are willing to learn and apply everything they can to restore the nature sanctuary Angachilla.

Keywords: education and training, ecological restoration, younger's

Fig. 1. YoungER's taking actions linking ecological restoration and education in different countries in Europe, Portugal, Spain and UK, and Chile.

YoungER Opportunity Board

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ABSTRACT

YoungER Opportunity Board is a pilot project proposed by SER Europe Work Group on Education and Training, which aims to create a relevant and frequently updated database of opportunities for graduating students and young professionals in ecological restoration.

By collecting and filtering opportunities from all over Europe, this pilot project intends to facilitate the professionalisation of young academics and professionals or whoever takes interest in the field. In order to achieve this, we ensure that the opportunities are *high quality,* ranging from volunteering, courses, internships, jobs and PhD positions.

After a selection process held in January 2022, the board is managed with support of a 3000 € grant by SERE by a group of volunteers from Generation Earth Portugal, an education program that aims to capacitate the youth with the *official* support of WWF Portugal | ANP. The pilot project is planned to run until September 2022.

One of the key indicators for the success of the pilot project is dissemination in order to effectively reach youth groups and other ecological restoration communities from all over Europe. We have set a target of presenting 25 opportunities per month on the board, from at least 6 countries from Europe. Therefore, to achieve it, we search for opportunities on social networks as well as encourage SERE's networks to forward opportunities to us. The communication at the September Conference will include data on the results achieved during the pilot project.

Keywords: Ecological Restoration, Young researchers, Opportunities, Education, Volunteering

Workshops

Tuesday, 6th September 2022

(A2/D03 room, Aulari II - General Lecture Hall II, University of Alicante)

E4

MITECO. The Spanish National Restoration Plan within the framework of the National Strategy on Green Infrastructure. *Manuel Oñorbe*

E11

European Investment Bank initiatives on ecological restoration. *Stephen Hart*

E2

Living Building Challenge: A Visionary Path to Regenerative Buildings. Júlia Perez Torres

E13

The International Network for Seed-based Restoration (INSR): A SER Section. Emma Ladouceur

E9

Presentation of SERIAC, the new Iberoamerican and Caribbean chapter of the SER. *Pilar Andrés*

E12

Struggling for climate neutrality in Europe: carbon sequestration as an opportunity for large scale restoration of agricultural soils. *Pilar Andrés*

E4.
MITECO. The Spanish National Restoration Plan within the framework of the National Strategy on Green Infrastructure.

Manuel Oñorbe

The EU Biodiversity Strategy to 2030 provides that the Commission would present a proposal for legally binding nature restoration targets with the aim of restoring degraded terrestrial and marine ecosystems. This legislative proposal, called Nature Restoration Law was published on June 22. It is a historic milestone that has already been compared to the approval of the Habitats Directive and the Natura 2000 Network in 1992. Nature Restoration Law lists detailed restoration objectives for terrestrial, marine and urban ecosystems, also for river connectivity, pollinators and agricultural ecosystems. It will urge Member States to prepare National Restoration Plans, which should at least address issues such as the identification of areas to be restored; restoration measures to be applied; monitoring mechanisms; implementing schedule; financing needs and participation processes.

On July 2021 the Spanish Strategy on Green Infrastructure and Ecological Connectivity and Restoration was approved. Within the framework of the development of the Spanish green infrastructure, ecological restoration represents an essential element. On the basis of this Strategy, the Ministry for the Ecological Transition and the Demographic Challenge is leading a project to define criteria and guidelines for the elaboration of a future Spanish Restoration Plan and to identify areas to be restored, based on national and European Union regulations. The approach is structured along 5 main axes: diagnose, prioritization, financing and cost-effectiveness, social impact and participation, and quality, and is involving ca. 100 experts.

E11.
European Investment Bank initiatives on ecological restoration.

Stephen Hart

E2.
Living Building Challenge: A Visionary Path to Regenerative Buildings

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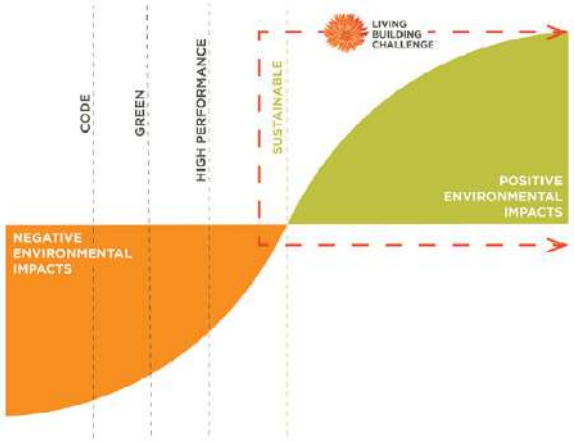

Fig. 1 Living Building Challenge regenerative impact

ABSTRACT

The Living Building Challenge[SM] is an attempt to dramatically raise the bar from a paradigm of doing less harm to one in which we view our role as a steward and co-creator of a true Living Future. The Challenge defines the most advanced measure of sustainability in the built environment today and acts to rapidly diminish the gap between current limits and the end-game positive solutions we seek.

The Challenge aims to transform how we think about every single act of design and construction as an opportunity to positively impact the greater community of life and the cultural fabric of our human communities. The program has always been a bit of a Trojan horse—a philosophical worldview cloaked within the frame of a certification program. The Challenge is successful because it satisfies our left-brain craving for order and thresholds, and our right-brain intuition that the focus needs to be on our relationship with and understanding of the whole of life.

As such the program is a philosophy first, an advocacy tool second, and a certification program third. Within the larger Living Future Challenge framework that covers the creation of all human artifacts and edifices, LBC focuses on humanity's most abundant creations—its buildings. It is in essence a unified tool for transformative thought, allowing us to envision a future that is Socially Just, Culturally Rich, and Ecologically Restorative.

Regardless of the size or location of the project, LBC provides a framework for design, construction and the symbiotic relationship between people, our community, and nature. LBC calls for action to restore the relationship between people and nature in an increasingly urbanized world as we become more and more disconnected from the world with which we evolved.

Keywords: Living Building Challenge, regenerative design, paradigm shift, built environment, Living Future Europe

E13.

The International Network for Seed-based Restoration (INSR): A SER Section

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ABSTRACT

The International Network for Seed-Based Restoration (INSR) is a thematic section of SER. We foster understanding and advancement of seed ecology, conservation and seed-based restoration of degraded systems. We bring together professionals, scientists, practitioners, students, industry, government and organisations such as botanic gardens from the international community who have an interested in promoting and enhancing seed-based solutions in restoration. Becoming a member of INSR is so easy, you need to be a member of the Society for Ecological Restoration and then check the box indicating you wish to be an INSR member! We are actively looking for INSR Ambassadors who are involved in seed-based restoration in their region. You can sign up for our newsletter, get involved, promote your seed-based research and events on our blog and website, and learn about others. Come find our poster, visit our website (https://ser-insr.org/), follow us on Twitter (@InfoInsr), and meet our attending Director-at-large (Author of this abstract) to chat and find out more. Share knowledge about native seeds worldwide with us. We look forward to meeting you!

Keywords: SER Section, INSR, Seed-based restoration, seeds, network

E9.
Presentation of SERIAC, the new Iberoamerican and Caribbean chapter of the SER

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ABSTRACT

In January 2022, the former *Sociedad Iberoamericana y del Caribe de Restauración Ecológica* (SIACRE) became the *Iberoamerican and Caribbean Chapter of SER*.

While integrated into SER, SERIAC conserves its founding objectives of promoting the identity and uniqueness of the Iberoamerican and Caribbean area in terms of the region's natural resources and socioeconomic conditions, while creating a path for knowledge exchange and mutual support with other world regions through SER Global. SERIAC will work in Spanish, Portuguese and English to facilitate the participation of a wide variety of local actors while sharing our experience with the global network of practitioners.

Just as was SIACRE, SERIAC is a network of networks oriented to prioritize synergies against unproductive competence. To accommodate the wide biological, and socio-economic diversity of such a wide region, the Board of Directors of SERIAC is integrated by delegates of societies for Ecological Restoration from Colombia, Brazil, Mexico, Argentina, Chile, Costa Rica, Bolivia and Spain. Negotiations are underway to include Portugal. Also, our intention is to promote focal points in those countries where ecological restoration is not active enough, seeking to provide support for education of experts in restauration and in governance for restoration.

The presence of two European countries belonging to SER-Europe is very stimulant since it opens a wide range of opportunities not only for co-creation of knowledge but also for improving fund raising capacities both sides.

This event pretends to introduce the young SERIAC in the SERE society. During the first part of the meeting, we will explain the current structure and intentions of SERIAC and will clarify the mechanisms for members of SERE to also become members of SERIAC. The second part will be devoted to brainstorming with the attendants with a view to find the best way to reinforce synergies between Europe and Latin America.

Keywords: new SER Chapter, SERIAC, Iberoamerica and the Caribbean

E.12
Struggling for climate neutrality in Europe: carbon sequestration as an opportunity for large scale restoration of agricultural soils.

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ABSTRACT

In 2019, in the framework of the Green Deal, the EU adopted the challenge of achieving climate-neutrality by 2050. More recently, in 2021, by supporting the "Fit for 55" package, the EU set out to reach climate neutrality in the entire land sector (agriculture, forestry and other land uses) by 2035.

In 2019, the agricultural sector was responsible for 11% of total GHG emissions in Europe (EU-27). Although total agricultural emissions declined by 20% from 1990 to 2019, most reduction occurred before 2005, and emissions have remained stable since then and there is consensus that there is low margin for further reduction if there is not a deep change in agricultural management and food preferences.

In the way towards climate neutrality, carbon sequestration in agricultural soils is a very important complementary strategy, with an estimated mitigation potential of 2248 Mt CO_2-eq in croplands and 1621 Mt CO_2-eq in grasslands from 2020 to 2050. Rewetting peatlands previously desiccated for agricultural uses has a mitigation potential ranging between 48 and 54 Mt CO_2-eq y^{-1}.

Organic matter is crucial for soil to deliver key environmental services, including plant production, water retention, or biodiversity provision and to improve soil health. Therefore, increasing soil organic matter offers the possibility of restoring agricultural soils while contributing to the EU climate goals. The occasion is particularly relevant for carbon depleted Mediterranean soils that show the greatest sequestration potential in Europe.

The reformed Common Agricultural Policy includes mechanisms oriented to stimulate farmers' engagement with carbon sequestration.

We will present the content of a recent report to the EU Parliament on the best agricultural practices for carbon sequestration in agricultural soils and will put forward complementary actions and mechanisms (in markets and governance) required to facilitate the desired restoration of croplands and grasslands at the large scale.

Keywords: Soil restoration; agricultural soils; Common Agricultural Policy; carbon sequestration.

The European Green Deal and Systemic approaches to Nature Restoration

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ABSTRACT

The Nature Restoration Law (NRL) is the main policy development in concretising the ambition embedded in the European Green Deal (EGD), namely to present a world leading Biodiversity Strategy. It comes after several decades of biodiversity ambitions, e.g. halting biodiversity loss, that were not reached. The NRL not only significantly increases the ambition level, it also shifts the focus to fundamentally bending the trend of biodiversity loss and specifies more than ever before how this should happen through concrete nature restoration targets for a variety of ecosystems. Quantitative goals (protecting more nature), qualitative goals and connectivity play a critical role. In addition, the stated objectives will require a fundamental approach towards dealing with the drivers of biodiversity loss, e.g. agricultural practices, landscape fragmentation, pollution,

This will require systemic approaches that connect the NRL in essential ways to other parts of the EGD, such as Zero pollution, the Soil strategy, Forest policies, Sustainable Food policies, etc. In other words to approaches that address the fundamental unsustainability of our systems of production and consumption.

Restoration measures for landscape connectivity and implementation of Green Infrastructure

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ABSTRACT

The Green Infrastructure is an ecologically coherent network of natural and semi-natural areas, designed and managed for the conservation of ecosystems and the maintenance of the ecosystem services. It is one of the measures against habitat loss and fragmentation, which are considered some of the main threats to biodiversity. Natural landscapes are suffering anthropization processes (deforestation, agricultural intensification, urbanizations, infrastructure constructions, etc.) and the agricultural abandonment as the main drivers of change in landscapes globally. On the one hand, anthropization processes are the main threats associated with wildlife populations and communities, since they generate direct mortality, for instance by destroying wildlife habitats or by road kills. Moreover, wildlife may also suffer changes in their distribution patterns, as well as population isolation that can lead to population and species extinction. On the other hand, the processes of agricultural abandonment generate different stages of succession on the vegetation cover, where populations and species can respond positively (if landscapes reach a pristine habitat) or negatively (if landscapes loss their ecological functions). Therefore, there is a challenge of proposing studies which address mitigation and restoration measures to promote the connectivity between natural areas (ecological corridors, wildlife passes, etc.), as well as policies that promote the Green Infrastructure. These proposals of increasing landscape connectivity will be improve the conservation of species in a context of global change.

This Symposium aims to describe patterns, process as wells as mitigation and restoration measures of effects habitat loss and fragmentation on population trends, abundance, distribution, range shift, genetic diversity or fitness of terrestrial or aquatic wildlife (plants or animal species). This Symposium will also provide a broad but integrative view of the main restoration strategies for the achievement of Green Infrastructure. Communications for this Symposium may include empirical (experimental or monitored observations) or simulating studies (modeling and simulation techniques) evaluating effects of different wildlife populations. Although some invited speakers are planned, we welcome different results on research studies, projects, management actions or commentaries from other attendees to take this opportunity to foster collaboration with who are engaged in this topic, both from a theoretical and applied point of view.

Keywords: land-use change, fragmentation, connectivity, rewilding, ecological corridors, wildlife passages, population dynamic, wildlife effects, road kills

Learning from secondary succession to assist in the restoration of semi-arid oldfields in SE Spain

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ABSTRACT

Among the ecosystems targeted to achieve global ecological restoration goals, abandoned agricultural areas represent an opportunity for enhancing ecological connectivity. More knowledge on the drivers of oldfield vegetation recovery is essential to develop nature-based restoration frameworks. Fleshy-fruited shrubs are indicators of oldfield secondary succession. However, patterns of colonization can shift notably across altitudinal gradients, making difficult to obtain robust conclusions that guide regional restoration strategies, especially the role that passive restoration might play.

We have studied the natural colonization patterns of fleshy-fruited shrubs in oldfields across altitudinal and lithological gradients in Murcia Region (SE Spain) taking into account plant specific traits. Earlier studies focused on pilot areas and were followed by regional assessments of land abandonment, from which we evaluated its potential contribution to biodiversity and ecological connectivity. More recently, after completing a regional survey spanning all the bioclimatic stages, we have used Hierarchical Modelling of Species Communities (HMSC) to test whether time since abandonment and local field features (remnant trees and nearby natural patches of vegetation) drive the colonization patterns. Altitude and lithology conditioned the structure of shrub communities, allowing to identify different focal species at a regional scale. Time since abandonment was not relevant, but remnant trees had a positive effect on the occurrence of several shrub species in the oldfields. Close sources of propagules (terrace edges, natural vegetation patches) benefited the occurrence of certain species mainly at lower altitude. Species traits (growth form, root depth, dispersal mode, fruit length and water content) helped to explain their performance along the altitudinal gradients.

Different management actions are recommended according to the regional altitudinal gradient. The results provide ecological knowledge to identify the species with higher potential for passive restoration, but also help practitioners to identify conditions under which spontaneous regeneration is less likely and more active restoration is needed.

Keywords: fleshy-fruited shrubs, oldfields, regional gradient, species traits, natural recovery

Amphibian road mortality in Spain: SAFE Project and other initiatives of AHE

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ABSTRACT

Amphibians are the most threatened group in the world due to several causes, including habitat loss and fragmentation. This is enhanced by the expansion of roads, which contributes to population fragmentation and the interruption of genetic flow. As amphibians have limited capacity of movement, human-landscape barriers could be critical for their dispersion towards water bodies and thus, breeding success is also seriously compromised. Although in the last years some conservation measures have been implemented to reduce vertebrate mortality rates, they are scarce and mainly focused on emblematic and/or big mammals, which can cause important traffic accidents. In addition, the essential information to solve the problem is unknown, and various essential questions as “which are the more affected species by the roads”, “how many specimens of each species are being killed every year” or “which are the main factors causing high mortality rates” are not answered yet. Therefore, the Spanish Ministry of Ecological Transition and Demographic Challenge -with the collaboration of AHE, Seo Birdlife and SECEM- started the SAFE project, a citizen participation project which aims to understand and quantify the impact of roadkills for vertebrates in Spain. As amphibians seem to result underrepresented in roads due to the accumulation of roadkills in specific nights of the year and the scarce time that carcasses spend in the road, AHE has also started a project to locate hotspots of amphibian mortality in Spanish roads. So, here we explain the stage of both projects and we also discuss the preliminary results with the information compiled and the conservation measures which need to be urgently applied to considerably reduce amphibian roadkill rates.

Keywords: Citizen participation, Conservation, Habitat fragmentation, Roadkills

Fig. 1. Pair of natterjacks toads (*Epidalea calamita*) in a road in Madrid.

Rehabilitation of bog woodlands and alluvial forests – best practice and lessons learned

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ABSTRACT

From 2014 to 2022, the Nature Conservation Foundation of Brandenburg (NaturSchutz-Fonds Brandenburg) is carrying out a LIFE Nature project for the conservation and restoration of alluvial forests and bog woodlands in Brandenburg (North-East Germany). The project aims to protect, stabilize and develop bog woodland and alluvial forests in their natural characteristic. Both habitat types represent important refuges and are important elements in the landscape connectivity of natural ecosystems in an increasingly intensively used landscape. In order to preserve and restore these important habitats, a wide variety of measures were implemented during the project. When implementing the necessary measures, the particular aim was to build them as close to nature as possible or to design them in such a way that human intervention is hardly visible after some time. In doing so, the project team followed best practice measures for these habitat types, but also tried out and developed new approaches in cooperation with other people. After eight years of project work, the project team can now draw a summary of those measures that are particularly effective, cost-efficient, easy to implement and that can be carried out without too much interference with nature.

With the presentation, the project team would like to give an overview of the measures carried out and present and discuss the lessons learned.

Keywords: Wetlands, restoration, measures, best practice, lessons learned

Fig. 1 Groyn made of dead wood to encourage re-meandering

Managing stress-inducing factors for better restoration outcomes, the case of low-lying Mediterranean Iberian coast

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ABSTRACT

A main cause of failing on dune and coastal wetland restoration projects is the lack of know-how about the management of the relevant drivers. To fill this gap, a survey has been conducted on both, previous project sites, and present locations with populations of target species.

The study area was the Llobregat delta (NE Spain), and the surveyed habitats were: Coastal dunes (Natura 2000 code 2210); Wet dune slacks with *Saccharum ravennae* (Natura 2000 code 2190); *Spartina versicolor* swards (Natura 2000 code 1320); Mediterranean halo-nitrophilous pioneer communities with *Salicornia patula* (Natura 2000 code 1310); and Mediterranean halophilous scrubs with *Arthorcnemum fruticosum* (Natura 2000 code 1420).

The measured drivers were:

Soil granulometry: through the distribution of weight percent of 2; 0,2; and 0,005 mm particle size fractions. The resulting values were integrated into a **fine sediment index** "***Indø***".

Soil salinity: by the determination of the mean of four different electrical conductivity predictions of the saturated paste extract EC_e from value of $EC_{1:5}$; and also, directly from the water table.

Moisture regime: visually determined by feel and appearance (i.e. water glistening on saturated soil); and by the presence of redoximorphic (gley colour pattern) features.

The analysis of the resulting data provided a first picture of how the stress-inducing factors that can promote the prevalence of the 5 surveyed communities. And furthermore, a strategic approach to overcome competition with invasive and ruderal-generalist species.

On the project design phase, the two first drivers can be controlled by site selection, along with the eventual management of altered sandy soils; meanwhile the moisture regime can be controlled by the design of the microtopography of the project, in accordance to the microtidal condition of the Iberian Mediterranean coast.

Keywords: soil salinity, soil moisture, texture, predictive-models

The Role of Green Roofs in Urban Ecological Restoration

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ABSTRACT

Green roofs (GR) are vegetative systems that work as complementary and additional techniques to restore ecological and hydrological functions in urban areas. GR are an engineered nature-based solution, that mimics natural processes to improve water quality and manage water quantity in the urban environment, especially when installed on a large scale. GR have the potential to retain, store and delaying of stormwater runoff, reduce the risk of flooding, and increase urban resilience in the face of intensifying extreme precipitation events. In addition, GR provide other socio-environmental benefits at the urban scale. They improve air quality, reduce urban noise, and can mitigate the urban heat island effect, especially in densely urbanised areas. When properly designed, GR have the potential to enhance urban biodiversity through endemic and indigenous species of birds and plants, that contribute to recovering and maintaining the necessary environmental balance. Consequently, GR contribute to improving health, well-being, and human quality of life in densely urbanized areas. In this study, we provide an overview of the main benefits of the widespread installation of GR in urban centres as well as the technical and political barriers that make green roofs a little-explored measure in the promotion of urban sustainability measures by public decision-makers and urban planners. The results provide quantitative evidence of the potential benefits of GR installation in urban ecological restoration. And the need for standardisation of quantification methods, including monetary quantification of these benefits in order to create confidence in building owners and private investors to attract investment in green roof projects and thus spread this typology of nature-based solution.

Keywords: Green infrastructure solutions, green roof benefits, biodiversity, barriers, sustainability.

Do lowland semi-improved grasslands have a natural restorative capacity to revert to semi-natural grassland vegetation?

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ABSTRACT

Grassland is Ireland's most expansive terrestrial habitat type covering (~59% land cover) however, much of the semi-natural grasslands have been lost due to agricultural intensification or land abandonment in recent years. While the decline in Irish grassland biodiversity has been recognised, there is a paucity of research into the restoration capacity of lowland mesotrophic grasslands because nutrient poor marginal grasslands have generally been the focus for conservation efforts. Most of Ireland's grasslands are privately farmed, therefore, appropriate agricultural management techniques for biodiversity restoration are important. This grassland restoration research is based in Killarney National Park, Co. Kerry, Ireland where there is access to semi-improved mesotrophic grasslands (~244ha), a herd of Kerry cattle and Park staff that facilitate our biodiversity management investigations. A baseline study has shown that the grasslands are mostly of low biodiversity value, however, vegetation classification as has revealed that some grassland types in particular have a potential to revert to important semi-natural grassland communities e.g 6510 lowland hay meadows/6210 Orchid-rich calcareous grassland. Three management regimes (mowing, extensive grazing, and mob grazing) are being tested for their effectiveness at enabling spontaneous regeneration of lowland grassland vegetation diversity. Seedbank analysis of these grasslands using the seedling emergence method has been carried out to assess whether these management regimes alone are effective at restoring these mesotrophic grasslands' biodiversity or whether additional intervention is needed (such as reseeding with native species). We have established that the seedbank is depauperate of rarer species, and grasslands such as these will depend on seed influx and their proximity to neighbouring semi-natural grassland sites if they are to regenerate independent of further anthropogenic measures. However, indications are that the management regimes will aid the spontaneous diversification of semi-natural grassland species to some extent and that the cover of previously sown commercial species will decrease.

Keywords: biodiversity, biodiversity management, farm management, seedbank, semi-natural grassland regeneration.

Fig. 1 The Three Management types (extensive grazing, holistic mob grazing and hay mowing) being examined for this study.

Recovering landscapes and its functionality. The holistic LIFE RIBERMINE project Guadalajara, Spain)

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ABSTRACT

It is well known that mining activity produce severe environmental impacts, but, at the same time, it is essential for technical developing and current estimations forecast extractive activities are expected to grow in the coming decades. Today's society is very demanding, especially when mining is to be carried out in an ecologically and scenically sensitive environment. In this context, mine rehabilitation is challenged not only recover damaged landscapes, but also its functionality and ecosystem services. LIFE RIBERMINE uses best available techniques focused on replicate the configuration and functionality of natural landscapes, with very success so far. Regarding topographic reconstruction, LIFE RIBERMINE actions have included: (a) the use of the GeoFluv™ - Natural Regrade method for the design of watersheds; (b) the SIBERIA Landscape Evolution Model to simulate the erosive processes that will occur in previously made designs; and (c) the ROYAL® Talus method to replicate natural cliffs in the former mining fronts. In soil replacement and management, surface formations (carbonate colluvium) have been used as soil 'support', with organic amendments of poultry and sheep manure and treatments aimed to increase surface roughness and decompaction. Regarding revegetation, the aim is to assemble a pines and gall oaks forest, with a first phase of introduction of herbaceous and camelephytes to form a stable substrate against erosion and biologically functional; and a second phase of implantation of trees and shrubs. Cutting-edge techniques such as mulching, the use of shrubs that prevent herbivory or the application of "biochar" have been also applied. Additionally, LIFE RIBERMINE monitors the behaviour of the rehabilitated areas, so that the lesson learned will help to improve other restorations in the future. Furthermore, downstream river environments are also being studied to ensure that the rehabilitation is contributing to improve the condition of aquatic habitats, the main objective of the project.

Keywords: Geomorphological mining rehabilitation, Ecological mining rehabilitation, Best available techniques, Ecosystem services recovery.

Early drought prevents annual species to persist on a Mediterranean extensive green roof

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ABSTRACT

Extensive green roofs are known to improve the urban environment but in the Mediterranean region, climatic conditions pose the problem of their sustainability when no irrigation is applied. After planting in 2012, 18 local plant species on different types of substrate of a non-irrigated extensive roof in Avignon, the physico-chemical characteristics of the soil, its seed bank, its mesofauna and the initially sown and spontaneous vegetation expressed on the surface were studied. In 2020, significant differences related to the sunlight conditions (shade / sun) and to a lesser extent to the depth of substrate used (5cm / 5cm or 10cm with a water retention layer) were found. The deeper plots in the shade have significantly higher fertility, cover and vegetation height. However, the plots in the sun have higher moss cover, planted vegetation abundance and springtails density. By 2020, 80% of the initially planted species had disappeared, except for several perennials, but an increase in the species richness of spontaneously established species was measured over time. In the absence of a permanent seed bank, the plant community is then mostly dependent on species flows via the local seed rain. A planting of perennial species followed by spontaneous colonisation of species present in the vicinity of the roof would then represent a more sustainable strategy for extensive non-irrigated green roofs in Mediterranean environments than sowing specie-rich seed mixtures.

Keywords: Succulents; Geophytes; Ruderals; Self-seeding; Substrate depth

Restoration measures for landscape connectivity and implementation of Green Infrastructure

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ABSTRACT

The Green Infrastructure is an ecologically coherent network of natural and semi-natural areas, designed and managed for the conservation of ecosystems and the maintenance of the ecosystem services. It is one of the measures against habitat loss and fragmentation, which are considered some of the main threats to biodiversity. Natural landscapes are suffering anthropization processes (deforestation, agricultural intensification, urbanizations, infrastructure constructions, etc.) and the agricultural abandonment as the main drivers of change in landscapes globally. On the one hand, anthropization processes are the main threats associated with wildlife populations and communities, since they generate direct mortality, for instance by destroying wildlife habitats or by road kills. Moreover, wildlife may also suffer changes in their distribution patterns, as well as population isolation that can lead to population and species extinction. On the other hand, the processes of agricultural abandonment generate different stages of succession on the vegetation cover, where populations and species can respond positively (if landscapes reach a pristine habitat) or negatively (if landscapes loss their ecological functions). Therefore, there is a challenge of proposing studies which address mitigation and restoration measures to promote the connectivity between natural areas (ecological corridors, wildlife passes, etc.), as well as policies that promote the Green Infrastructure. These proposals of increasing landscape connectivity will be improve the conservation of species in a context of global change.

This Symposium aims to describe patterns, process as wells as mitigation and restoration measures of effects habitat loss and fragmentation on population trends, abundance, distribution, range shift, genetic diversity or fitness of terrestrial or aquatic wildlife (plants or animal species). This Symposium will also provide a broad but integrative view of the main restoration strategies for the achievement of Green Infrastructure. Communications for this Symposium may include empirical (experimental or monitored observations) or simulating studies (modeling and simulation techniques) evaluating effects of different wildlife populations. Although some invited speakers are planned, we welcome different results on research studies, projects, management actions or commentaries from other attendees to take this opportunity to foster collaboration with who are engaged in this topic, both from a theoretical and applied point of view.

Keywords: land-use change, fragmentation, connectivity, rewilding, ecological corridors, wildlife passages, population dynamic, wildlife effects, road kills

Identification of plant indicators for high pollinator diversity when prioritizing roadside restoration

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ABSTRACT

Habitat loss, often resulting from land use change, is one of the main reason for the well documented pollinator decline throughout the world. However, negative effects on pollinators can be reduced if novel ecosystems created by human land use, can be used by wild pollinators. Road verges have a considerable potential as an alternative habitat for pollinators associated with semi-natural grasslands, especially given the significant area of land that these roadside habitats collectively cover.

Finding efficient methods to identify roadside habitats with plants species that support pollinating insects, could be a valuable tool for pollinator conservation. One potential approach, and the aim for this study is to identify a set of easily recognizable plant species that indicate high floral resource diversity for wild bees, and thereby high bee diversity along road verges.

We used both flower and bee-data sampled systematically at 70 sites along a 682km latitudinal gradient in Denmark and Norway. We also included a previously published Danish bee-flower-data set.

We are using a combination of ordination techniques and regression methods to identify sets of plant species that maximize the number of bee species at each site.

There are several flowers that indicates high bee diversity in the road verge. To limit the number of species in the indicator set, a set of criteria was included: a) A variation in flowering time to support pollination throughout the whole season, b) Include both bi-symmetric and radially-symmetric flowers to optimize for both bumblebees and solitary bees, c) Flower species that are easily recognizable to ensure the road administration select the right road verges.

The use of this indicator set can be both to prioritize bee-friendly management and as target-species for restoration of new road verges to increase habitat connectivity.

Keywords: pollination, road verge, indicator plant species, wild bees

LIFE PRIMED (LIFE17NAT/GR/000511): promoting interdisciplinarity and ecosystem-based approach when restoring declined Mediterranean forest

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ABSTRACT

Transitional wetlands and coastal forests are among the most degraded and threatened ecosystems in the European Union. This has resulted in many habitats and species in Mediterranean coastal areas having 'unfavourable', 'vulnerable' or 'near threatened' conservation status according to the EU Habitats Directive (92/43/EEC).

Traditional and innovative ecological restoration solutions have been designed and implemented in two such areas along the Greek and Italian coasts, 'Bosco di Palo Laziale' and 'Delta Nestou', to improve the conservation status of 'Pannonian-Balkanic turkey oak-sessile oak forests' (habitat 91M0), 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*' (habitat 91E0), and 'Mediterranean temporary ponds' (*3170) that have been increasingly exposed to climate change and inappropriate forest and water management.

Such ecological restoration practices have included selective trimming of encroaching shrub vegetation, new Mediterranean temporary ponds, a remote-controlled irrigation system to catch and distribute rainwater in the woodland during the driest periods, a free-pathogen forestry nursery and ex-situ and in-situ conservation practices of keystone plant populations. To tailor and size these interventions, a team of experts from different disciplines have previously carried out an assessment and quantification of the abiotic and biotic factors of the target habitat types.

The successful outcomes of this set of conservation solutions emphasise the crucial importance of interdisciplinarity and the ecosystem-based approach to restoring degraded ecosystems and habitats. LIFE PRIMED fosters such a vision in the hope of a more systematic and regular application of these practices among practitioners and competent authorities.

Keywords: nature-based solutions, Natura 2000, LIFE programme, Habitats Directive, declined Mediterranean forests

A proposal for classifying nature-based solutions

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ABSTRACT

In the first decade of the 21st century, a new concept emerged strongly resulting from a better understanding of the ecosystem and environmental value of the territory: the Green Infrastructure. Knowledge of territorial ecosystem value has improved substantially over time. Now the whole territory can be actively considered to be of ecological interest, with different intensities or concretions depending on its strategic interest.

Indeed, Green Infrastructure, understood as a *network of zones and spaces, and other environmental elements, strategically planned, designed and managed for the provision of a wide range of ecosystem services* defines how ecosystems and their functions can be useful to enhance Europe's natural capital. The idea has opened up the possibility of proposing actions for territorial improvement in a more solid and consistent way than we did before. Actions to protect, to restore natural or altered ecosystems in a sustainable way, to address social challenges in an adaptative and effective way, and at the same time provide benefits for human well-being and biodiversity.

Nature-Based Solutions (NBS) is a new concept that emerges, consolidating this change of perspective based on applied ecology to provide a more operational development. It encompasses actions that are supported in ecosystems and the services they provide, to respond to multiple societal challenges such as ecosystems degradation, climate change, food security or natural hazards. There is a whole creative field when it comes to proposing designing, and settle them on. This is a technically strong concept in the approach, but still young in development, so it is especially interesting to establish a simple, solid and consistent system in order to strategically classify NBS according to differentiated categories. This article provides a proposal in this sense, the result of experience in the generation of NBS at a professional level.

Keywords: Applied ecology, Green Infrastructure; NBS, Ecosystem Services.

Assessing limiting factors for natural regeneration in Mediterranean hedgerows

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ABSTRACT

Conservation and restoration of hedgerows increase biodiversity and multifunctionality in agricultural landscapes. However, natural regeneration is often low in Mediterranean environments due to various limiting factors of plant establishment. The present study aimed (1) to estimate the natural regeneration (by germination and resprouting) of planted species and the establishment of woody non-planted species in hedgerows, and (2) to experimentally assess the impact of herbivory, herb competition and summer drought on woody seedling establishment. We selected 12 hedgerows planted at four sites in Central Spain and quantified recruitment of woody plants. We also planted 1356 seedlings of *Colutea arborescens*, *Crataegus monogyna*, and *Rhamnus alaternus*, which grew under the combination of three treatments: exclusion of herbivores, herb clipping to reduce competition, and summer watering to reduce summer drought. We counted 66 seedlings and 316 recently grown resprouts spontaneously recruited in 2063 m long x 2 m wide hedgerows over 10 years resulting in a recruitment rate of 94 individuals ha^{-1} yr^{-1}. One and a half year after planting, the average survival of seedlings was 25.7%. Survival analyses showed highly significant effects of site (Fig. 1a), species (Fig. 1b), and herbivory (Fig. 1c), marginally significant effects of summer drought, and non-significant effects of herb competition reduction (c^2= 0.01, p = 0.95). We conclude that protecting recruited seedlings against herbivores will accelerate hedgerow regeneration and that the impact of treatments to reduce summer drought and herb competition will depend on local context.

Keywords: emergence, herb competition, herbivory, resprout, summer drought.

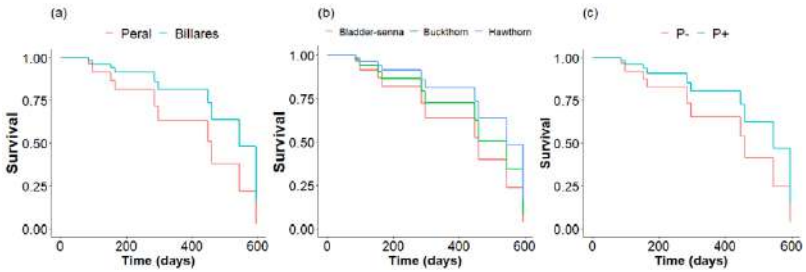

Fig. 1 Survival analyses of planted seedlings by site (a), species (b), and herbivory level (c). P – stands for high herbivory; P + stands for low herbivory.

Composition and diversity of arbuscular mycorrhizal fungal communities associated with planted Mediterranean hedgerows

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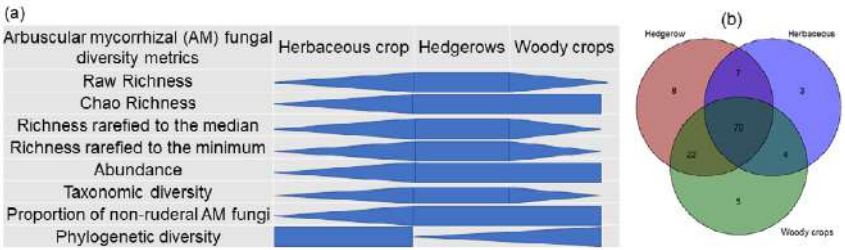
ABSTRACT

Sustainable agriculture is essential to address global challenges such as climate change and biodiversity loss. Hedgerows enhance aboveground biodiversity and provide ecosystem services, but little is known about their impact on soil biota. Arbuscular mycorrhizal (AM) fungi are one of the key components of belowground biodiversity. In this study, we compared the diversity (Fig. 1a) and composition (Fig. 1b) of AM fungal communities among hedgerows, woody crops (i.e., olive groves, vineyards) and an herbaceous crop (i.e., barley). A hundred and twenty soil samples were collected from four sites in Central Spain. AM fungal metabarcode data was used to compare the richness (number of AM fungal taxa), abundance (number of sequences), taxonomic, functional, phylogenetic diversity, and composition of AM fungal communities across these three land use types (herbaceous crops, hedgerows, and woody crops). Our results showed positive effects of hedgerows on most diversity metrics (Fig. 1a). Majority of AM fungal taxa were shared among the three land use types. Planting hedgerows increased AM fungal richness ($F_{2,112}$=23.21, P<0.001) and alpha diversity ($F_{2,112}$= 11.62, P<0.001), especially compared to herbaceous crops (Fig. 1a). Hedgerows and woody crops harboured more AM fungal sequences than herbaceous crops ($F_{2,112}$=15.10, P<0.001). Hedgerows were also related to higher proportions of AM fungi with non-ruderal life-history strategies ($F_{2,112}$=11.08, P<0.001). The communities of AM fungi were more similar in hedgerows and woody crops ($F_{2,112}$= 3.93, P<0.01) than in hedgerows and herbaceous crops (Fig. 1b) due to their lack of tillage. Unexpectedly, planting hedgerows reduced phylogenetic diversity, which might be related to random processes shaping communities in crops. Overall, observed results suggest that planting hedgerows plays an important role in restoring belowground diversity. Thus, European farmers should plant more hedgerows to attain the goals of the EU Biodiversity Strategy for 2030.

Keywords: Arbuscular mycorrhizal fungi**,** belowground biodiversity, ecological restoration, herbaceous crops, woody crops.

Fig 1. Levels of diversity metrics (a), and community composition (b) among land use types. Wider polygons indicate higher biodiversity levels. Venn diagram represents the number of unique and shared AM fungal taxa.



Designing diverse and functional green areas: a toolkit for decision makers

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ABSTRACT

Biodiversity loss is one of the main risks for economy and societal wellbeing. Thus, European Biodiversity strategy has set ambitious targets in order to preserve and restore ecosystems, their communities and the goods and services they provide. To achieve Europe biodiversity goals is specially challenging in cities where most of natural habitats have disappeared. Anthropogenic urban areas are commonly perceived from a simplistic point of view, where aesthetic values prevail. However, urban green areas play a key role in landscape connectivity and it has a high potential for providing a wide range of ecosystem services such as the maintenance of nursery habitats for multiple species or the regulation of microclimatic conditions. Current urban green infrastructure frameworks, both at European and at national level, claim for a change in the way that green spaces are planned, design and managed. Climate change also drives urban landscaping towards a more sustainable and resilient practice. Nowadays there is sufficient scientific knowledge able to guide this process. Unfortunately, most of the times this knowledge is neither accessible nor comprehensive to local decision makers. In this talk we present decision-makers-oriented-tools to better plan, preserve and restore urban areas for increasing its ecological functionality both as habitat for different species and to enhance climate change adaptation in urban areas.

Keywords: green infrastructure, urban areas, ecosystem services

Fig. 1 Good practices in green infrastructure design

Scaling up action for resilient wetland landscapes

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ABSTRACT

Wetlands are at the centre of the planet's triple crisis of climate change, biodiversity loss and land degradation[1,2,3]. Impacts are heightened because more than two-thirds of wetlands have been lost or degraded [4]. Large scale wetland conservation and restoration is urgent yet this is poorly translated into targets, budgets and action. So far, wetlands are hidden in the post 2030 Global Biodiversity Framework. Europe's position is important, considering the European Nature Restoration Law, while the global response overall is weak and fragmented.

There are attempts to clarify the scale of wetland restoration needed to reach the climate goals and SDGs. Global knowledge partnerships are proving an effective mechanism to map drivers of change and wetland restoration potential at all scales, using the best globally available data.[5] Carbon markets offer a unique opportunity to channel large investments into wetlands, while adherence to high social and environmental integrity standards is essential[6]. There is a finance gap for the preparatory stages of landscape-scale wetland restoration.

Nature-based solutions are mostly small-scale, short-term, and single-sector driven. Systemic, landscape approaches are required. The key enablers for restoration success at a landscape scale and a common language and framework are emerging, which can help bridge the implementation gap[7]. Finance is not always the limiting factor. The lack of inclusive approaches and institutional embedding, limits societal buy-in and means that many wetland values are overlooked[8]. Community-driven programmes can enable people to refrain from unsustainable practices and be actively involved in restoration. Diverse landscape partnerships and shared systems understanding is the basis for defining a long-term vision and plan of action, that reconciles trade-offs, stimulates innovation and invites investment [9,10]. Results in key landscapes often inspire replication and national action. Through partnerships with other sectors, the body of knowledge and experience on wetland restoration can be more widely taken up and applied.

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S15.

Management and Policy in Restoration

Chair: Sabine Tischew

Is it a Man's world? Gender bias in Ecosystem Restoration

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ABSTRACT

The UN Decade on Ecosystem Restoration aims to create a new trajectory for the relationships between societies and nature, considering gender equality as one of the main values that need to be included in restoration. Gender has been discussed and included in stakeholder participation in restoration projects, but scant attention has been devoted to gender bias in ecosystem restoration leadership. The objective of this study is to analyze gender bias within three dimensions of ecosystem restoration: research, outreach and practice. We created a database using three main sources: Restoration Ecology journal (researchers), Twitter and Altmetric Attention (communicators) and the SER's databases (practitioners). First, we studied whether gender bias existed among people leading ecosystem restoration in the three dimensions. Second, we analyzed factors that could influence gender bias (year, target ecosystem and socioeconomic country development). Third, we analyzed whether the impact of scientific knowledge in society depends on the scientific team's gender. Our results indicate that men were primary leaders in the three studied dimensions. This leadership was greater in more advanced career stages. There seems to be a trend over time towards equality in research, but gender inequality is still present in most types of ecosystems. Gender bias persisted in restoration science and practice in all countries, with women leading more projects in more developed countries. The impact of scientific knowledge was independent of the author's gender, but research of male senior authors seems to reach society more easily. On Twitter, each gender tended to communicate articles authored by people of the same gender. This broad perspective of inequality in the three dimensions needs to be addressed by promoting gender approaches in restoration policies and initiatives, acknowledging the importance of women in decision making, monitoring gender indicators in restoration success, and incorporating women's needs and perceptions in restoration communication.

Keywords: gender balance, leaky pipeline, Sustainable Development Goals (SDGs), women in science, women in practice

Identifying Training needs in Ecological Restoration at European scale

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ABSTRACT

Ecological Restoration (ER) is crucial to protecting biodiversity, reversing degradation and mitigating climate change, as recognized by the *UN Decade on Ecosystem Restoration* and the *European Biodiversity Strategy for 2030*. Furthermore, the recent European Commission's proposal for a *Nature Restoration Law* aims to restore ecosystems, habitats and species across the EU's land and sea areas. The Erasmus+ TRAIN#ER Project (Training in Ecological Restoration) will help to upscale training in ER, by achieving a shared model for vocational training needs in ER, which is fundamental to meeting the aims of this law. The Project is identifying training needs in ER across a wide variety of institutions and sectors, analyzing knowledge production and use in ER across the EU, with key activities such as targeted dissemination, a Focus Group, a Survey and a final joint definition of recommendations. A Communication Plan with targeted and general dissemination is being implemented, so that all relevant organizations working on ER in Europe are informed of the project activities and outcomes. The Focus Group has been conducted at the EU level, with the participation of fifteen decision-makers and promoters of ER, and has highlighted the importance of training across all professional sectors in ER, with an emphasis on training young professionals and socially excluded people. The flow of knowledge and information in ER is being analyzed in a survey aimed at European experts and practitioners in ER, with an assessment on how professionals produce, use and transfer knowledge in their daily work, as well as contents and channels that should be used to improve vocational training in ER. Preliminary results on the Focus Group and the Survey at the European level will be presented. A summary with a final set of recommendations in training in ER to all European practitioners and educators in ER will be submitted.

Keywords: Ecological Restoration, Knowledge production and use, Vocational Education and Training (VET), Focus Groups, Targeted dissemination

Knowledge needs of restoration practitioners in southeastern Spain

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ABSTRACT

Knowledge transfer has been recognized as major barrier for advancing ecological restoration in Europe. Yet, while science-practice and science-policy gaps have been widely acknowledged, our understanding on knowledge production, transfer and needs of different actors in the ecological restoration network is scarce. Furthermore, we do not know if knowledge gaps and knowledge transfer deficiencies are common in different European socio-ecological and governance contexts. These deficiencies limit our capacity to respond to the environmental crisis and foster effective ecological restoration. Under the framework of the Erasmus+ TRAIN#ER project (Training in Ecological Restoration), we surveyed restoration practitioners in southeastern Spain and developed a focus group discussion to describe practitioners' role in knowledge production and exchanges, identify flaws and suggest solutions. In this presentation, we will show the results of the survey and the focus group discussion, analyze needs of different practitioner profiles, discuss similarities with practitioners' needs in other European regions, and suggest actions to foster high quality ecological restoration under the European Biodiversity Strategy for 2030.

Keywords: professional training, vocational education, stakeholders, restoration practitioners, generation restoration

Management Prioritisation of Czech Natura 2000 Sites

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ABSTRACT

Nature Conservation Agency of the Czech Republic (NCA CR) and four other beneficiaries have been working on an Integrated LIFE project for the Natura 2000 network in the Czech Republic (2019–2026) with the aim to establish an effective management system for the Natura 2000 network in the country. Under this project, a mechanism for regular priority setting in active management was established in order to ensure efficient allocation of resources. The prioritisation mechanism proposal was developed in 2020 and consists of three parts: (a) habitat maintenance – five priority levels for 79 habitats requiring active management, (b) habitat improvement and restoration – 3 priority levels for 83 degraded habitats, and (c) species support – four priority levels for approximately a hundred plant and animal species. Each part is annually evaluated separately on the national as well as regional level. Parts (b) and (c) of the mechanism have been tested in practice since 2021. In the year 2021 alone, 195 management contracts worth c. € 0.8 million were concluded in 81 SCIs and 3 SPAs. The project pays close attention to communication with owners and tenants of Natura 2000 sites.

Key words: prioritisation, habitats, LIFE project, management

Fifty Shades of Restoration in Italy: Analysis of Legal Tools and Drivers for Transformative Change

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ABSTRACT

Environmental policies traditionally directed to nature conservation and prevention of damage turned out to be insufficient. Against this backdrop, restoration actions have been increasingly attracting international and national efforts, with 2021-2030 declared as the UN Decade on Ecosystem Restoration. Moreover, in 2021 the EU Commission put forward a proposal for legally binding nature restoration targets to halt further degradation of habitats and species. Notwithstanding the explosion of restoration initiatives following these political calls for action, projects and programmes turned out to be often insufficient and uncoordinated. Major barriers are to be found in socio-economic factors, rather than environmental (Cortina-Segarra et al., 2021).

Therefore, the aim of this paper is to identify norms and institutions that are likely to facilitate or hinder the achievement of full ecological restoration, drawing on Italy as a case study. Based on a preliminary review of Italian environmental laws and mandates, the legal landscape seems to be highly scattered and characterised by a plethora of terms referring to restoration (for example: *rigenerazione, rivegetazione, recupero, bonifica, risanamento, ripristino, riparazione, ricostituzione and others*). As a consequence of this heterogeneous legal framework, pursuing full ecological restoration is uncertain and it largely rests discretional. For instance, conservation laws oblige public bodies to restore the ecological value of protected areas, whereas the goal of remediation after damage laws is limited to re-establish the socio-economic value of degraded areas.

Following the legal analysis, our contribution is to show differences in stakeholders' groups involved in ecological restoration, both as cost-bearers and as beneficiaries, and to check whether the law is taking into account all these interests when imposing obligations and/or incentivising behaviours. Improving the connection between cost-bearers and beneficiaries of restoration might help re-imagine a blueprint to upscale the "transformative change" (IPBES, 2019) towards sustainability at all social levels.

Keywords: Italian Environmental Law, Restoration Governance, Stakeholders' Analysis, Restoration targets

Is the proposed EU Nature Restoration Regulation 'fit for purpose'?

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ABSTRACT

On 22 June, the European Commission launched its proposal for a Nature Restoration Regulation. We analyse its strengths, weaknesses, opportunities and threats. We compare the law with the demands in SERE's declaration on Ecological Restoration that was supported by 33 European expert networks and associations and more than 1400 individual scientists. The results will be used to propose a SERE2022 conference declaration to support upcoming decisions at the European Parliament and European Council levels for the final adoption of the regulation.

Keywords: Nature Restoration Law, SWOT-analysis, SERE2022 conference declaration

S13.

Drylands Restoration

Chair: Fernando T. Maestre Gil

Land Degradation Neutrality, addressing land degradation beyond drylands and restoration

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ABSTRACT

Land Degradation Neutrality (LDN) has become the UNCCD's main argument for tackling desertification. It is integrated into Sustainable Development Goal 15.3 which aims to "combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world by 2030". In this communication we aim to address the main principles of LDN and their relation to land restoration. Although the LDN opens the door to degradation, considering that economic and social development is necessary to, among other things, avoid spirals of degradation spurred by poverty, the rules, and principles for achieving such compensation are strict. For example, offsetting must be limited to a territorial scope smaller than national, and land degradation can only be compensated within the same type of land. The LDN prioritizes prevention strategies and proposes that its actions be integrated into existing land-use planning, addressing the problem on two sides: (i) managing land more sustainably, which would reduce the rate of degradation; and (ii) increasing the rate of restoration of degraded land, so that the two trends converge to give a zero net rate of land degradation. It is a novel approach that improves as countries implement it and overcome obstacles. One of the major difficulties encountered by the LDN, which is the basis of the National Action Plans to combat Desertification, is its voluntary character. A country can achieve good performance at the cost of outsourcing its production and, therefore, its environmental footprint. A successful LDN implementation requires a collective effort, as is the case in the fight against climate change. To this end, each country can report on the additional footprint of food and raw material imports and require the same environmental and social criteria for domestic production as for imports.

Keywords: drylands, desertification, prevention, land-use planning

Priority effects in dry grasslands: insights from a field experiment and implications for restoration

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Abstract:
Grasslands are one of the most threatened ecosystems in Europe due to pollution, land use and climate change. It is well known that grassland assembly can be modulated by the organisms that arrive first, through so-called priority effects. Sowing different plant functional groups (PFGs) before others can result in significant priority effects that may influence community trajectories and hence opportunities for multifunctional outcomes for grassland restoration. However, the strength and persistence of priority effects and how they are modulated by weather conditions are still poorly understood. To fill this knowledge gap, we set up the POEM experiment, a long-term field experiment in which the order of arrival of forbs, grasses and legumes was manipulated to explore the mechanisms, strength, and direction of priority effects in dry acidic grasslands over time, by setting up multiple experiments in different years. Results from the first two sub-experiments initiated in 2020 and 2021 showed that manipulating PFG order of arrival affected the structure and functioning of plant communities, but priority effects only became apparent in the second growing season. In the longer term, POEM will allow us to examine the extent to which the strength and persistence of priority effects are modulated by the effect of the year of initiation due to weather conditions. A better understanding of how functional biodiversity interactions can scale up to affect grassland communities can result in potential applications for restoration, by leading communities into desired trajectories that focus on maximizing species diversity as well as the functioning of ecosystems and the services they provide. Finding patterns in nature's responses to the interactions between weather conditions and changes in the order of arrival of PFGs could be useful to create multifunctional ecosystems with the least possible trade-offs in their establishment. POEM aims to provide a contribution to this endeavour.

Keywords: priority effects, aboveground-belowground productivity, restoration, dry grasslands, plant functional group order of arrival, weather conditions.

Fig. 1 The POEM experiment (PriOrity Effects Mechanisms)

Livestock grazing and ecosystem service delivery in global drylands

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ABSTRACT

Livestock grazing is the single most extensive form of land use worldwide. Yet its impacts on ecosystem services remain uncertain because pervasive interactions among grazing pressure, soils, above and belowground biodiversity, and climate are likely to occur but have never been addressed simultaneously. We used a standardized survey of 326 plots from six continents and showed that these interactions are critical to explain the delivery of nine fundamental ecosystem services across global drylands. For instance, the effects of grazing pressure on ecosystem services were mostly negative in hotter sites with higher rainfall seasonality and lower plant species richness. We also observed positive relationships between herbivore richness and ecosystem services such as carbon storage and ecosystem productivity and stability. Considering interactions between livestock grazing and local abiotic and biotic factors is key for understanding the fate of drylands under climate change and increasing human pressure and for using large herbivores in restoration programs.

Keywords: grazing, rewilding, drylands, livestock, ecosystem services

Overgrazing reduces the ability of soil microbes to sustain dryland functioning: implications for ecosystem restoration

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ABSTRACT

Soil organisms substantially enhance success of ecosystem restoration, especially under environmental stress and nutrient limitation – as is the case in dryland ecosystems. Drylands are regions characterized by water scarcity, are vulnerable to ongoing global environmental changes, and subject to important grazing by livestock - fundamental for supporting a third of the world's population. While aridity effects on dryland diversity and functioning have been assessed in recent years, much less is known on how increases in grazing pressure alters the relationship between dryland biodiversity and functioning. Soil biodiversity is fundamental of dryland functioning and through severe vegetation disturbance, overgrazing will likely alter soil biodiversity and composition, ultimately weakening their ability to support high levels of dryland functioning. Assessment of grazing effects on the ability of soil biodiversity to sustain dryland functioning can identify situations where soil inoculation might be needed for restoring drylands degraded through overgrazing.

The analysis of a novel global survey including 98 dryland sites from 25 countries covering a large aridity gradient revealed that soil biodiversity sustained multiple ecosystem functions, but this ability diminished with grazing intensification. High grazing pressure weakened the positive soil biodiversity-ecosystem functioning relationship across global drylands. This effect, however, varied between groups of soil microorganisms and their specific support for individual functions, and in some cases was climate dependent. Rainfall seasonality interacted with grazing and diversity effects on functioning, counteracting the reduction of positive diversity effects on biomass production under high grazing pressures, while enhancing negative grazing effects on nutrient cycling and decomposition.

In summary, we found that soil biodiversity fundamentally sustains ecosystem multifunctionality but is vulnerable to grazing intensification, especially under arid conditions. Thus, ecosystem conservation and restoration should prioritise controlling grazing intensities and considering soil inoculation to accompany restoration efforts in arid dryland sites.

Keywords: drylands, plant-soil interactions, grazing, ecosystem functioning, soil biodiversity.

Maximizing runoff capture by vegetation by spatial modelling as a tool to enhance dryland restoration

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ABSTRACT

Current threats, such as climate changes and land-use intensification, are hastening dryland degradation processes. Since the ecosystem may need a long time to re-establish its pre-degraded state, it is essential to accelerate the process with active restoration. However, traditional restoration efforts usually yield unsatisfactory results in drylands since they do not consider the ecohydrological interactions between open areas and vegetation patches. In this sense, restoration activities should focus on finding an adequate spatial distribution that can optimize resource use efficiency thus increasing vegetation survival and productivity. The aim of this study is to test the ability of spatially distributed models to identify the best plant-biocrust configuration that optimizes water captured by vegetation while minimizing soil loss. The Limburg Soil Erosion Model (LISEM) was used to simulate runoff and erosion in a degraded hillslope in SE Spain. After validation, three vegetation spatial configurations were simulated to obtain water redistribution and soil loss maps: (i) increasing vegetation at the end of the slope; (ii) staggered pattern; (iii) and plants located in the areas of higher Wetness Index (WI) value. Each scenario was simulated with two plant sizes, under two rainfall intensities, and with and without biocrust. All the tested scenarios with the introduced plants retained more water than the unrestored slope, reducing erosion by 4-19% and runoff by 2-28%. The scenario with vegetation in the areas of high WI was the one that showed the lowest erosion rate. In addition, when also biocrust active restoration was considered, erosion was reduced up to 90%. Results highlight the potential of the proposed technique to improve restoration actions by previously identifying the optimal spatial configuration of ground covers. The two spatial configurations that gave the most successful modelling were also implemented on the field by inoculating biocrust in the clearings and preliminary results were obtained.

Keywords: dryland restoration, biological soil crusts, runoff, erosion, spatially distributed models.

Acknowledgment: This work has been supported by the REBIOARID (RTI2018-101921-B-I00) project, funded by the FEDER/Ministry of Science and Innovation National Research Agency; the RH2O-ARID (P18-RT-5130) project, funded by the Andalusian regional government and FEDER funds; and the UAL2020-RNM-A2051 project, funded by Plan Propio de Investigación y Transferencia of the University of Almeria, Junta de Andalucía and FEDER funds.

Establishing resource-conserving species-diverse patchy vegetation: a nature-based path forward to restore drylands

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ABSTRACT

Dryland restoration could benefit from approaches that base on the particular structure-function relationships of dryland landscapes. Promoting the establishment of species-diverse plant patches that enhance resource conservation could be such type of approach and contribute to overall restoration success and biodiversity conservation in drylands. This work investigated the effects of increasing patch size and/or diversity on the productivity, resource conservation, and restoration potential of a degraded dryland. On 56 experimental plots established on a bare dryland slope, we created replicated patchy plant communities that combined different numbers of both individuals and species per patch (up to 8 species per patch). Over a 5-year period, we monitored patch productivity, total plant cover, and sediment yield (captured by silt-fences). We found that increasing within-patch plant diversity and density reduced individual plant growth due to increasing competition within the patch. However, the individual biomass reductions did not compromise a positive net increase in total patch biomass with increasing patch size and diversity, which suggests some degree of functional complementarity within the patch. Both patch size and diversity independently contributed to resource conservation and productivity. In general, larger and more diverse vegetation patches benefited from a higher sink capacity for rainfall and runoff water and a higher capacity for trapping sediments and reducing soil loss. Our results demonstrate that patch diversity and size control the recovery of drylands, and highlight the potential of establishing functionally-diverse plant patches as a cost-effective approach for dryland restoration.

Keywords: Dryland restoration, patch size, patchy vegetation, plant diversity, soil loss

Fig. 1. Partial view of the experimental slope, showing several (8 x 5 m) plots of patchy (12 patches) plant communities with different levels of within-patch diversity and plant density. Silt-fences at the bottom of each plot allow monitoring sediment yield after each productive rainfall event.

Effect of seed biopriming with biocrust-forming cyanobacteria on radicle growth and germination of semiarid native plants

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ABSTRACT

The complexity and high economic cost of restoration projects in drylands usually make them unviable. The direct seeding approach can be useful to restore large areas and reduce costs, but this technique needs to be improved to enhance seed survival and establishment. One improvement technique is biopriming, which involves inoculation of seeds with beneficial microorganisms such as cyanobacteria. In this study, the effect of seed biopriming with native biocrust-forming cyanobacteria on seed germination and radicle length was evaluated.

Four native plant species (*Macrochloa tenacissima* (L.) Kunth, *Thymus hyemalis* Lange, *Plantago ovata* Forssk. and *Stipa capensis* Thunb.) were chosen because of their ubiquity in southeastern Spain drylands. Biopriming was carried out during 26 hours, including these treatments: seeds exposed to deionized water, culture medium (BG11), cyanobacteria exudate and complete inoculum (exudate + cyanobacteria biomass). Biopriming was performed using four different native biocrust-forming cyanobacteria: *Nostoc commune*, *Tolypothrix distorta*, *Trichocoleus desertorum* and *Leptolyngbya frigida*. Seeds were incubated in a phytotron under controlled conditions (25ºC with 16/8 hours of photoperiod). Germination monitoring was carried out daily, during 15 days for annuals and one month for perennials. In addition, radicle length was measured 7 days after germination for each seed.

No significant effect of biopriming was detected on seed germination in the case of annual plants (*S. capensis* and *P. ovata*), while the effects were significant for perennials (*M. tenacissima* and *T. hyemalis*) and they depended on the cyanobacteria species. Regarding radicle length, no significant effect of biopriming was found for the perennial plants. In contrast, the radicle length of annual plants was enhanced by the biopriming with the exudate and biomass of nitrogen-fixing cyanobacteria (*N. commune* and *T. distorta*).

These results indicate that seed biopriming with cyanobacteria may enhance plant establishment in dryland, making restoration actions less expensive and more successful.

Keywords: Cost-effective, cyanobacteria, annual plants, perennial plants.

Acknowledgment: This work has been part of the REBIOARID project (RTI2018 101921 B I00) funded by: FEDER/Ministry of Science and Innovation State Research Agency and the project UAL2020-RNM-A2051 funded by Plan Propio de Investigación y Transferencia of the University of Almeria, Junta de Andalucía and FEDER funds.

Forest restoration in drylands is conditioned by climatic legacies

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ABSTRACT

Knowing the extent and environmental drivers of forests is key to successfully restore degraded ecosystems, and to mitigate climate change and desertification impacts using tree planting. Water availability is the main limiting factor for the development of forests in drylands, yet the importance of groundwater resources and paleoclimate as drivers of their current distribution has been neglected. Here we report that mid-Holocene climates and aquifer trends are key predictors of the distribution of dryland forests worldwide. We also updated the global extent of dryland forests to 1283 million hectares and showed that failing to consider past climates and aquifers has resulted in ignoring or misplacing up to 130 million hectares of forests in drylands. Our findings highlight the importance of a wetter past and well-preserved aquifers to explain the current distribution of dryland forests and can guide restoration actions by avoiding unsuitable areas for tree establishment in a drier world.

Keywords: restoration, forest, drylands, climatic legacies, groundwater

S2.1
Forest regrowth after land abandonment in Europe: extent, threats, and opportunities

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ABSTRACT

Europe has historically faced intensive habitat fragmentation, but the region was also the first to undergo a turnaround from diminishing to increasing forest cover. Since 1950, Europe's forests have increased by >300 000 km^2 (about the size of Italy) as a consequence of farmland abandonment and rural exodus. Projections of the European Commission estimate that a further 200,000 km^2 of EU farmlands are under high risk of abandonment by 2030, suggesting that secondary forests will represent a significant portion of the overall forest cover by 2100. These "new" forests can significantly contribute to carbon uptake and storage, thus contributing to achieve the net-zero carbon emission goal of the EU. Yet, while European and national policies have historically invested billions of euros in actively planting trees on former farmlands, they have to date neglected opportunities for passive forest restoration as a cost-efficient and politically feasible nature-based solution for increasing the extent and multifunctionality of European forests. Instead, natural forest regrowth is commonly conceptualised as a challenge for landscape conservation, management, and policy. Secondary forest establishment propelled by passive or active restoration can foster biodiversity and carbon storage, reduce landscape fragmentation, catalyse tree adaptation to climate change, and offer diverse ecosystem services to local communities. It can enhance rural development and the forest-based bioeconomy, increasing the utility of wood and non-wood forest products and other goods. However, the management of these new forests also needs to address associated environmental hazards such as fires, as well as issues of social perception and governance. In this context, a proper understanding of the potential extent, ecological processes, and socio-economic trade-offs brought about by secondary forests is critical to untap the full potential of active and passive forest restoration for creating diverse, healthy, and resilient forests in Europe, as a potential path for restoring nature and reconnecting people, two of the focus of the SERE 2022 conference.

What can ecosystem change over 30,000 years tell us about future ecological restoration options?

Some hints from NE Portugal

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ABSTRACT

Ecological restoration aims to bring degraded ecosystems to a more “natural state”, often benchmarked as “pristine” ecosystems with minimal human intervention. Here, we argue that such benchmark can be elusive and deceptive in regions strongly transformed by humans over millennia, based on very long-term social-ecological research in the Sabor valley (NE Portugal). In the Upper Palaeolithic (30000-12000 BC) and Epipaleolithic/Mesolithic (8,000-5,500 BC), hunter-gatherers inhabited vast forest landscapes (*Quercus*, *Juniperus*, *Fraxinus*), probably contributing to the extinction of wild horses, wild goats, and aurochs. Pastoralism started in the Neolithic and Chalcolithic (4500-2200 BC), while deforestation and erosion intensified with Bronze Age (2200-600 BC) agro-pastoralists, creating a mosaic of forests (*Fraxinus*, *Quercus*) and shrubland (*Cistus*, *Erica*, Fabaceae). Changes accelerated during the Iron Age (600 – 1st century BC) and Roman period (1st century BC – 5th century AD), with expansion of shrubs and *Pinus pinaster*, human population increases, growth of agriculture, and grazing by improved cattle breeds. Poorly known changes occurred during the following centuries, but in the 1940s only a few small forest patches remained within an agricultural landscape. Thereafter, ecosystem recovery has followed rural depopulation and land abandonment, with the return of large fauna (deer, wolf, vultures) and development of habitat mosaics benefiting biodiversity. However, forest recovery has remained slow and sparse, and it is very unlikely that anything like the Upper Palaeolithic “natural state” can be restored at any significant spatial scale and within a reasonable time frame, due to social-ecological legacies (erosion, species extinctions, invasive species) and current processes (climate change, fire, land use dynamics, land ownership, social acceptance). Accordingly, restoration in such landscapes should target at achieving “new” social-ecological systems meeting key societal goals, inspired where appropriate on ancient ecological patterns and processes, but that are adapted to contemporary conditions, sustainable, and resilient to climate and socio-economic changes.

Keywords: Historical Ecology, Land Abandonment, Mediterranean Forests, Rewilding, Social-Ecological Systems.

Fig. 1 Landscape under agricultural land abandonment in the Sbor River Valley (NE Portugal

Outcomes and drivers of forest recovery

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ABSTRACT

Earth forests are becoming younger every year in average since we keep cutting and transforming old-growth and primary forests. At the same time, secondary forests are regrowing, and restored forests are being created. Understanding how the structure and functioning of these new forests is and how forest communities are reassembled under the increasing stressors linked to global change, such us land-use changes and legacies or temperature warming, is essential to inform forest restoration and protection in the coming decades. Assessments of the restoration performance worldwide show that active restoration may not yield better results than naturally regenerated forests, although they can maximize specific functions. But is there a better way for restoring our forests? Where is the threshold of land degradation to keep the natural forest resilience working? During the talk I will present the recovery patterns recently found for secondary and restored forests at different spatial scales with a special focus on Mediterranean forests. We will also explore the context factors (climate, connectivity, type of disturbance) that can contribute to the restoration success. For studying these patterns, we used a range of information from empirical data of different Spanish forests to regional forests databases and metanalytical approaches. Our results suggest that traditional forest restoration can work and it is needed in some environments but, in general, secondary forests are more similar to reference forests. We will discuss the importance of different monitoring methods for measuring restoration success, that may show different stories. Also, we will talk about the difficulties that forest restoration planning faces since climatic constrains, land-use legacies and landscape transformation interact to condition recovery.

Keywords: restoration success, forest resilience, spatial patterns, land-use changes, active restoration, secondary succession

Tree species diversity increase in Catalan forests is associated to forest history, connectivity, and management

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ABSTRACT

Forest restoration targets have been set to halt global biodiversity loss (e.g., UN Decade on Ecosystems Restoration). Yet, forest area in Europe has expanded in the last century following the abandonment of former agricultural land, and previous studies reveal differences in the structure, composition and functioning of recent *versus* pre-existing forests. In this study, we assessed how land use legacy (i.e., land use in 1956), forest connectivity (i.e., forest proportion in the landscape), forest protection (i.e., inclusion in Natura 2000 network) and management (i.e., evidence of thinning and logging) have shaped recent increase in tree species richness and diversity (Shannon Index) in forests within contrasting climatic regions (Mediterranean, Supramediterranean, and Montane) in Catalonia (NE Spain). We compared data from Spanish Forest Inventories (IFN2 and IFN4; carried out between 1986-1996 and 2008-2018, respectively) to assess changes in species richness and diversity for tree and regeneration layers in relation to the abovementioned factors using generalized linear mixed models. Our results show an increase in tree species richness and diversity in the studied period, mostly associated to the pre-existing (IFN2) values. Although, it was also associated to land use in 1956, forest connectivity and recent forest management, particularly in the regeneration layer. This suggests that the human footprint, both historical and recent, and propagule pressure associated to forest cover in the landscape mostly drive tree community assembly rather than climate or forest protection. From a management perspective, climatic differences between forests do not seem to be so determinant in the restoration of biodiversity, while the effect of land-use legacy (i.e., forest age) could lead to uncertainty in the outcome of forest management and restoration efforts. Thus, this trend needs to be considered for delivering adequate strategies to enhance efforts for ecosystem restoration of human-altered landscapes.

Keywords: forest expansion, recent and pre-existing forests, restoration

Degree of ecological specialization in vegetation succession in Central European disturbed sites

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ABSTRACT

Ecological specialization is one of the concepts to explain how and why species co-occur at a given time and place. Identifying how the degree of community specialization changes after disturbance is fundamental to understand coexistence and diversity patterns, which has great applicability in conservation and restoration ecology. Here we assessed trends in community specialization, as well as the participation of generalists and specialists in 12 types of successional series based on a large dataset of dated plots of spontaneously established vegetation at disturbed sites in the Czech Republic. The sites included various stone quarries, coal spoil-heaps from mining, extracted peatlands, gravel-sandpits, fishpond-islands, burned-down forests and abandoned fields. We classified species into generalists and specialists using a co-occurrence specialization metric developed for species in the Czech Republic, determined community specialization at the plot level, and assessed trends in response to successional age for each of the series using regression analyses, community weighted-means (CWM) and the fourth-corner approach. In addition, we assessed the participation of endangered species among generalists and specialists during succession. We found ecological specialization generally increased during succession, mainly due to the decline of generalists and the increase of typical species of particular habitats such as grasslands, woodland and wetlands. The degree of specialization increased in series in peatlands, limestone, basalt and acid quarries and particular coal spoil-heaps while decreased in abandoned fields. Specialists were always less abundant than generalists and occurred in fewer particular series, mainly in early or advanced successional stages. Specialists exhibited greater changes than generalists in their ecological strategies during succession being more ruderal or stress-tolerant while generalists were more competitive strategists. According to their conservation status, specialists were proportionally more endangered than generalists. Our study shows how tracking changes in community specialization can help to assess successional trends and conservation interest of disturbed sites.

Keywords: generalists, ecological strategies, specialists, community specialization, spontaneous succession, conservation status.

The role of remnant trees differs among oak species in the colonization of pine plantations

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ABSTRACT

The abundance and spatial arrangement of seed sources in strongly fragmented forest landscapes may affect forest colonization. These seed sources, often occur as small patches and isolated trees, and are remnants of previous forests degraded by human activity. This study evaluates the effect of forest remnants characteristics on the colonization of pine forest plantations by two ecologically contrasting Mediterranean oaks. We established 153 plots of 10×10 m regularly distributed over 60 ha in a 51-year-old *Pinus pinaster* plantation adjacent to a natural mixed forest of *Quercus ilex* and *Quercus faginea,* located in central Spain. We measured the abundance of oak juveniles in each plot and geolocated and measured the dbh of all oak reproductive trees in a 500 m-radius buffer around each plot. Reproductive trees were classified into three categories according to their dbh: large (160-50 cm, old-growth established and reproductive long time before pine plantation); medium (<50-15 cm); and small (<15 cm, young recently reproductive trees). For each category, we calculated tree distance to plots and basal area as an indicator of seed availability. We also quantified the topographic wetness index (TWI) and classified the past land use of plots (agricultural vs. shrubland) using historical aerial images. Results showed differences between oak species. Distance of reproductive trees affected negatively *Q. ilex* juvenile abundance, while basal area increased it, with significant effects for large old-growth trees but not for medium or small ones. Distance and basal area did not affect *Q. faginea* colonization, but juvenile abundance decreased with TWI, suggesting a greater dependence of microsite conditions than *Q. ilex*. Previous agricultural land use favoured colonization of both oaks as compared to shrubland use. Our study shows that forest remnants affect differently the colonization of oak species and that large old-growth trees play a key role in spontaneous forest restoration.

Keywords: Old-growth trees, remnant trees, *Quercus*, past land use, spontaneous restoration

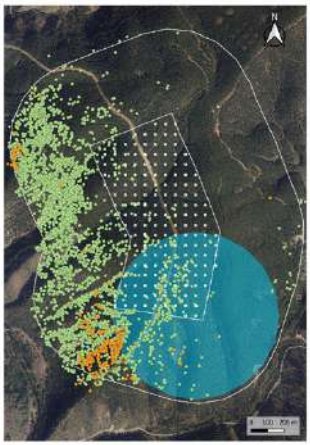

Fig. 1. Map of the study area. Green dots are *Q. ilex* reproductive trees and orange dots are *Q. faginea* reproductive trees. Small white squares in the centre of the picture are the 10×10 m plots in which the number of juveniles was counted. The blue circle indicates an example of a 500 m-radius buffer around a plot, in which all reproductive trees were measured.

Being in or out the climatic niche influences the performance of Pinus plantations in Spain

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ABSTRACT

Aims of achieving “climate neutrality” are leading to strong efforts to decarbonise the economy and ambitious plans for increasing CO2 uptake by terrestrial ecosystems (e.g. 3 billion tree planting within the European Green Deal). Indeed, tree planting is envisaged as an important nature-based solution to reduce CO2 atmospheric concentrations. In this scenario, it will be crucial to understand the processes underlying the viability of forest plantations, to select appropriate habitats and maximize mitigation benefits. Niche modeling and the assessment of the plantation location (in vs. out) may be a useful tool to understand the current patterns in plantations die-off and vulnerability, and to predict their responses to future climate scenarios, although these analyses are not commonly considered during the plantation process. Here, we investigated (i) the overlap between pine plantations and their respective climatic niches and (ii) the differences in growth and mortality among plantations inside vs. outside the niche. We focused in Spain where extensive pine plantations (up to 2.8 million ha) were carried out during the XX century, including: Pinus halepensis, P. nigra, P. pinaster, P. pinea and P. sylvestris. The proportion of plantations located outside the niche varied widely depending on the species, from 7% in P. halepensis to 29% in P. pinea, increasing up to two or three folds for the period 2041-2060 under climate change scenarios. Plantations differed in tree growth rate and, specially, in mortality depending on their position: i.e., 3 of the 5 pines species showed lower growth rates outside their niches while 4 out of 5 species exhibited higher mortality in plantations outside the niche. These results highlight the usefulness of ecological niche modelling for predicting the viability of forest plantations not only under present but also under future climatic conditions to better design tree-planting strategies.

Recovering soil fungal communities in abandoned mined sites; how should we act?

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ABSTRACT

Mined sites restoration is one of the most difficult restorations practices currently faced, because all the biotic component should be recovered after the cessation of mining activity. During the recent years, scientific and practical research has focused on ways to improve plant establishment, however, the recovery and evolution of soil biotic component remains under studied. The soil microbiome, especially fungi, are globally related with biogeochemical cycles. Soil fungi provide relevant ecosystem services, such as organic matter recycling or carbon sequestration with clear implications in plant performance and composition. Thus, understanding how below-ground microbial communities recover after anthropogenic disturbances is fundamental to enhance the recover ecosystems services provided by these areas. In this work, we compared the soil fungal communities of abandoned mined sites *vs* natural olm oak stands in Mediterranean Spain. Our main aim was to characterize the community compositional and diversity differences and relate them with different soil properties and biochemical cycles. The results showed that the soil fungal composition and diversity was different between oak forest and abandoned mined sites. For example, decomposers and arbuscular fungi species, more related with herbs, were more abundant in abandoned mine sites than in natural holm oak stands. Moreover, the amount of rare and causal fungi species was higher in abandoned mined sites. Clearly, the fungal communities were significantly different, excluding a close convergence with time, thus, the ecosystem functions provided by abandoned mine fungal community and forest fungal community will be different. These findings suggest that efforts to recover the soil fungal component could be implemented in these mines to try to recover ecosystem functioning. Further research is be needed to understand which ways should be implemented to restore the fungi soil component.

Keywords: Abandoned mined sites, soil properties, Soil microbial community, N cycling, metabarcoding, soil fungi.

Fig. 1 Pictures of the main characteristic features of the abandoned mines in PNIN Poblet natural area in Tarragona (Spain); a) natural holm oak and restoring plain sites b) abandoned mine tailing.

Plant-animal seed dispersal interactions as key drivers of ecological restoration in a changing world

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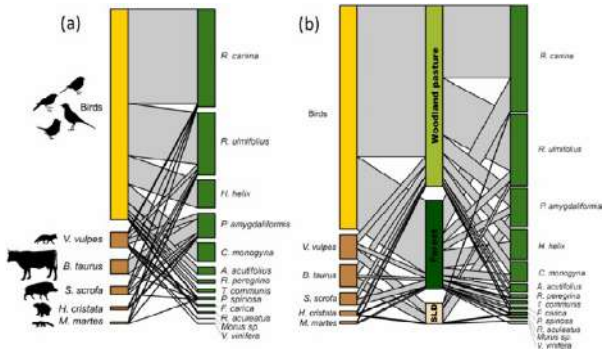
ABSTRACT

Many global and European commitments state the need to plant billions of trees and restore millions of hectares of degraded ecosystems to contrast biodiversity loss, desertification and climate change. Seed dispersal is a crucial process promoting vegetation dynamics, and in the Mediterranean, up to 65% of woody plant species need animals for seed dispersal. Therefore, such mutualistic ecological interaction represents a key nature-based solution to help us reaching our commitments.

In this presentation first we will report the strong expansion rate and correlated fine-scale spatio-temporal patterns of woody natural regeneration over a pastureland, using a spatially-explicit framework deployed over 30 ha inside the last large forest remnant in western Sicily, Italy. Then we will quantitatively demonstrate the key and complementary seed dispersal services promoted by birds, wild mammals and cattle across three different habitats, revealing the structure, specialization and modularity of the trophic and spatial seed dispersal networks. Finally, we will discuss the effects of human-made habitat heterogeneity and climate change on animal seed dispersal services and explore some strategies to take advantage of such services to promote ecological restoration of natural habitats as well as to increase biodiversity in agroecosystems.



Keywords: biodiversity, defaunation, ecological networks, frugivory, seed dispersal

Fig. 1 Plant-animal trophic (a) and spatial (b) seed dispersal networks underpinning vegetation expansion in a Mediterranean area

S2.2
Forest regrowth after land abandonment in Europe: extent, threats, and opportunities

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ABSTRACT

Europe has historically faced intensive habitat fragmentation, but the region was also the first to undergo a turnaround from diminishing to increasing forest cover. Since 1950, Europe's forests have increased by >300 000 km^2 (about the size of Italy) as a consequence of farmland abandonment and rural exodus. Projections of the European Commission estimate that a further 200,000 km^2 of EU farmlands are under high risk of abandonment by 2030, suggesting that secondary forests will represent a significant portion of the overall forest cover by 2100. These "new" forests can significantly contribute to carbon uptake and storage, thus contributing to achieve the net-zero carbon emission goal of the EU. Yet, while European and national policies have historically invested billions of euros in actively planting trees on former farmlands, they have to date neglected opportunities for passive forest restoration as a cost-efficient and politically feasible nature-based solution for increasing the extent and multifunctionality of European forests. Instead, natural forest regrowth is commonly conceptualised as a challenge for landscape conservation, management, and policy. Secondary forest establishment propelled by passive or active restoration can foster biodiversity and carbon storage, reduce landscape fragmentation, catalyse tree adaptation to climate change, and offer diverse ecosystem services to local communities. It can enhance rural development and the forest-based bioeconomy, increasing the utility of wood and non-wood forest products and other goods. However, the management of these new forests also needs to address associated environmental hazards such as fires, as well as issues of social perception and governance. In this context, a proper understanding of the potential extent, ecological processes, and socio-economic trade-offs brought about by secondary forests is critical to untap the full potential of active and passive forest restoration for creating diverse, healthy, and resilient forests in Europe, as a potential path for restoring nature and reconnecting people, two of the focus of the SERE 2022 conference.

When nature concludes the forest transition – natural forest regrowth in the eyes of society

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ABSTRACT

While the political debate on forests is dominated by both tackling (tropical) deforestation and goals to (actively) restore forests and their biodiversity at the global scale, in parts of Europe (as well as some other world regions) forests are growing back naturally connected to changing rural socioeconomic conditions and related land abandonment. In this presentation, we investigate societal perceptions on natural forest regrowth in Europe. We first illustrate the overall very positive societal perceptions of forests, based on large scale European surveys; these surveys indicate specifically the societal emphasis on forests as places of nature, for public health and recreation. We then zoom in on Southwestern Europe and present the views of local stakeholders and policy makers on natural forest regrowth, based on a set of qualitative interviews conducted in Spain and France. Our data paints an ambiguous picture here: especially local actors connected to agriculture and traditional land use practices perceive natural forest regrowth negatively, as a symbol for the decline of rural socio-economies. Furthermore, the phenomena is largely ignored by the traditional land use policy sectors. At the same time, there are also positive views, connecting the new forests to a process of natural restoration of the landscape and rewilding, indicating a change of perspective on landscapes arising from urbanizing societies. We finally connect these observations to the thesis of a transitioning spiritual/cultural relationship between people and forests, and conclude by formulating recommendations for future social science research and policy making related to the “nature driven” forest transition in landscapes with natural forest regrowth.

Keywords: societal perceptions, forest and nature governance, forest restoration, EU forest policy, EU biodiversity policy

Ten golden rules for reforestation – and when natural regeneration has a need for seed

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ABSTRACT

Tree planting is often portrayed as an easy answer to the climate crisis, but there are problematic issues with many global large-scale tree planting initiatives. In our recent paper '10 golden rules for reforestation', we advocated, amongst other measures, promoting natural regeneration (NR) wherever possible, to deliver low cost, high carbon, biodiverse and resilient reforestation (Rule 5). However, we recognise that NR can face certain challenges, including: (i) site-based limiting factors, such as isolation from a large, genetically diverse seed source, or a high level of site degradation; (ii) species-related factors, such as slow dispersal of large-seeded species; and (iii) guild-related factors, including the poor re-establishment of understorey species. Failure to address these issues could lead to failure of the restored forest population to progress towards the reference ecosystem, biotic homogenization, loss of rare species and low resilience of the restored forest to climate change. To mitigate against these risks, natural regrowth can be augmented through enrichment planting, assisted migration and genetic enhancement. These measures require access to plant material of diverse native species, sourced from a wide range of provenances. We present information on the distribution of native seed material held within seed banks focused on wild species conservation. We discuss case studies at two levels, the global collection of the Millennium Seed Bank and a regional example, the collections and conservation activities of the European Native Seed Conservation Network (ENSCONET). We highlight the challenges of making native seeds available for use and the opportunities for the future of restoration work.

Keywords: ecological restoration, natural regeneration, tree planting, seed banks.

Carbon offsetting through reforestation: how can society enable a great opportunity for sparsely populated areas

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ABSTRACT

The demand of carbon credits from removals (CO_2 captured from the atmosphere to be stored) is expected to be enormously increased due to the international commitments concerning with carbon neutrality. Fortunatelly we can use some very evolved devices that are able to separate the carbon from the carbon dioxide molecules and storing it inside: trees. In Spain there are 9 million of hectares available to be planted, where trees can be introduced with the appropriate technics, boosting the environmental impact, but social too. Most of these lands are located not only in the rural areas, but in areas currently not covered with agriculture or other profitable uses. Therefore the future big carbon sinks to be created will be carried out with absolute certainty in “empty” areas where usually there is a lack of opportunities for developing.

On the other hand, there are some voices, most of them from some civil servants, suggesting that since it is always advisable more investment in forest management, this kind of CO_2 absorption projects should not be undertaken. Taking into account that reforestation and forest management are, and must be, compatible activities, these messages can create a confusion than can block very important investments on the forest sector and the rural areas. Right now, when it seems than Society (big corporations, SME and citizens) finally are willing to pay for a service from the forests, beyond timber products: the capacity to offset CO_2 emisions.

It is clear that an active dialogue and coordination at all levels is necessary to make feasible and on an appropriate technical way the development of these projects, avoiding too academic attitudes that can hinder one of the solutions that Society require on its way towards carbon neutrality.

Keywords: offsetting, reforestation, rural development, investment, social impact.
Fig. 1. Extract from the 3 Billion Trees Factsheet, as part of the European Green Deal
Fig. 2. Headline of the news where the President of the Spanish Forest Engineers Association is obstructing a potential huge investment on reforestations


LA VANGUARDIA

Ingenieros de Montes rechazan dedicar el 15% del impuesto sobre hidrocarburos a reforestación a gran escala en España

• El Colegio Oficial de Ingenieros de Montes ha asegurado en un comunicado que "no es buena idea" dedicar el 15 por ciento del impuesto sobre hidrocarburos a programas de reforestación a gran escala en España.

Mixed forest establishment in a degraded area in northern Spain – an experimental approach

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ABSTRACT

Reforestation is considered an important tool to achieve the restoration of degraded ecosystems. During this process, ensuring the early tree establishment is a key factor, considering planted saplings are particularly vulnerable to prolonged periods of drought and competing weeds. Therefore, it is important to find an effective methodology for plantations to mitigate these adverse conditions. In this study, we present a mixed forests plantation at Matamorisca in Northern Spain, covering 17ha of an abandoned and degraded land. We have compared three planting treatments (1) Cocoon technology (biodegradable pulp-based reservoir with one-off watering), (2) Mycorrhiza, and (3) Control in five species (*Fraxinus excelsior, Quercus petraea, Quercus pyrenaica, Sorbus aria,* and *Sorbus aucuparia*). From 2018 to 2021 we have monitored 20 randomly selected permanent circular plots (8m radius) across the plantation. Once a year after the dry season, the height, vigor, animal damage, and branching were recorded of 616 trees in total. We studied the growth of each species using a repeated measures mixed model to analyze the effect of the fixed factors of the species (treatment, year, species, and all their possible interactions). The year was considered as a repeated-measures factor with ARH1 structure. Finally, a pairwise t-test was used to compare the significance level of the estimated means for the different levels of fixed effects considered. Our results showed, that the Cocoon technology significantly improved the height growth rate of *Fraxinus excelsior, Sorbus aria*, and *Sorbus aucuparia* year after year and also over the other treatments. On the other hand, *Quercus spp*. showed a lower but constant growth regardless of implemented treatment. We conclude that a mixed-species planting in combination with Cocoon technology could be a suitable approach to mitigating biodiversity loss in degraded lands.

Keywords: Mixed Forests, reforestation, cocoon, seedlings, tree establishment.

Long-term shrub encroachment of Mediterranean mountain grasslands in relation to climate and rewilding

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ABSTRACT

Grasslands are among the most widespread ecosystems, covering about 40% of the Earth's surface. One of the main drivers of primary productivity is climate, particularly in arid and semi-arid regions, where water availability is the main controlling factor. Despite this, biotic factors play a key role in grassland functioning. For instance, herbivores are important moderators of these ecosystems by defining the spatial and temporal pattern of primary productivity. Here, we apply a time series analysis with a Bayesian approach to evaluate the interaction between vegetation and climate over a 30-year period in an area (Sierra de Cazorla, SE Spain) where domestic ungulates (mainly sheep) where domestic ungulates were replaced by wild ungulates following the declaration of the hunting reserve. We benefited from tools such as remote sensing and large climatic databases to provide long time series integrating climate and vegetation. We found a significant increase in primary productivity over time. This increase suggests a change in ecological succession leading to an expansion in shrub cover. Thus, our results show that the interaction of climate and herbivory is a major driver of the functioning and structure of these Mediterranean mountain grassland ecosystems. In Mediterranean biomes, grazing practices have been strongly influenced by herbivore activity, which is one of the oldest and most important drivers of heterogeneity in Mediterranean landscapes. Ecological succession has therefore been a continuous readjustment towards agriculture and livestock grazing, which has served to control shrub encroachment. The abandonment of traditional practices and climatic changes have transformed agro-pastoral systems, in a dynamic process that is still ongoing. Our results show that rewilding mediated by wild ungulates might drive to different grassland landscapes than those previously supported by domestic herbivores.

Keywords: primary productivity, shrub encroachment, remote sensing, herbivory, wild ungulates.

S10.
Restoring Agricultural Land and Other Heavily Transformed Landscapes.

Chair: Pilar Andrés Pastor

Restoration in the agricultural landscape as key to regenerative agriculture: summary of the EASAC report

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ABSTRACT

The European Academies Science Advisory Council (EASAC) has recently published a policy report on the future perspectives of regenerative agriculture (https://easac.eu/publications/details/regenerative-agriculture-in-europe/). Working group members reviewed the recent literature in the field of regenerative agriculture, identified the most important challenges in the European food production system, and evaluated how regenerative agricultural practices can address these challenges. We analysed the synergies and trade-offs that may occur between biodiversity conservation, carbon capture and storage and agricultural production at different spatial scales from plot-, farm- to landscape scale. We found that restoration of semi-natural habitats in the agricultural landscape is a key to regenerative agriculture as the restored habitats increase landscape-scale biodiversity, and also have a huge potential for carbon capture and storage and the provision of other ecosystem services. We suggested several important points for improving agri-environmental policies with a special focus on habitat restoration in the agricultural landscape. 1) We suggest that allocating resources to the diversification and restoration of semi-natural habitats in conventionally farmed agricultural landscapes would be at least equally important for biodiversity as prioritising organic agriculture. 2) Restoration should be prioritized in agricultural landscapes where there is an existing green infrastructure containing semi-natural habitat patches. 3) Besides creation of new high-diversity landscape features, conservation and management of existing ones should also be prioritized. 4) Restoration measures that increase landscape complexity and connectivity of natural habitats should be prioritized. We concluded that the highest co-benefits between biodiversity conservation, carbon capture and storage and agricultural production can be achieved when the practices are coordinated at the landscape scale and fit the local environmental and socio-economic conditions.

Keywords: high diversity landscape features, landscape scale, restoration planning, semi-natural habitats, sustainable agriculture

Assessing farm biodiversity in orchards to identify good management practices using a global online tool

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ABSTRACT

One of the challenges of global food supplies to achieve sustainability is to create awareness among farmers about the relationship between management practices and the presence of biodiversity. The objective of this work was to describe the relationship between management practices and biodiversity in orchard farms located in the Chilean Mediterranean ecoregion using a combination of on-farm field assessments, farmers interview and the Cool Farm Tool: Biodiversity (CFT). The online tool allows farmers to see which species groups are benefiting from their practices and identify alternatives to improve it. For 12 large fruit farms (60 to 250 ha) we collected information about their productive and non-productive areas, including management practices, vegetation resources and habitats. In addition, we used farms biodiversity field reports (birds, mammals, and vegetation). Farm managers were also interviewed about their perception about biodiversity functionality in their farms. Biodiversity assessments using the online CFT were used to provide scores for different management practices and species groups. The results of the CFT show that on average, from the total list of actions recommended for Mediterranean ecoregions, farmers implement 24% of them for crop selection and production, 29% of good management practices for pest management, fertilization, and soil health. Only 26% implement management option in the small non-productive habitats (<1 hectare). Farms on average, use 28% of the actions oriented to promote conservation on large habitats. Farms that were in complex landscapes surrounded by seminatural areas score better than isolated farms. The CFT scores were positively correlated to the total farm species richness obtained from the field assessments. We found a positive relationship between farmers perception about the presence of biodiversity in their farms and the CFT scores. The use of online tools such as CFT Biodiversity allows the producer to self-assess and observe the effect of changing practices on the management and status of biodiversity. Funding from ANID PIA/BASAL FB0002 2014.

Keywords: fruit farms, habitat management, farmland indicators, cool farm tool, ecological intensification

Using complementary diversity metrics to promote the resilience of agroforestry systems to climate change

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ABSTRACT

Oak woodlands (*montados*) are semi-natural agroforestry systems of high ecological and socio-economic importance, dominating in south-eastern Portugal. These agro-sylvo-pastoral systems are highly vulnerable to climate change and are currently in decline due to multiple interacting environmental factors, including increasing aridity, coupled with unsustainable land use. This work is part of the project RENEWAL, aimed at the use complementary biodiversity metrics of plant taxonomic, functional, and phylogenetic diversity as indicators of resilience to climate of key ecological functions in these semi-arid systems, to inform land management strategies and decision-making to combat desertification. This is being done using a spatiotemporal correlational approach addressing different scales, studying these indicators across an aridity gradient along space and over time in consecutive years subject to inter-annual climatic fluctuations, and complemented with drought-induced manipulative experiments. These manipulative experiments are being installed at three Research and Monitoring Stations of the *montado* Long-term Ecological Research platform. Here, we present the main challenges of the project implementation and some preliminary results related to changes in plant community composition and diversity, in response to long and short-term climatic conditions.

Keywords: functional diversity, grasslands, oak woodlands, plant functional traits

Soil C sequestration and P dynamics after restoration of arable croplands into grasslands in humid temperate areas

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ABSTRACT

Naturalization of croplands into grasslands is postulated as a strategy for increasing C sequestration. This usually involves the increase in Soil Organic C (SOC) and the restoration of a whole range of physicochemical and biological properties, among them P dynamics. The turnover rate of SOC is highly determined by the distribution and quality of the SOM in the different physical fractions. At the same time, the P dynamic is also very sensitive and related to changes in SOM distribution.

The objective of this study was to evaluate the evolution of the SOM and P qualities after the sequential conversion of croplands to grasslands. The present study is focused in a chronosequence considering 10 arable fields which were converted to grasslands at different times in the past, from 1 to 45 yr. Soil samples were subjected to fractionation to separate the free particulate OM (POM) and the mineral associated OM (MAF). For SOM quality characterization, thermal analysis (DSC/TG) and ^{13}C NMR spectroscopy were applied. The evolution of the parallel P fractions was determined by using ^{31}P NMR spectroscopy.

The conversion of croplands to grasslands implied an SOC increase of 1.25 Mg C ha^{-1} yr^{-1}. The high rate of C sequestration can be attributed to the high productivity and to the acidity of the soils. Most part most of the C gained was found as labile SOM compounds (high litter input through fine root biomass and the addition of cow slurry) but associated to the MAF. The data indicate that the accumulation of organic labile C is stabilized by adsorption in clay mineral surfaces and by the soil acidification. As a consequence of these changes in SOM, the conversion of arable lands to grasslands led to a recovery of the organic P fractions (mainly P monoesters and diesters) reduced during intensive crop management.

Keywords: Grasslands; Soils; Restoration strategy/ planning

Fig. 1. New grassland established on a former arable land

Valle Salado Botanic Site: to restore the halophilic vegetation

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ABSTRACT

The Valle Salado (Salt Valley), is an inland salt facility with uninterrupted exploitation during 6000 years .It was recognized by the Fao with the title of World Agricultural Heritage in 2017 This special site has its own biodiversity , linked to the salt productions.

In 2018 was realized a project located at the beginning of the valley that aims to recover the environment of the main spring, the source of Santa Engracia, turning it into a botanical spot that allows the enhancement of the specific botanical species of the place as well as their recovery and dispersal This salty water spring is connected to a system of wooden channels, that distributes the brine by gravity all over the saline

From the formal point of view, the design of the botanical spot emanates from the superposition of the history of the place, the botanical study carried out and the dispersion strategy designed: The halophilic biodiversity of Salinas, its specificity, is closely linked to the production of Salt. This idea is transferred to the plant in a formal way, creating the flora orchards, that recover the formal part of the landscape and are integrated into the area favoring the appearance of the characteristic vegetation.

From 2019 there is a collaboration between Aranzadi, The Olarizu Garden and the Alava Department of Biodiversity in order to develop protocols for germination and cultivation of different threatened species. In the case of Araba/**Álava** we could highlight the works carried out with, among other species, Puccinellia fasciculata Frankenia pulverulenta, Ephedra fragilis y Primula farinosa. these activities are focused on the collection of seeds and material vegetative, but in recent years work has also been done on plant production for Restoration works

Keywords : Biodiversity, halophilic vegetation, connectivity, resilience, heritage

Fig. 1 Botanical site after construction and with the first seed production

Hydrological management of Castellet basin for taking control of avenues, forest fires, and improve biodiversity

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ABSTRACT

Some Mediterranean stream basins are natural in the upper part and urbanised in the bottom. The basin makes a funnel so a big concentration of water in a small space creates big flooding problems. In Castellet some people have died for flood events. Due to the steep slope most of the water just flows down and the area is essentially dry. But when a natural space keeps water you can see the difference in the quality and health of the vegetation. There are also big issues of water capability in the farms/houses of the valley.

Castellet stream basin topography and its torrentiality has triggered numerous avenues and caused several damages in the last decades. In addition, this area is formed by immature forests, vulnerable in front of fire risk.

Defining and locating different actions for runoff water management in the basin, lets us increase the retention time to laminate the avenues and increase the humidity of the terrain. The project consists in the execution of lamination ponds, cribwall dikes, infiltration channel and fascines. Some works are going on successfully.

Most of the planning actions will be done using troncs and branches from the same forest. So we are going to manage the woods in order to have less tree density and bigger specimens.

The definition of actions in the basin, has allowed to calculate the volume of water that would intercept and compare it with the total volume of the runoff. The results show that for 2-year return periods the volume of water retained is around 38-66%, while for periods of 50-year it is down to 4-14%.

Keywords: stormwater, soil bioengineering, biodiversity, lamination pound

S17
Forest Restoration

Deciphering the performance of holm oak saplings to improve restoration success of Mediterranean forests

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ABSTRACT

The implementation of trait-based ecology in the framework of ecosystem restoration is crucial to develop precision-forestry strategies that promote the recovery of Mediterranean forests. We focused on studying the resilience of holm oaks (*Quercus ilex* L. subsp. *ballota* (Desf.) Samp.) in a climate change context and combined sapling traits with remote sensing techniques to obtain a precise view of the responses of this drought-tolerant species to changes in soil water and nutrient availability. In December 2017, we set up a common garden experiment under Mediterranean xeric conditions with nursery-grown holm oak seedlings coming from four different provenances of the Iberian Peninsula. The experiment followed a randomized block design with two factorially crossed factors, namely irrigation and nutrient addition during two consecutive growing seasons. In September 2020, we harvested 240 individuals and measured leader stem length, aboveground biomass, leaf nutrient concentrations (N, P and K), leaf isotopic composition ($\delta^{13}C$ and $\delta^{18}O$) and remote sensing-derived indices (NDVI and NDWI). Sapling traits and spectral indices did not significantly change after irrigation or nutrient addition. However, among all individuals and factors, we found a significant positive correlation between $\delta^{18}O$ and $\delta^{13}C$ and, in turn, this pointed out that the holm oak saplings –which were growing under xeric conditions– were unable to maintain an adequate control of transpiration flux when values of water-use efficiency were higher than -25 $\delta^{13}C$. Moreover, saplings coming from the driest provenance showed the greatest water stress tolerance and photosynthetic activity, as reflected by the lowest value of NDWI and the highest value of NDVI, respectively. These findings contribute to a better understanding of the intra-specific physiological plasticity and resource-acquisition strategies of holm oak saplings and expand the knowledge about how changing abiotic conditions could affect early success of reforestation in the Mediterranean Basin.

Keywords: Irrigation, nutrient addition, reforestation, resource-use strategies

Potential impacts of afforestation/deforestation scenarios on regional precipitation recycling in a Mediterranean area in SE Spain

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ABSTRACT

During the last decades, the rural collapse produced important land transformation in the Mediterranean coastal areas of SE Spain. The intensive migration movement towards the coasts increased the land abandonment in the inland areas and the urban growth in the coastal areas affecting considerably the forest expanses. According to some authors these changes impacted the regional precipitation recycling defined as the measure of the contribution of local evaporation/evaporationtranspiration (E) to local precipitation (P). In this work we used a modified version of the Weather Research and Forecasting model (WRF-tag) and two land use change scenarios (maximizing the afforestation (SC1) and the deforestation (SC2)) to investigate its potential impacts on regional precipitation recycling. The WRF-tag allows to track the tagged atmospheric water species originated from evaporation in a source region, in this case the Jucar Basin. The preliminary results show that 1.2% of the E is recycled in the Jucar basin. This percentage changes in space and it depends on the season. The afforestation scenario showed an increase in the precipitation recycling in limited areas.

Keywords: Afforestation, deforestation, regional precipitation recycling, Mediterranean

Plant functional diversity affects the macroinvertebrate community in a Hawaiian wet forest restoration

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ABSTRACT

Traditionally, restoration projects have focused on the plant community and have assumed for animals that "if you build it they will come", however, this is not necessarily true. Also, restored ecosystems offer an opportunity to know how plant species composition and functional diversity affect animal diversity in a more controlled way than in natural systems. In this study, we take advantage of an experimental restoration experiment in a lowland tropical wet forest in Hawai'i where arboreal communities (20x20m plots) were planted with the same species richness (n = 10) but with different functional diversities (i.e., complementary or redundant species) and rates of nutrient turnover (i.e., slow or moderate), totaling 5 treatments (reference, slow-complementary, slow-redundant, moderate-complementary and moderate-redundant). We set 5 blocks including the 5 treatments each, and each plot was sampled at 4 different points and 4 times over a 2-year period. Sampling was done using litterbags located under outplants. We identified individuals to species and calculated species richness and abundance of micro and macroinvertebrates based on the main invertebrate families.

Overall, we found the species richness and abundance did not change among treatments, but that the composition of the communities differed between the reference and all the treatments. We also found differences in the richness of spiders and mites and on the abundance of spiders, mites and psocoptera among treatments. The slow-complementary treatment was poor on spider and mite richness, and on spider abundance compared to the reference. The slow-redundant treatment was rich in psocoptera compared to the reference and the moderate-redundant. Finally, the abundance of mites differed among all treatments except for the slow-redundant. Our results suggest that the functional diversity and rate of nutrient turnover of tree communities affects the species richness and abundance of some invertebrate groups in tropical wet forests.

Keywords: arboreal restoration, BEF, functional diversity, macroinvertebrates.

Conservation and Restoration of Mediterranean Taxus baccata woods in southeastern Spain

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ABSTRACT

Taxus baccata (Yew) Mediterranean woods are listed as priority habitats in the EU Habitats Directive, being a relict plant community qualified by the European Environment Agency for the conservation status "U2 Unfavourable-bad" in the Mediterranean biogeographical region. In the Valencian Community (=Region of Valencia, Eastern Spain) the EU's LIFE Programme supports conservation efforts to improve this habitat through the LIFE Teixeres project (LIFE20/NAT/ES/001128), recently approved. Several actions are programmed to reduce the main conservation threats acting over the Yew and its plant community: habitat fragmentation, small population sizes, low seed productivity and recruitment, herbivory and trampling by wild fauna, climate change and wildfires. Amongst other, one of the main measures consists of the establishment of seed producing orchards placed under controlled conditions in areas close to the natural favorable sites for this habitat, in order to improve natural seed dispersal by birds and future recruitment, following the *quasi in situ* model for recovery of endangered species. The yew plants used for the orchards were obtained from cuttings, coming from the natural close populations, willing to get quicker seed production by shortening tree maturity, avoiding sex ratio problems and increasing the genetic diversity. In addition, seed production is proved to be bigger than in the close native populations. Both in seed orchards and field plantations, yews are accompanied by a set of native, fleshy fruits producing species, able to attract birds and to improve the seed dispersal, as well as by spiny shrubs, which will act as facilitator plants to protect the recruited ones against the effect of herbivores. Additional actions include measures such as forestry treatments to reduce competition and wildfire risk, germplasm collections for plant production and ex-situ conservation, experimental fencings, plant production and population reinforcements using 37 key species for the priority habitat.

Keywords: Taxus baccata, yew, climate change, seed production, recruitment, dispersal

Fig. 1 Solitary Taxus Baccata in Serra de Mariola, Alacant.

Rehabilitation of cork oak forests through the involvement of the local population from Northwestern Tunisia

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ABSTRACT

Because natural regeneration and direct sowing are difficult plantation has been approved as the best method used for the rehabilitation of cork oak forests, especially with the improvement of seedling production techniques. In Tunisia, cork oak forests are publically owned allowing only free usage to the local population without involvement in management and conservation issues, exclusively fulfilled by Forest Administration (FA) ledding then to a conflictual situation. Moreover, carried out by FA agents or given to companies, the plantations have given disappointing results. This study aimed to test, for the first time in Tunisia, the feasibility and effectiveness of co-executing the rehabilitation operation. In the framework of a project funded by Korea International Cooperation Agency (KOICA), the local population living in 3 selected sites, located in Northwestern Tunisia, were assisted to set up agricultural development groups and a contract was signed in 2016 with their representatives. With FA and researchers, they contribute as stakeholders to the Business Continuity Plan (BCP). Average cost of plantation was estimated at 1388 € per ha. Actually, local population contributed in all the activities from the fencing by 46.4% of the costs to the strip clearing (100% of the charge) and planting (68.5%). Guarding (66.1%) and summer irrigation (100%) were added to ensure plantation success . Although the high charge of this experience but the local population contribution rise awarness and reduced also grazing. After two years, the results showed an average of survival rate of cork oaks estimated at 66 % which is considered high compared to similar planations fulfilled before.

Keywords: Tunisia, cork oak, rural development, participatory approach.

Five years' experience of Natura2000 oak forest habitat restoration in Hungary

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ABSTRACT

In the framework of a running LIFE project (LIFE4OakForests), we have started the restoration of four Natura2000 oak forest habitats to enhance structural and compositional complexity in 2017. The active management takes place on 19 pilot sites of three national parks and will affect approx. 1500 ha *Quercus petraea, Q. cerris,* and *Q. pubescens* dominated oak forest stands. The following management actions have been started: girdling of trees to create standing deadwood, felling of trees to create downed woods, high stumps, and smaller and larger gaps in the canopy. Microhabitats were created to provide nesting, breeding, and sheltering habitats for forest-dwelling species. Tens of thousands of saplings of ten native tree species were planted to increase tree species diversity. We have developed a two-level monitoring protocol; a network survey to detect the changes at the stand level and intensive forest experiments for targeted observation of deadwood enrichment and gap openings. Surveys of several organism / functional groups, including regeneration, herb, and moss layers, different beetle groups, mammals (incl. bats), and birds (incl. woodpeckers), have begun. Preliminary data shows that the original volume of deadwood and the number of microhabitats were generally multiplied on each monitored site that had undergone some intervention. The cover of the herb layer species increased significantly two years after the treatments, but species diversity of herbaceous species did not increase. Artificial gaps enhanced the height growth of saplings, especially of the admixing species. We have detected the rapid answer of woodpeckers by the fast utilization of the treated trees; we have found a significant difference between deadwood types and tree species in foraging activity. Camera traps revealed the importance of deadwood enrichment for mammals – lying deadwood is used as a transport route, observation, and marking sites for wild cats, martens, and foxes.

Keywords: oak forest restoration, microhabitats, deadwood, structural complexity, tree diversity

S8
Mine Restoration
Chair: Klara Rehounkova

INNOVATIVE RESTORATION

"La Chanta" quarry: a study case of restoration and reconnecting people with nature

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ABSTRACT

La Chanta quarry (Madrid) is an example of groundbreaking mining restoration.

It is located in a territory destined mainly to agriculture and infrastructures, where many species of fauna and flora do not find their necessary habitat requirements. In this context, the habitats created by mining activity appeared as rare shelters for the proliferation of valuable species. To protect and promote the biodiversity that had colonized the site, the original restoration project was modified. In a small area (20 hectares), multiple restoration techniques were applied, creating a complex mosaic. State-of-the-art techniques such as GeoFluv- Natural Regrade or Talud Royal were applied. Revegetation was carried out with native plants and innovative techniques. In a creative and unique initiative, old facilities were used to generate shelters for cliff-nesting birds and bats. Also, a wetland was re-naturalized for amphibians, insects and birds, becoming the only wetland in 15 km.

All this was developed by a multidisciplinary team of mining experts, geologists, biologists and ecologists, from the private and the conservation sectors, proving that restoration projects can create green jobs.

LafargeHolcim Spain signed a Land Stewardship agreement with the local NGO Brinzal. Different actions where established, among which the 'School of Naturalists' stands out. This is a space in which to develop outreach, training and environmental education activities for children.

This restoration is a clear case of IUCN Resolution WCC-2020-Res-088 (Conservation of the natural diversity and natural heritage in mining environments) and proves that each mining site offers unique opportunities for the promotion of biodiversity and has distinct opportunities for restoration. This makes them ideal blank canvases to experiment in, while returning a territory rich in ecosystem services to nature and society. We hope this project will inspire the application of similar restoration models in the mining sector.

Keywords: Groundbreaking mining restoration, protect and promote the biodiversity, innovative techniques, close collaboration, 'School of Naturalists'.

Using various artificial soil mixtures to restore dry grasslands in quarries

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ABSTRACT

Quarry restoration is difficult to implement due to the scarcity of the original soil. The restoration of Mediterranean dry grasslands to mitigate similar ecosystem/habitat loss is thus still a developing process. So far, very few studies have created artificial substrates to address the lack of soil. In the La Crau plain (Southeastern France), quarries were established in an ancient Mediterranean steppe-like dry grassland. Once the remaining grassland zones were protected in 2001, quarries were extended over former intensive orchards established on the grassland in the 1990s before it was protected. Now, restoration has to be done without the unaltered protected grassland soil but with the soil from orchards, which contains fertilizers spread during the orchard exploitation. To recreate a more suitable substrate, the orchard topsoil was mixed with poor substrate materials directly extracted from the quarry (0–30 mm pebbles with sandy matrix). Different substrate mixtures were tested with or without sowing the dominant species of the grassland, a perennial grass: Brachypodium retusum (and an annual grass *B. hybridum*). After 5 years of monitoring, our results show that raw substrate materials (100%) limit the establishment of all species, and that, at the opposite, orchard topsoil (100%) favors a significantly higher species richness of target and non-target species.

The recommended substrate mixture to reach a compromise between high target species cover and low non-target species cover is composed of 50% raw quarry material and 50% arable soil. Sowing *Brachypodium* not only limits non-target species richness and cover but also reduces target species richness establishment.

Keywords: artificial soil mixture, Mediterranean grassland, raw substrate materials, soil restoration, habitat Natura2000 6220 - Thero-Brachypodietea

Fig. 1 Experimental plots set up in the Ménudelle quarry in 2016

Understanding biodiversity threats from mining construction minerals for conservation and restoration

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ABSTRACT

Construction minerals – sand, gravel, limestone – are the most extracted solid raw materials and account for most of the world's anthropogenic mass, which as of 2020 outweighed all of Earth's living biomass. However, knowledge about the magnitude, geography, and profile of this widespread threat to biodiversity remains scarce and scattered. Understanding how species will respond to extractive activities is crucial to promote their effective conservation and restoration of their habitats. In this presentation, I will show the results of the first systematic evaluation of species threatened by mining of construction minerals globally, combining long-term data from the IUCN Red List and new species descriptions. We found 1,047 species in the Red List impacted by this type of mining, of which 62% are threatened with extinction and four species already went extinct, and 234 species descriptions in 20 biodiversity hotspots reporting impacts from mining. The temporal trends of assessments evidence the increased saliency of this threat to biodiversity, whose full extent may well reach over 24,000 animal and plant species. While rock quarrying mostly threatens karst biodiversity and narrow-ranged species, sand and gravel extraction is a more prominent threat to freshwater and coastal systems. Building on our findings and ongoing initiatives in cooperation with the Global Sand Observatory of UNEP, I will present an 8-point strategy to limit the biodiversity impacts of mineral extraction and promote the restoration of degraded ecosystems, including the use of science-based evaluation and monitoring, the public reporting of mitigation and monitoring outcomes, and the mainstreaming the mitigation hierarchy within the mining industry. Aligning material needs with the objectives of the 2021-2020 UN Decade for Ecosystems Restoration will be crucial to halt biodiversity loss while ensuring supply and equity.

Keywords: extractive industries, sand, limestone, endangered species, infrastructure development.

The effect of tree foliage traits on soil carbon storage depends on soil development

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ABSTRACT

Soils and forest soil in particular represent important pools of carbon (C). Here, we present a quantitative review of common garden experiments in which various tree species were planted alongside each other in European countries to answer following questions: Does soil sequester more C under broadleaf than under conifer trees? and How do the effects of tree species and litter quality on soil C sequestration change with soil development (i.e., maturity) and other soil properties? We found that the effects of broadleaf and coniferous trees on C sequestration differed with the stage of soil development. In mature soils, more C was stored under coniferous trees than under broadleaf trees. In soils in early stages of soil development, on post-mining spoil heaps, the opposite trend was found, i.e., more C was stored under broadleaf. C sequestration under broadleaf trees was highest in immature soils and in soils with high pH. C sequestration was negatively correlated with the litter C:N ratio in post-mining soils but not in other more mature soils. Similarly C sequestration was negatively correlated with the litter C:N in alkaline soils and in soil with high clay content. These results suggest that C sequestration mechanisms differ in immature vs. mature soils such that C storage is greater under broadleaf trees in immature soils but is greater under coniferous trees in mature soils. This was tested in detail by comparison of Alder and spruce forest in soil developed in mining sites near Sokolov and surrounding soils. The study was supported by LIFE17/IPE/CZ/000005 project.

Keywords: mining sites, soil organic matter, carbon storage

Monitoring Quercus seedlings' survival and growth beneath nurse shrubs in coal mines reclaimed to grasslands

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ABSTRACT

Plant-to-plant facilitation enables some species to persist in stressful environments. However, the effectiveness, in the long term, of using nurse shrubs as ecosystem engineering species for the tree seedlings establishment in degraded man-made ecosystems requires more knowledge. Thus, a 10-year field experiment was conducted to determine if native colonizer shrubs (*Genista florida* and *Cytisus scoparius*) used as nurse plants enhance the survival and growth of seedlings of ecologically contrasted *Quercus* species (*Q. pyrenaica* and *Q. petraeae*) in open-cast coal mines rehabilitated to pastures in Northern Spain. Of each tree species, 400 seedlings were planted under four different treatments combining the influence of nurse shrubs and fencing upon *Quercus* seedlings. Fenced plots within this experimental design allow the differentiation of the two main facilitator effects exerted by shrubs: the protection from biotic (herbivory by ungulates) and abiotic (summer droughts) stresses.

Shrubs enhanced seedling survival compared to areas without shrubs, particularly for *Q. pyrenaica*. Ten years after plantation, mortality reached 83% for *Q. petraea* and 66% for *Q.pyrenaica* under shrubs compared to 96 and 99%, respectively, outside the canopy of shrubs. Seedling herbivory did not seem to be a great limitation to survival; a marginally positive effect of the fence was found only in specific years.

The protection from abiotic stress (summer droughts) mediated by shrubs may be more determinant of the *Quercus* seedlings' growth at the early stage than the protection from biotic stress (herbivory), while the fence became more relevant later in areas without shrubs, especially for *Q.petraea*. The differences in *Quercus* seedling annual growth between areas with and without shrubs were lower in the most stressful years.

We conclude that our leguminous nurse shrubs constitute a promising technique for the long-term effective reintroduction of late-successional oak species, especially the Eurosiberian species, under a bioclimatic limit in sub-Mediterranean grazed areas.

Keywords: facilitation, *Quercus* spp., nurse shrubs, coal mines, survival and growth.

Comparison between active and passive restoration in extractive activities

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ABSTRACT

A comparative paired study of six different types of extractive activities (EA), representing different exploitation and restoration models was performed. Each type was represented by two EAs, one with current active restoration works and the other with passive restoration. Each pair of EAs are close to each other and have similar climate, orientation and elevation. Restoration ages are in a range between fifty and twenty years. The soils were characterized, both by its particle-size distribution and chemically. The vegetation was analysed, both in terms of floristic composition and vegetation cover. One of the most important factors for the progress of restoration is the quality and quantity of soil substrate. In the studies carried out, stony soils predominate, with percentages of less than 40% of fine soil (<2mm). The predominant fraction, therefore, was gravel, being more noticeable in activities with passive restoration. On the other hand, in activities with active restoration the soils were more clayey and with a higher organic matter content than in activities with passive restoration. The electrical conductivity values of soil extracts remained between 0.13 and 0.24 dS/m, except in gypsum quarries where this value was much higher. Active restorations have higher nitrogen and potassium contents than passive restorations. This is due to the contribution of organic amendments or the regrading of old agricultural land. In those activities where EDAR sludge has been used as a soil amendment, phosphorus levels are also higher.

Keywords: quarry restoration, Mediterranean climate, restoration techniques optimization, soil organic matter, vegetation development.

Meso and macro-fauna ecosystem engineers as indicators of restoration success in a rehabilitated mine tailings chronosequence

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ABSTRACT

Long-term success of mine tailings restoration requires moving from monitoring just aboveground indicators, such as vegetation composition, or physico-chemical analysis of the substrate toward a more ecosystem integrated approach. Traditionally, restoration assessment in mining sites worldwide, had overlooked and undervalued the functional roles of soil fauna. However, the extended literature suggests that soil fauna, specially meso- and macrofauna, are major drivers in soil formation and development, and soil multifunctionality in post-mining sites. Our aim is to understand the colonization and community development of soil invertebrates, especially soil ecosystem engineers in restored mine sites. We compared invertebrate communities from three different restoration stages (a chronosequence of 5, 15 and 30 years old). Invertebrate samples were taken using D-vac, hand-sorting and pitfalls during 2019 and 2020. Soil physico-chemical and biological properties of the substrate were also analysed. We found that community assemblage and dominance indices Simpson's (D2) and Berger–Parker (BP) are a better predictor of successional stage and invertebrate species assemblage than Simpson's Index of Diversity (D1) and Shannon-Wiener index of diversity (H). Also, the abundance and diversity of ecosystem engineers such as earthworms, ants, collembola and mites differ across the chronosequence. Presence and abundance of ecosystem engineers were correlated to some soil properties and soil functions in the chronosequence. The abundance of Formicidae and Lumbricidae, was significantly higher in later stage of succession (30 years old). Our results suggest that monitoring and assessment of rehabilitation success by targeting soil fauna ecosystem engineers is a more promising tool than looking at diversity indexes alone in restored mine tailings. Further research is required on the links between above- and belowground food webs to understand how soil fauna communities and their interactions contribute to soil functions in rehabilitated industrial sites.

Keywords: ecosystem engineers, monitoring restoration, soil food webs, diversity indices, soil multifunctionality.

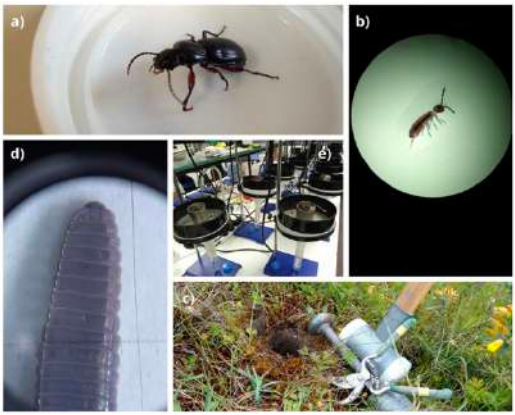

Image. 1 Extraction, identification of soil fauna and soil sampling in a chronosequence of restored mine tailings. a) Ground beetle from the genus Pterostichus sp. captured in pitfalls traps; b) Collembola extracted from soil cores; c) soil core method in the field; d) Lumbricus sp. captured by hand-sorting; e) extraction of mesofauna from soil cores using a modified Tullgren apparatus.

Soil and Water Bioengineering, a Nature based discipline between grey and green Infrastructures

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The past t year we presented online the symposium Soil and Water Bioengineering as a tool for ecological restoration

The session presented a wide spectrum of different approaches, from a general overview of the possible applications of Soil and Water Bioengineering (SWB) techniques In ecological restoration to more specific experiences of concrete projects in a very wide diversity of fields: rivers, coastal areas, lagoons, landslides, roads etc. mitigate with innovative and environmentally friendly methods, this serious threat.

The European Union is promoting Nature-Based Solutions (NBS) because they can help mitigate global environmental challenges while creating jobs and promoting economic growth and innovation. This new concept promotes nature as a more sustainable and efficient solution to environmental problems Soil and Water Bioengineering, as Nature-based Solution, is able to both mitigate and restore lost ecosystems and to avoid the degradation of our environment. It must work hand in hand (in parallel) with ecological restoration.

The application of combined techniques of Gray-green structures and NBS are becoming more important worldwide to protect a generalized increasing erosion risk due to climate change.

Soil and Water Bioengineering as a hybrid discipline The term “Engineering” refers to the knowledge-based use of technical and scientific techniques and solutions for building, stabilization and erosion control and “bio” because these functions are related to living organisms, mainly native plant species, with appropriate biotechnical characteristics and for the purpose of rebuilding ecosystems and increasing biodiversity. It includes technical functions (e.g. soil protection and slope stabilization), ecological objectives (ecosystem restoration), landscape objectives (improvement of landscape value and integration) and also takes into account several socio-economic aspects (efficiency and employability).

The fact that it is a hybrid discipline makes it sometimes mistrust both those who must project from traditional engineering and those who deal with restoration.

In this workshop starting from a selection of some examples (3 or 4 Projects) in roads construction , urban rivers or mining areas, and then open the discussion on the different approaches and possibilities of Bioengineering as NBS and as a a meeting point between the world of traditional engineering and that of ecological restoration .

Soil and Water Bioengineering (SWB) is and has always been a Nature-Based Solution (NBS): a reasoned comparision of terms and definitions

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ABSTRACT

Nature-based solutions (NBS) is a collective term for solutions that are based on natural processes, in healthy or restored ecosystems, and their services to address the three pillars of sustainability, including climate-related challenges. Soil and Water Bioengineering (SWB) is a hazard mitigation and restoration discipline formally established and structured since the aftermath of World War II, but finding its roots in age old applications, which have many objectives in common with NBS. However, a structured comparison of SWB and NBS terminologies and objectives is lacking, and this is much needed to highlight that SWB are amenable to the concept of NBS in the context of climate change adaptation and disaster risk reduction (DRR). This work presents a comparison between the definition of SWB, NBS, and other terminologies that fall under the NBS concept. A matrix was created to compare NBS and NBS-related terminologies with the three main aspects of the SWB practice: "main aims", "fields of application" and "other objectives". Results from the comparison confirm that NBS is a unifying concept to prioritise nature to integrate climate change adaptation, mitigation, and disaster reduction efforts, embracing also many aspects of SWB criteria and applications. Thus, SWB can and should be recognized as having always been an NBS.

Keywords: disaster risk reduction, ecological engineering, slope and stream stabilization, ecological restoration, biodiversity.

Soil Substitutes for Sustainable Land Reclamation of Coal Mining-Affected Areas

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ABSTRACT

This contribution presents the development of soil substitutes for land rehabilitation of coal mining-affected areas (waste heaps) using fly ashes from coal, aggregates from mine waste processing, sealing material and energetic slag. Spent mushroom compost was incorporated as a substrate to enrich the artificial soils with organic matter and valuable nutrients. Various soil substitutes were prepared, differing in the type of waste and their percentage share. Two tests were carried out to assess each soil substitute's suitability. White mustard (Sinapis alba) was used for germination tests in the first step. In the second step, seeds of semi-natural meadow communities were additionally used. They were represented by plant species typical for meadow communities in Central Europe. Considering the habitat condition on waste heaps slopes, species with low (dry meadow) and moderate soil moisture requirements (mesic meadow) have been considered. The evaluation of semi-natural meadow communities on such types of reclaimed coal-mining affected areas has already started at Libiąż coal waste heap in Poland. The coal mining waste heaps seem to offer suitable conditions for these semi-natural communities' development. The safe and efficient application of such anthropogenic materials is compatible with sustainability principles and the circular economy concept, combining the adverse effects of industrial activities with environmental benefits. As an expensive and non-renewable material for reclamation, natural soils could be replaced by valuable soil substitutes made from waste. This innovative approach has the potential to be widely applied in mining regions undergoing transformation.

Keywords: soil substitutes, industrial by-products, acidic waste heaps, land rehabilitation, circular economy.

Fig. 1 Land rehabilitation at Libiąż coal waste heap in Poland

Solutions to the flooding of the Estepona river in the urban area of Bakio (Vizkaya) with Soil and Water Bioengineering

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ABSTRACT

The municipality of Bakio, located on the Biscayan coast, suffers significant floods due to the confluence of the effects of the Estepona river floods with the equinocial tides, affecting an important part of its urban area. In order to mitigate the adverse effects and in order to improve the resilience of the area to the climatic emergency, the project consist in open and de-channelling a section of the river ,allowing the current flood plains (4 has) to laminate the avenues and to protect the homes located in proximity , with the urban integration as a new floodable park.

The project´s objectives could be summarized in the following points

1-Allow the Estepona river to express its current hydrodynamics in various areas

2- Create an interior marsh in the zone of tidal influence,

3-Upstream is designed a bypass to transform the area into a flooded forest integrated into the current park

4-The integration of hydraulic and environmental solutions in the urban fabric of the municipality in order to create a central urban park Integration from the landscape

The project creates a new topography, which while improving the Flood scenarios in the return period considered (100 years), proposes a frequent operation of the system, a recovery of ecosystems and their services and an improvement of the designated spaces. a park. All the proposed solutions are based on Soil and Water Bioengineering techniques and the landscape has been the inspiration and coordinator of the different disciplines

The project and its subsequent execution is integrated into the Life Urban Kllima project

Keywords: Adaptation, climate emergency, flood abatement, mitigation, Life Urban Klima

Fig. 1 Flooding problems and a new floodable park

Technosols for slope stabilization and ecosystem services maximization: pilot experiences and long-term results.

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Abstract: *Technosol* construction in slope restoration works is a practice that allows reusing former soils, recovering mineral wastes and recycling organic residues, contributing to the green and circular economy, while improving the results of revegetation. The use of organic amendments, which can be organic wastes (sewage sludge, digestate of selectively collected organic fraction of municipal waste, biostabilized, manure, etc.) or comercial products (compost, vermicompost, humic organic amendments, etc.), allows to accelerate the biological colonization of inert substrates. The appropriate combination of these mineral and organic materials, mixed and placed emulating the horizons of natural reference soils, allows the construction of *Technosols*, to cover the surface of geotechnically-stable slopes. In the medium term (5-10 years) these *Technosols*, built with adequate doses of organic amendment (a maximum of 50 Tm/ha, dry weight), allow the recruitment of native species, increasing the plant diversity of the slopes and its ecological value. In the long term (>20 years), these *Technosols* manage to sequester organic carbon significantly and effectively, up to nine times more than without the use of amendments. The short, medium and long-term results of various cases of success (and failure) of the use of organic amendments in rehabilitation of road embankments, extractive activities and dump fills are presented. In turn, a series of criteria are proposed for the selection and use of organic amendments in soil rehabilitation tasks, giving specific guidelines for the different residues and organic products usually available in European countries, while establishing the requirements of quality of mineral substrates in the context of their use for *Technosols* construction.

Keywords: circular economy, organic amendments, application guidelines, carbon sequestration, biodiversity.

Figure 1. Quarry restored with *Technosols* constructed using sewage sludge, just before sludge application (a) and 20 years after (b).

Functional biodiversity associated to soil bioengineering cribwalls

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ABSTRACT

Due to the clime change scenario, severe hydro-meteorological phenomena are having a high impact on the ecosystems of the earth. Some strategies based on the use of natural communities associated with geomorphological changes that restore the natural landscape are gaining success due the resistance and resilience against damages. All of these strategies are known as nature-based solutions (NBS). Soil and water bioengineering techniques are one of the most appreciated tools to reach effectiveness for slope stabilization. They are based on the capacity of some plants to consolidate the soil with his rooting system in special conditions (high slope, flooding impact.)

Slope stabilization solutions with soil and water bioengineering techniques need to be adapted to this new scenario. Crib wall is one of the most complete soil and water bioengineering technique for structural slope stabilization. It is based on a wooden box full of live plants that in the future will grow and gain stability at the same time that wood decays. The crib wall front area is traditionally stabilized with fascines made of branches of riparian species with the capacity for vegetative propagation. Their diameter can change due to the humidity variation, so the stiffness of the system is at risk against severe hydro-meteorological phenomena. The introduction of HDCL in crib walls improves planting success and makes them more resistant to adverse weather events in Mediterranean areas.

During last spring we have flow a selection of 20 cribwalls done in the last 15 years. These visits give us information about biodiversity associated to crib walls. We have data about the number and characteristics of the plants presents in the system. We know which are the original plants planted and which new species appear. Also, we get data about the quality of the wood (decaiment observed) and structure in general.

Keywords: clima, bioengineering, cribwall, biodiversity

Using soil and germination models to predict seed germination in geomorphic restoration in mines

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ABSTRACT

In recent years, geomorphic restoration (GR) has begun to be applied in Spain to reconstruct the landscape after mine closures. GR produces stable landforms and soils which are resistant to erosion, but it remains unknown how RG landforms and soils influence soil water availability for plants. Measures in several mining slopes with and without GR indicate that there is more soil water content in GR slopes. But, what is the ecological meaning of said differences in soil water content? How much water is sufficient for seed germination after sowing? Do differences in soil water availability between treatments explain differences in seedling establishment? To answer these questions, we modelled germination of seeds (used in mine restoration) according to soil water potentials and temperature which provide us with the probability of seed germination according to temperature and soil moisture in the field. We will compare these models with the humidity and temperature measured in the field and simulated using the Hydrus-2D soil model. This will allow us to know when humidity and temperature conditions are suitable for the germination of these species, identify the window for germination of the studied species and understand if higher soil water content translates in higher soil water availability. In addition, thanks to the use of the Hydrus-2D model, we will be able to know the spatial distribution of humidity and temperature, and thus estimate the probability of germination, in areas different from our study site, e.g. in different locations, slopes, landforms or soils.

Keywords: Mining, Seed germination, Soil water potential, Geomorphic restoration.

Flagship program in the Mediterranean Region UN Decade on Ecosystem Restoration

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Session supported by the Food and Agriculture Organization of the United Nations (FAO) through the Silva Mediterranea statutory body and the Forest and Landscape Restoration Mechanism (FLRM).

The Mediterranean region includes more than 88 million hectares of forested area, under threat of degradation due to climate change effects and population increase.

Endorsed in 2017 by ten Mediterranean countries, the Agadir Commitment was proposed to establish a new Regional Mediterranean Initiative on Forest and landscape restoration (FLR) to restore at least 8 million hectares of degraded land in the Mediterranean region by 2030.

Assessing the restoration activities being promoted and implemented in the region has been a key element in presenting the Mediterranean region to the Restoration Flagship Initiatives under the framework of the United Nations Decade on Ecosystem Restoration 2021–2030 (UN Decade).

Restoration Flagship Initiatives will be identified as the best (or most promising) examples of successful ecosystem restoration that countries or regions would like to obtain global recognition for, to inspire other countries and regions to scale up successful restoration efforts.

In this session, the assessment of the restoration activities promoted and implemented in the Mediterranean will be presented. The focus is on Lebanon, Morocco, Tunisia and Turkey.

By its National Forest Programme, Lebanon identifies the interventions for the sustainable management of forest resources, including the restoration of degraded forest land.

- Morocco has developed and implemented several strategies to deal with land degradation and promote restoration. The recent strategy Forests of Morocco 2020-2030 includes a reforestation program with 600,000 ha of forest plantations.
- Tunisia has established the new National Strategy for the Development and Sustainable Management of Forests and Rangelands 2015-2024. With this new strategy social, economic and material support have become of paramount importance to promote forest resources.
- Turkey has adopted several laws to increase the forest area and tree wealth and protect environmental values.

Successful case studies from the four Mediterranean countries are showcased as examples to be replicated in other Mediterranean environments and identified as constituting the representative cases for the Flagship in the Mediterranean region.

Assessing the restoration activities in the Mediterranean for the Restoration Flagship Initiatives

Forest and Landscape restoration in Lebanon
A case study on post fire restoration

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ABSTRACT

Lebanon is a country of 10.452 sq Km, on the Eastern part of the Mediterranean, with a forest cover of 13% and 11% OWL.

Due to many factors (climate change, human activities) land degradation became an urgent challenge to be dealt with.

In 2012 Lebanon launched its National Afforestation and Reforestation Program with an objective of reaching 20% of forest cover (Also known as the 40 million trees program).

The Forest and Landscape Restoration Mechanism was the triggering tool to find balance between restoring ecosystem services (biodiversity, soil and water conservation) and productive land functions for agriculture.

The first part of the FLRM financed by the Republic of Korea aimed at restoring abandoned agricultural terraces that are a very important cultural and natural heritage in the mountainous areas of Lebanon.

The second part funded by Germany (IKI) focused on large scale national FLR plans/programs implemented to maximize the contribution of FLR options to achieve the Paris Agreement and the Bonn Challenge. Restoration of rangeland areas was an important achievement.

Forest fires in the Mediterranean are becoming a major disaster. In Lebanon this is one of the greatest causes of land degradation.

Post fire restoration is a crucial issue that is often done without any scientific background leading to negative impacts thus hindering the success of the operation.

A case study on a post fire action in Akkar region (North of Lebanon) in 2021 showed the importance of setting a work methodology using satellite maps along with field reports in order to develop a model for the prediction of post-fire degradation (GIS).

Production of data on fire distribution according to landscape and forest types, allowed to develop a land degradation risk map helping orienting restoration activities by priorities.

Field activities were oriented into three objectives:

- Assisting post-fire vegetation recover
- Post-fire reduction of soil erosion
- Preservation of soil fertility

Participatory forest restoration in the Talassemtane National Park, North Morocco

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ABSTRACT

Ecological restoration is one of the suitable tools to revert land degradation. In North African countries, restoration interventions take place in complex socioeconomic and cultural contexts and often face bare social acceptance and support. The present project, labelled RESTORMED Morocco, aims at establishing a dynamic of participatory forest restoration in the Talassemtane National Park in North Morocco, within the perspective of sustainable forest management. Co-funded by EDF Foundation and SUD PACA Region and launched in 2020, the project involved a multitude of stakeholders, including local populations, NGO members, administrative staff, local cooperatives and students. Thus, several activities could be carried out: (i) participatory planting of 4000 seedlings of maritime pine in a demonstrative plot of 15 ha, (ii) organization of six workshop sessions aiming at social awareness raising, (iii) distribution of education and communication supports on restoration, (iv) award of scholarships to support academic research on the restoration topic in the area, among others. The project contributed to straightening local technical capacities and stimulating constructive debate on restoration issues while creating economic opportunities to local populations. Preliminary evaluation showed a seedlings' survival rate of 90% and an overall social acceptance. Next steps consist of direct seeding of the endemic *Abies marocana*, assessment of the project outcomes and continuous monitoring of the restored site.

Keywords: sustainable development, conflict management, stakeholders, social engagement

Fig. 1 Participatory planting in the demonstrative plot

The co-management of forest landscapes: An innovative approach for climate change adaptation and mitigation measures

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ABSTRACT

In a Tunisian context marked by socio-economic, political and ecological changes, the management of natural resources can no longer be effective and sustainable without the active participation of all stakeholders and following an integrated and participatory management of forest landscapes with the integration of the impact of climate change.

The Integrated and Participatory Landscape Management Project aims to contribute to sustainable development through the rational management of natural resources and the establishment of mechanisms for good governance of forest landscapes as an innovative process that can be developed locally for the co-management of forest resources taking into account economic, social and cultural aspects.

This approach of co-management of forest landscapes is represented by agreements with agricultural management groups and productive alliances with economic operators to facilitate the access to value-added markets. This will support to developing of a participatory and territorial governance model based on co-management within these forest ecosystems / landscapes using a win-win approach that allows for: 1) empowering users who take ownership of good management practices, 2) building mutual trust between the administration and users, 3) strengthening the sense of independence and financial autonomy thus relieving pressure on forest sector and 4) the creation of active partners who play their part in protecting the forest and conserving biodiversity and subsequently reducing the impact of climate change.

This mode of governance can help to find the measures of adaptation to climate change and mitigation of its effects by a responsible contribution to the preservation of forests thus helping in the positive impacts on economic, social and environmental aspects.

Restoration/Rehablitation activies in Turkiye and its Carbon Benefits

Author(s): Ozdemir, Eray

ABSTRACT

Mediterranean region is one of the vulnerable region to climate change. Many impacts of climate change and extreme climate events such as deforestation, forest degredation and forest fires have damaged Mediterranean ecosystems since last decades. Turkish forests also has been effected by climate change.

Restoration is one of the important way to combat climate change in forests. Therefore restoration acvtities in forests and ecosystems are also important to become resistant to climate change and to increase carbon stocks in carbon pools.

Restoration/rehabilitation has a significant contribution to forest ecosystems for the aspects which mentioned above. In addition to these benefits restoration/rehabilitation activites also biggest part of post fire management in Turkiye.

In this presentation, good practices on restoration/rehabilitation activities in Turkiye within the scope of ecosystem restoration will be presented with the scope of carbon benefits.

S6.
Restoration Planning

Chair: Johannes Kollmann

Contrasting vegetation, soil, and climatic drivers determine plant contribution to soil carbon stocks globally

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ABSTRACT

Restoration efforts worldwide aim to increase the natural sequestration of carbon in our soils to reverse the negative consequences of ongoing climate change. However, how and when plants fix more carbon in the soil across contrasting environmental conditions remains largely undetermined at a global scale. Here, we evaluated to what extent vegetation increased soil carbon stocks compared to open areas between plant patches across contrasting environments worldwide. To do so, we used soils collected from 648 sites from all continents except Antarctica, encompassing a wide range of vegetation types, soil properties, and climatic conditions. As expected, soil carbon stocks are greater in vegetated areas compared to open areas. Furthermore, we observed that forests have greater soil carbon stocks than grasslands and shrublands. The positive effects of vegetation on soil carbon increased in the presence of ectomycorrhiza and with increased net primary productivity and mean annual precipitation. Additionally, the observed positive effects of vegetation exponential increased with increases in soil organic carbon, whereas the relationship between plant contribution and mean annual temperature was nonlinear. Specifically, vegetation showed a positive effect on sites with mean annual temperatures between -6 and 15 ºC, as well as, between 20 and 30 ºC, while it had a negative effect in regions with a mean annual temperature between 15 and 20 ºC. Our findings provide new insights into the actual plant contribution to soil carbon stocks at a global scale and the key drivers that determine the magnitude of the effects of vegetation on soil carbon stocks. This knowledge is key to guide restoration projects aiming to maximize the ability of vegetation to sequester carbon in the soil and, subsequently, to reduce the negative impacts of ongoing climate change.

Keywords: climate change, ecosystem restoration, soil carbon stocks, soil properties, vegetation properties

Ecosystem multifunctionality in Mediterranean-type ecosystems – a matter of species composition and environmental conditions

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ABSTRACT

Ecological restoration increasingly aims at improving ecosystem multifunctionality (EMF) and making landscapes resilient to future threats, especially in biodiversity hotspots such as Mediterranean-type ecosystems (MTEs). Successful realisation of such a strategy requires a fundamental mechanistic understanding of the link between ecosystem plant composition and multiple ecosystem functions, as well as trade-offs among functions. However, findings on these relationships from one study area, with limited environmental variation and species composition, might not be generalizable.

Here, we assessed these relationships by using the process-based simulation model ModEST (Modelling Ecosystem Functions and Services Based on Traits) that connects water and nutrient flows with the survival and growth of individual plants characterized by traits. We parameterized ModEST for combinations of six representative woody plant functional types and determined the provision of three major ecosystem functions (carbon increment [ECI], nitrogen use efficiency [ENU] and water use efficiency [EWU]) for a broad range of Mediterranean climate and soil settings.

As expected, we found that the maximally provided ecosystem function depended strongly on environmental conditions, e.g. the highest ECI under warm and wet conditions, but the highest EWU under dry conditions. Also, mean traits of those plant communities leading to the highest provision differed across conditions. The emerging trade-offs between functions were complex, with strong differences between soils. For instance, minor trade-offs between EWU and ECI in loamy soils were much stronger in sandy loamy soils.

In this study, we provide evidence that trade-offs among functions can vary depending on species pool and environmental conditions. Consequently, restoration towards multiple desirable functions and thus EMF through the selection of species might be shaped by the environmental conditions found at the restoration site. Our findings help reconcile contrasting experimental observations from different locations and will aid in improving restoration towards EMF in different MTEs worldwide.

Keywords: Mediterranean-type ecosystems, multifunctionality, trade-offs, process-based modelling, context dependency

Spatial restoration design: insights from theory

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ABSTRACT

Ecosystem restoration has been receiving increasing recognition from both the academia and the public partly due to its endorsement by United Nations who declared the current decade (2021-2030) as the Decade on Ecosystem Restoration. Despite this, there is still a substantial gap between science and practice. Specifically, we lack a theoretical framework which would improve our understanding of how ecosystems recover. The current uncertainty in the outcome of restoration poses challenges for the planning of restoration projects.

In this study, we narrow this gap by developing a theoretical framework which can provide recommendations on efficient design of restoration projects. We achieve this by employing the theory of metacommunities (i.e., sets of local communities connected through the dispersal of multiple interacting species) and developing spatially explicit models for simulating the destruction and restoration of habitat. By employing empirical networks of species interactions, we study the recovery dynamics of communities during restoration. We quantify the efficiency of the recovery using a metric with compares the abundance of species during habitat destruction and restoration.

Specifically, we investigate in what order sites in the landscape should be restored to maximise the recovery efficiency. Our simulations show that, generally, the more damaged the landscape is, the less efficient restoration is, meaning that more habitat must be restored in order to recover a given species abundance. However, the most optimised restoration strategy depends on how damaged the landscape is when restoration begins. For example, at intermediate fractions of habitat loss, it is best to restore patches in a random order. However, in highly fragmented landscapes, it is more efficient to restore patches adjacent to occupied patches. This suggests that, when restoring a highly damaged landscape, switching between strategies may be most beneficial. Overall, our results demonstrate the importance of spatial planning of restoration projects.

Keywords: theoretical ecological restoration; spatial restoration design; ecological networks; community recovery

BirkiVist: Trans-disciplinary research to support scaling-up of woodland restoration

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ABSTRACT

Large-scale restoration of natural ecosystems is now considered crucial to counteract loss of biodiversity, promote sustainable land-use, and mitigate climate change. Growing realization of synergies among these has led to such initiatives. Their outcome, however, hinges on successful integration of societal needs, governance, and the ecological foundation of restoration.

Mountain birch (*Betula pubescens*) is the only native tree species that formed woodlands in Iceland during the Holocene. Widespread at time of settlement (9th century), the woodlands were decimated during the subsequent millennium by extensive deforestation and unsustainable land-use. A growing emphasis is on restoration, protection, and sustainable use of ecosystems in recent policy developments, including revisions of the Nature Conservation Act (2013), Soil Conservation Act (2018) and Forestry Act (2019). Large-scale ecosystem restoration, protection and sustainable use has also been defined as part of Iceland's climate change mitigation measures. In 2021 the Ministry for the Environment and Natural Resources revealed that the country's confirmed pledge to the Bonn Challenge is to increase the extend of native birch woodlands from the current cover of 1.5% of the country to 5%. This requires substantial scaling-up of the current restoration efforts and solutions that harness the birch's capacity for natural regeneration and spread.

BirkiVist (EcoBirch) is a trans-disciplinary research project with the aim to support scaling-up of birch woodland restoration. It addresses ecological limitations to natural regeneration and defines stakeholders and ways in which governance and institutional and societal factors may facilitate or impede restoration. There is particular emphasis on impact of the restoration on biodiversity and landscape and its potential benefits for climate mitigation and hydrology, but the aesthetic value of birch woodlands and their cultural and artistic significance are also addressed. In the talk we propose how restoration of an ecosystem type on a national scale can be approached.

Keywords: Birch woodlands, Bonn challenge, Iceland, landscape restoration, sub-arctic.

Forest Restoration Productive Chain: challenges and opportunities in the involvement of local communities.

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ABSTRACT

The Renova Foundation is the entity responsible for mitigating the damage caused by the collapse of the Fundão dam in Mariana, Minas Gerais. The foundation is committed to restoring 40.000 hectares of Permanent Preservation Areas and Water Recharge Areas, and 5.000 Springs, in degraded areas placed in the Doce river basin, in the states of Minas Gerais and Espírito Santo.The river basin area is about 8.434.000 hectares and it has been suffering from deforestation and exhaustive soil exploitation.

Given the scenarios the challenges with restoration collide with the low supply of seeds in the Doce river basin. Involving local communities is essential to protect the biodiversity and gain scale in restoration. Generating income by selling the forest seeds creates a collective perception of the importance of preserving forests for the local economy.

In line with the Term of Transaction and Adjustment of Conduct, the Seeds and Seedlings Network was created to provide inputs for forest restoration programs. Considering the current legislation, popular knowledge, technical support through forestry extension, practical training and direct involvement between local communities, managers of public and private Conservation Units and other Atlantic Forest remnants in the RDHB.

Approximately 87,213 hectares have been mapped as collection areas in the BHRD so far. Currently 14 groups of collectors are part of the Seed Network. The groups are comprised by Quilombolas, Agrarian Reform Settlements, adjacent communities to the Conservation Units, and the indigenous people Tupiniquins, Guaranis, (which 83% are represented by women) and Pataxós. It is estimated that by the end of 2022, 400 people will be mobilized and that 20 tons of seeds from 120 native species will be collected, directly adding about 500.000,00 euros to the income of the seed collector's families.

Keywords: Forest Restoration, Seed Network, seed collectors, Conservation units, Family income.

Planning for landscape-scale restoration: which tools do we need?

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ABSTRACT

Landscape-scale is the scale “where ecological, social and economic priorities can be balanced”, according to IUCN, and it is also the scale where restoration has the potential to deliver the largest benefits both for ecological functioning as well as for people. The importance of landscape-scale processes is long acknowledged in determining restoration success, indicating that focus on the landscape rather than individual habitat patches is needed during restoration. However, restoration is still often largely confined to site scale, and scaling up from local habitat patches to landscape-level is considered a key challenge in restoration and conservation over the following decades.

In my talk, I will give an overview of the current state of landscape-scale approaches in Europe, from rewilding initiatives to large-scale active restoration actions. I discuss to what extent we have the necessary tools, knowledge, and public support for launching effective restoration across sufficiently large areas. There is an increasing need for pan-European tools and knowledge-sharing hubs. As one of the applications that can guide local decisions regarding habitat and landscape restoration, we have developed a Greenmeter - a web-based tool that informs the general public, restoration practitioners, and municipalities on restoration needs in any particular landscape. Greenmeter compiles information from more than 60 detailed geographic information system (GIS) layers expressing land-use parameters and biodiversity indicators that are relevant in determining the condition of habitats and landscapes. These kinds of tools have the potential to help with the planning and execution of landscape-scale restoration if they are built on good-quality data and on a good understanding of factors that influence biodiversity in a particular region.

Assessing restoration suitability and regeneration potential for reforestation success in Panamá Canal Area

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ABSTRACT

In response to decades of deforestation, large-scale reforestation programs are underway in many tropical developing countries. However, there is little information on the factors that influence the success of reforestation and how they interact to determine environmental and socioeconomic results. This study aims to predict and to select areas that have higher chances of assisted-reforestation success (potential forest growth), based on historical forest occurrence and regeneration patterns from 1990 to 2020 in the Panam**á** Canal Area. Using land-cover data from the years 1990, 2000, 2005, 2010, 2015 and 2020, we first fit Random Forest classification trees to account for the relationship between the historical absence (0) and presence (1) of forest and several biophysical, bioclimatic, landscape structure, topographic and socio-economic factors (forest distribution metrics, distance to nearest rural area, distance to nearest urban area, distance to nearest road, altitude, slope, potential insolation, topographic wetness index, mean annual precipitations, mean annual temperature, distance to nearest river, distance to nearest Protected Area, distance to nearest lake). Based on the results, we obtain a first predictive map of forest restoration suitability. We then fit Random Forest classification trees to account for the relationship between two trajectories of forest cover change, loss (0) and recover (1), and the same factors used previously to obtain a second predictive map of regeneration potential. The two resulting maps are overlapped to identify areas with potentially higher assisted-reforestation success in the Panamá Canal Area.

Keywords: Forest-landscape Restoration, Landscape analysis, Panamá, Random Forest Classification, Natural Regeneration.

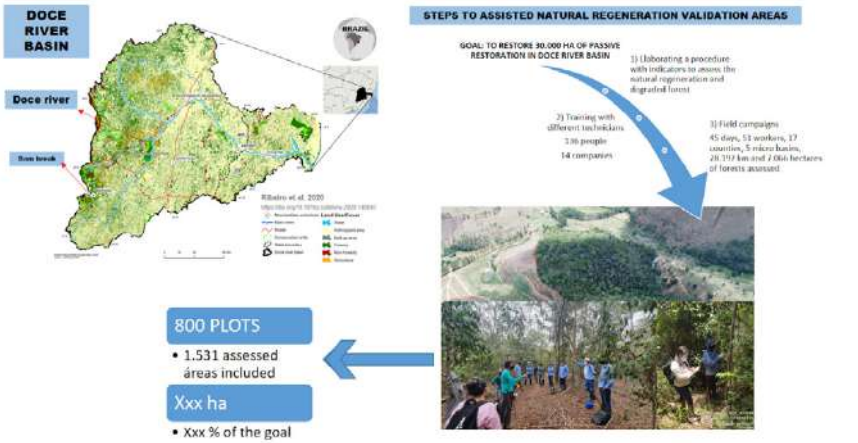
The importance of investing in human resources to achieve large-scale forest restoration goals in south-eastern Brazil

Author(s): Barbosa, Karina Cavalheiro; Tieppo, Felipe M.M.; Boeni, Ana Flavia; Meireles, D.A.L.; Abrahão, L.L.F.; Oliveira, A.B.; Fontes, C.V.A; Pires, N.H.; Junior Jacomelli, J.A.; Peixoto, G.V.; Tonon, W.E.

ABSTRACT

Several ecological restoration goals are established at different scales to decrease degradation and reverse its consequences on ecosystem functions and services. The Renova Foundation was established to repair and compensate the damage resulted of the iron ore dam failure in Mariana city, south-eastern Brazil, in 2015. One of the Foundation´s goals is to offset 30,000 hectares through forest restoration using assisted natural regeneration along the Rio Doce basin, the fifth largest and most degraded basin in Brazil, within 10 years. To enable future decision-making of this large-scale program with accurate information, it is essential to know about the condition of local natural regeneration. Here, it is presented the workflow created to generate standardized evidence of young and degraded secondary forests in the study area and the validation of additional restoration actions. First, it was developed the legal and technical procedure, containing all framework structures for the forest assessment, and parameters that would be considered in deciding inclusion in the restoration program. Therefore, training was carried out with different background technicians that were responsible for data collection and analysis. The Foundation performed training involving 136 people from 14 companies that were hired to restore the basin. After 12 months, more than 800 sample plots in 5 micro basins and 21 counties were sampled. At least 1,531 restoration areas were approved, summing up to 8,800 hectares of early-stage forests that require ecological intervention, representing 30% of the goal within a short period. This process shows the complexity of implementing large-scale forest restoration and the practice of it, and that even when using assisted natural regeneration, forest restoration should go beyond simple operational actions. It highlights the importance of having these baseline tools to make decisions and monitor the ecological succession trajectories in order to assure that forest restoration is taking place.

Keywords: Assisted natural regeneration, training, restoration goals, offsetting, tropical forest restoration



S11.

Response to Risks and Disturbances

Chair: Víctor Santana

The role of invasive species control and assembly on restoration

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Abstract:
Controlling invasive non-native species is a necessary, yet usually expensive, step towards the restoration of an ecosystem. Understanding how plant communities assemble is also an important topic to better plan restoration. The talk will cover both, invasive species control and assembly rules in restoration, showing results of global systematic reviews where we synthesized information from studies on invasive species control in restoration, and studies that manipulated species order of arrival. Both topics will be explored with examples of research done in Southern Brazil, and a collaboration between Brazilian and European working groups.
Keywords: invasive non-native species, community assembly, priority effects.

Vegetation degradation promotes the invasion potential of *Impatiens glandulifera* in an oligotrophic mountain habitat

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ABSTRACT

An annual plant Himalayan balsam (*Impatiens glandulifera* Royle) is globally widespread and one of the Europe's well-investigated top invaders. Yet, there is very limited knowledge on the effects of environment on the invasion potential of this species. We focused on two questions: does this species indeed not invade the southern areas of the continent; and, does the environment affect some of its key invasibility traits. In an isolated model valley (Sharr mountain, Western Balkans), we jointly analyzed the soil (21 parameter), the life history traits of the invader (height, stem diameter, aboveground dw), and the resident vegetation (species composition and abundances, Ellenberg indicator values), and supplemented it by the local knowledge (semi-structured interviews). Uncontrolled discharge of fecal wastewaters directly into the local dense hydrological network fostered mass infestation of an atypical, nutrient poor habitat. The phenotypic plasticity of the measured invasion-related traits was very high in the surveyed early invasion (30-50% invader cover) stages. Different microhabitat conditions consistently correlated with its growth performance. The largest individuals were restricted to the deforested riparian habitats with extreme soil nutrient enrichment (primarily by P and K) and low-competitive, species-poor resident vegetation. We showed that ecological context can modify invasion-related traits, what could affect further invasion process. Finally, this species is likely underreported in the wider region; public attitude and loss of traditional ecological knowledge are further management risks.

Keywords: Himalayan balsam, invasive alien species, soil nutrient enrichment, phenotypic plasticity; Western Balkans.

Return of a native Mediterranean ant community after Carpobrotus removal on a small island

Author(s): Romane Blaya, Sébastien Aurelle, Olivier Blight, Elise Buisson

ABSTRACT

Invasive alien species (IAS) are a major driver of global change and one of the main causes of extinctions on islands. *Carpobrotus* spp. is one of the most impacting and widespread plant IAS in Mediterranean areas. Ants are ideal bioindicators of environmental changes, as they are strongly influenced by their environment. The study site, Bagaud Island (Hyère archipelago, South of France), was part of a 10-year program of ecological restoration that included the eradication of *Carpobrotus* spp. In order to study the response of ant communities to the eradication program, samplings were carried out in a control IAS-free area and in an area of the island where the IAS was present. Pitfall traps were set up before (2010 and 2011) and after (2013, 2015, 2017 and 2019) eradication. No major changes were observed in the control IAS-free area. While no major changes of global composition were observed in the invaded area, the community structure changed significantly after eradication . Species and functional richness per trap gradually increased. Six species of common Mediterranean ant were more frequently sampled after the eradication. *Carpobrotus* spp. eradication increases habitat and feeding resource diversities and generates a modification of the microclimate leading to drier and warmer composition. These changes were favorable to the return of native xerophilic and thermophilic ant in the area. This study confirms the benefits of *Carpobrotus* eradication for native community recolonization. Moreover, it confirms that ants are good indicators of habitat restoration besides providing essential ecosystem services, such as nutrient cycling, soil aeration and seed dispersion.

Keywords: Invasion biology, Island, Alien species, Iceplant, Formicidae, Bioindicator

How do native species compete against the reproductive success of exotic pines after fires? A restoring approach

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ABSTRACT

Thousands of hectares of native forest and plantations of exotic species (Pinus radiata) were burned in the megafires in the summer of 2017 in Central Chile. After fires, pines showed a high rate of regeneration that could affect the establishment outcomes of native species for restoration purposes. Our objective was to determine the ecological interaction between pine and Quillaja saponaria (quillay, native species) under different regeneration densities of pines and plant quality attributes for four years. A combination of 0; 250,000; and 500,000 seedlings/ha of pine seedlings, plus two levels of size-based plant quality attributes (small: 15 and large: 40 cm) of quillay were evaluated. Negative (competition) or positive (facilitation) interaction between both species was analyzed through the response to survival, height increment, photosynthetic rate, xylem water potential, and chlorophyll fluorescence. The results showed higher survival and height growth in large plants of quillay established under a high density of pines. The lowest survival was shown in small plants established in sites without pine regeneration. The highest water stress was observed in large plants without pine regeneration, while stomatal conductance was higher in small plants, and in sites without pine regeneration. After 4 years of monitoring, it is concluded that 60 cm tall (large plants) quillay plants had a positive response to growth and survival in sites with high regeneration of pines post-fires. Although the high density of pines affected the water status of quillay, this interaction is not yet competitive, since quillay continues to be able to maintain its annual growth rate and high survival. Identifying the moment when pine begins to compete for resources with the target species is crucial to timely initiate silvicultural actions with the purpose of favoring the recovery of native species in post- fire reconversion processes.

Keywords: interspecific competence, facilitation, burned forest, field establishment.

Fig. 1. General view of study plot where a native tree species (quillay) were established in high
regeneration density of exotic pines after fires in Central Chile. The objective of the study is to determine the ecological interaction between both species under different regeneration densities and plant quality attributes for four years.

Post-fire management: Restoration tools in semiarid Aleppo Pine forests (SE Spain)

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ABSTRACT

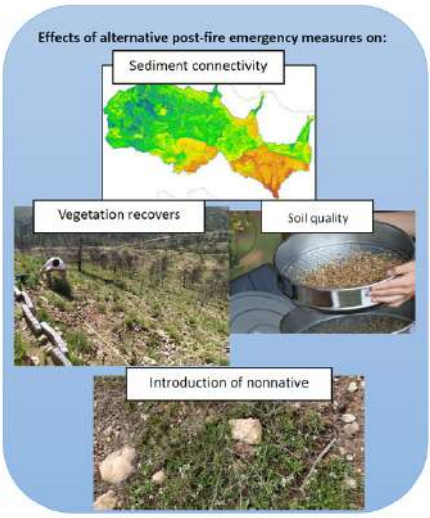
We monitored the effectiveness of restoration techniques in semi-arid landscapes affected by a wildfire burning 266 ha in July 2020. We developed an experimental design including different post-fire tools to mitigate negative burn damage.

The burned area is a semi-arid *Pinus halepensis* Mill. forest located in south-eastern Iberian Peninsula. It was an open forest with a companion vegetation dominated by shrub species such as *Quercus coccifera* L., Pistacia lentiscus L. or *Rosmarinus officinalis* L. and an herbaceous layer mainly covered by *Stipa tenacissima* L. (a widely spread species in Northern Africa and Iberian Peninsula).

The selected post-fire emergency measures to protect soil were settled in 12 different micro-catchments (≈ 0.5 ha), selecting 3 as control plots. The applied treatments were the combination of straw mulch (density of about 0.25 kg/m^2) with contour-felled logs and prefabricated biodegradable barriers (density of Easy-Barriers ® about 350 m/ha). Rainfall intensity and erodibility were measured with a pluviometry installed on the field.

The variables measured to evaluate the effectivity included infiltration, surface runoff and erosion, recorded with sediment traps located at the outlet of each micro-catchment. Also the vegetation recovery is monitored, including total cover and taking into account the introduction of non-native species. Additionally, the top layer of soil is sampled to analize some indicators of soil quality including physic-chemical variables (such as pH, soil organic matter, texture or nutrients) and biological parameters (such as microbial carbon, soil respiration and enzymatic activity).

Overall, the control of erosion in these semi-arid lands is beneficial to reduce the possible hydrological effects downstream of these fire-prone areas, promoting the recovery of soil quality and vegetation recovery in the short-term. Also, mulching promoted soil protection by non-native plants which were poorly presented one year after the treatment.



Keywords: Ecological engineering, Ecosystem functioning, Forests, Post-fire restoration

Fig. 1 Effects of post-fire restoration tools in semiarid Aleppo pine forests (SE Spain).

Multifunctionality of Mediterranean landscapes is increased by the application of different post-fire management actions

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ABSTRACT

After a wildfire, Mediterranean pine forests often regenerate as highly fire-prone ecosystems such as overstocked pine stands or dense shrublands. These ecosystems are characterised by both present high vulnerability and limited ability to supply ecosystem services. Although several management techniques can redirect these regenerated ecosystems toward less vulnerable and more functional communities, it is not yet known which among them could establish more functional landscapes.

We assess at stand and landscape scale, how different management combinations determine the provision of multiple ecosystem services (linked to biodiversity conservation, carbon sequestration, food production, disturbance regulation and supporting services) in two post-fire ecosystems after Pinus halepensis forests are burned (overstocked pine forests and dense shrublands). We do so by assessing the effectiveness of plantation of resprouting species in combination with tree thinning (overstocked pine forests), clearing (dense shrublands), and prescribed burns (dense shrublands), compared to the unmanaged (control) and unburned (reference) ecosystems. This assessment was performed in the medium-long term, up to 30 years since treatments´ application. We also created and analyzed artificial landscapes to find which combinations of ecosystem and management types produce the highest levels of landscape multifunctionality (high levels of multiple functions and ecosystem services simultaneously).

At stand scale, we found that thinning and clearing combined with plantation of resprouting species enhance ecosystem attributes associated with biodiversity conservation, carbon sequestration, disturbance regulation and multifunctionality. Prescribed burning enhanced services related to food production and reduced fire risk. Therefore, we show that a suitable combination of the different treatments in specific proportions establish functional landscapes that maximize the supply of ecosystem services. Our study provides important information to land-managers and policy-makers that help restoring degraded Mediterranean ecosystem towards less vulnerable and more functional landscapes.

Keywords: clearing, dense shrubland, ecosystem services, overstocked pine stands, prescribed burns, thinning.

Climate impacts on radial growth of *Quercus* suber growing in the Northwest of Tunisia

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ABSTRACT

For decades, cork oak (*Quercus suber* L.), an endemic species of the Western Mediterranean basin, has been assumed to be relatively drought resistant and able to adapt to various soil types and climate conditions in Mediterranean region. Nevertheless, recent studies have pointed out that cork oaks are sensitive to summer drought which constitutes an outstanding ecological and economic concern. This study represents a dendroecological approach aiming to explain the climate influence upon the annual radial growth of cork oak trees in the Northwestern Mountains of Tunisia using stem analysis of 57 felled trees. Correlations with precipitations, temperature and Standardized Precipitation Index (SPI) as climate indicators were evaluated and the determination of the most influencing season was investigated. Annual and seasonal precipitations as well as mean annual and seasonal temperature were considered for the periods 1915-2003 and 1950-2001, respectively. Mean annual radial increments (under cork) of trees ranged from 0.52 to 2.37mm/year with an estimated mean of 1.3 ± 0.4 mm/year. The results showed a positive significant correlation between radial growth and cumulative precipitations of the period between autumn of the previous year and the spring of the current year. However, precipitations of June have a negative effect on the annual radial growth. No correlation was found between mean annual temperature and annual radial growth whereas a negative significant correlation was noticed with mean autumn temperature of the previous year. The autumn season seems to be the decisive period for the growth of the following year whether with the increase in temperature (negative influence) or with the importance of the positive values of the SPI indicating the availability of water (positive action). As increase in drought frequency and intensity is expected in the Mediterranean basin, it is important to establish a strategy based on climate data and a fitting silviculture.

Keywords: Cork Oak, Tunisia, Tree rings, management, Draught

Root properties relevant for erosion control, and vegetation morphometry using LIDAR in a field experiment

Author(s): Virgil, Iordache[1]; Aurora, Neagoe[1]; Marilena, Onete[2]; Ersilia, Oniga[3]; Elena, Stănescu[1]; George, Dincă[1]; Luiza, Chiriac[2]; Maximilian, Diac[3]

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ABSTRACT

We performed a bivariate experiment on a tailing dam using a randomized block design in order to see the effect of amendments (top soil, and top soil with Trifolium green fertilizer), and inoculation with mycorrhizal fungi (0%, 1%, and 2%) on plant development. The experiment with 5 replicates for each variant was installed in 2015, and monitored until 2019. Besides usual variables for phytoremediation experiments (not reported here), in the last year we attempted to measure plant traits controlling the role of plants in erosion control. The objective of this communication is to present these innovative results. We measured morphometrical root variables with WinRHIZO, mechanical root properties with an Instron machine, and aboveground parts by terrestrial laser scanning technology (TLS). For morphometrical and mechanical properties of roots we used 3 samples from each plot. The TLS point cloud contains also points measured on ground surface and in order to segment the point cloud into vegetation points and ground points, respectively, the Digital Terrain Model and a height criterion were used. The attributes of the 3D point cloud of each plot were extracted using the OPALS software. The two-way ANOVA of the data showed that for several classes of root diameters the root length was significantly different in function the mycorrhizal fungi percent. Roots tensile strength was significantly influence by the amendments, and the elasticity was controlled both by amendments and the percent of mycorrhizal fungi. Although, visually the TLS data perfectly described the vegetation, and the plant cover was significantly controlled by amendments and fungi, the attributes extracted with OPALS did not describe well these differences. Another software would be needed, computing other attributes relevant for ecologists and ecohydrologist. In the end we present a technology readiness level 2 scheme for the further development of this approach.

Keywords: tailing dam, myco-phytoremediation, root length density, root tensile strength, LIDAR

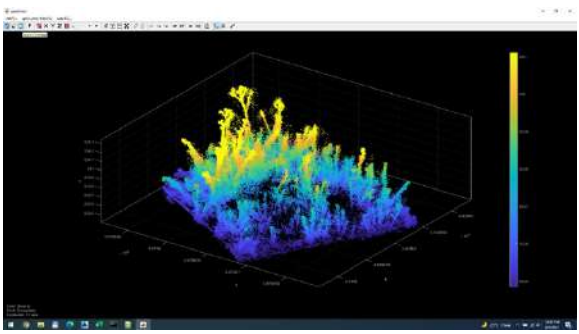

Fig. 1 LIDAR image of the vegetation on a plot

S12.1
Grassland Restoration I

The long-term effect of restoration practices and landscape composition on the success of sand grasslands restoration

Author(s): Reis, B.P.[1,2]; Szitár, K.[2,3]; Kövendi-Jakó, A[2]; Török, K. [2]; Sáradi, N.[2,4]; Csákvári E.[2,4]; Halassy, M.[2]

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ABSTRACT

In order to achieve global targets, landscape factors need to be taken into account when prioritizing restoration efforts and best practices need to be selected based on long-term data. We studied the impact of restoration treatment, two indices of landscape composition, and time elapsed since the start of restoration on the progress of sand grassland restoration. We included eight experimental blocks belonging to three experiments studying the impact of seeding, mowing, and/or carbon amendment in the KIskunság, Hungary. Monitoring lasted from 16 up to 23 years after the first treatment applications. We estimated the abundance of target and neophyte species and the distance from the major propagule sources of the target (primary grasslands) and neophyte species (plantations) in 500-m buffers around each block to characterize landscape composition. We used the difference between the relative cover of target/neophyte species in treatment and control plots as an indication of restoration progress. Restoration treatment and the abundance of neophyte species in the landscape had a significant effect on the restoration progress, but time did not. Seeding had the highest positive effect on target species and also prevented the invasion of neophyte species. A higher abundance of neophytes in the landscape and the proximity to plantations resulted in a higher relative cover of neophytes in treatment plots. We conclude that restoration practices can successfully overcome landscape constraints and shorten the time required for recovery. Of the three treatments applied, early seeding with a low-diversity seed mixture of target species proved to be the best method for restoring sand grasslands, both in favor of target species and in controlling invasion. From the landscape factors, the abundance of neophyte species and the distance to plantations should be considered when prioritizing areas and efforts for restoring sand grasslands.

Keywords: long-term monitoring, seeding, mowing, carbon amendment, invasion

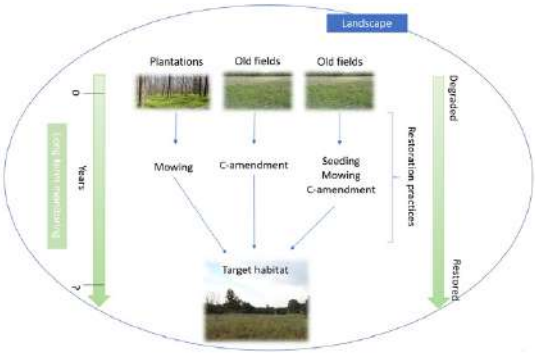

Fig. 1 A scheme to summarize the objectives of the present research.

No mid-term detrimental effects of soil disturbance linked to grassland restoration on established ground-dwelling invertebrates

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ABSTRACT

Active grassland restoration requires soil disturbance by harrowing or ploughing prior to seeding to create favourable conditions for plant germination. Yet, it is still unknown if these soil interventions are detrimental to the local ground-dwelling invertebrate fauna. We evaluated how ground beetle (Carabidae) and spider (Araneae) communities responded to three common grassland restoration methods, differing in soil disturbance intensity and seed application method (Fig. 1). The study was carried out in extensively managed mesic meadows using a before-after-control-intervention design. It was applied at the field scale and replicated twelve times across selected Swiss lowland sites. In addition, the potential mitigating effect of leaving an undisturbed area around the restored meadows was investigated. We did not detect a significant difference in abundance and species richness of ground beetles and spiders between restored and control meadows one year after restoration. At the community level we observed a slight shift towards a preference for wetter habitat (for both invertebrate groups), and restored meadows harboured a smaller weighted mean body size of spiders than control meadows. The latter was mainly driven by a higher abundance of some pioneer species typically found in frequently disturbed habitats, like in arable fields. No influences of surrounding undisturbed areas were found. Our results suggest that one year after restoration action, the ground-beetle and spider communities recovered almost entirely to their pre-disturbance state, indicating that harrowing or ploughing can be applied when restoring plant species-poor grasslands without being concerned about detrimental effects on the local ground-dwelling invertebrates.

Keywords: Ground beetles, spiders, hay transfer, plough, meadows

Fig. 1 Hay transfer on a ploughed meadow in Pfaffnau (Switzerland) in June 2019

Restoration of dry and sandy habitats in Brandenburg, Germany by LIFE projects

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ABSTRACT

A huge variety of open dry sandy habitats has been frequently found in Brandenburg, the area around Berlin between the rivers Elbe and Oder for quite a long time. But mainly due to changes in land use, these characteristic landscapes are about to disappear. With the LIFE Sandrasen project, the foundation “Stiftung NaturSchutzFonds Brandenburg” has supported the protection of sandy habitats in several Natura 2000 areas from 2013 to 2019 in the area ‘Dahme-Seengebiet’ southeast of Berlin. The project was set up to stop the rapid loss of xeric sandy calcareous grasslands (HT *6120) and dune and heathland habitats (HT 2310, 2330, 4030). From the second half of 20th century, these open habitats have been virtually vanished due to intensification and abandonment of land use and afforestation. According to results of ex-ante monitoring habitat type *6120 was shrunk to small and often isolated occurrences of habitats and plant communities in Natura2000-sites of the project region. This loss of habitat type *6120 was mainly connected to acidification, loss of open sandy habitats and reduction or even extinction of plant populations characteristic for habitat type *6120. Due to this situation, the LIFE Sandrasen not only addressed classical conservation actions such as shrub removal and implementation of regular grazing on the project sites. It focused additionally on creating new open sand habitats and reintroducing typical, often threatened plant species. The presentation will highlight the main results and lessons learned from LIFE Sandrasen.

Furthermore it will give first results on the LIFE Trockenrasen project, which focuses on calcareous and steppic dry grasslands (HT *6240) in Brandenburg from 2019 to 2026.

Keywords: restoration, LIFE project, dry grasslands, creating open sand, plant reintroduction

Dry Grassland Restoration Activities in the Dinara back to LIFE project – experiences and challenge

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ABSTRACT

Dinara mountain is situated in the southern part of Croatia, on the border with Bosnia and Herzegovina. It is a karstic area that was extensively used for grazing in the past, but due to population decline, large areas of karstic pastures are now under succession. These changes in this historically pastoral landscape, has had a negative impact not only on the sustainability of the remaining farmers, but also on the regional biodiversity, as a lot of bird and insect species are highly dependant on these open areas.

In order to slow the successional processes and restore dry grasslands, we performed four different activities on pilot sites. With the creation of a service flock we intensified grazing on 105ha, shrub removal was carried out on 48ha, controlled burning on 7ha and we restored 7 wells and ponds. These activities were also intended to revitalize interest for pastoralism in local people and get them actively involved, as grassland restoration in the long term is pointless without local farmers and enough cattle to maintain restored grasslands.

For most of the activities, the main challenges were of administrative nature and often proved to be more time consuming than the activity itself. The activity with most progress was shrub removal while the most challenging activity was controlled burning. The activity with the highest impact on local people was well restoration as water is often the limiting factor when farmers choose grazing sites. The experiences gathered in this pilot project gave us a valuable insight on practical limitations for grassland restoration in Croatia, and what needs to change if we want to restore and maintain larger grassland areas in the future.

Keywords: Dinara, Grassland Restoration, Administration, Pastoralism

Application of regeneration potential trajectories to prioritize ecological restoration interventions in the Hungarian sand regions

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ABSTRACT

The Decade on Ecosystem Restoration offers an opportunity to restore 350 million hectares of degraded terrestrial and aquatic ecosystems worldwide. National and regional spatial planning requires prioritization of areas and the identification of optimal restoration interventions to create a sustainable landscape, maintain biodiversity and ecosystem services. Arid ecosystems and grasslands have high ecological and economic value and increased viability in setting restoration priorities. We investigated the regeneration trajectories of different forest-steppe vegetation types (open and closed sand grasslands, poplar-juniper sand dune forests and thickets) in the Pannonian sand regions to provide restoration recommendations for conservation management, policy and research. We created spatial restoration trajectories based on local, neighbouring and old-field regeneration capacity estimates of the Hungarian Habitat Mapping Database, compared the trajectories between different mesoregions and determined which environmental predictors can influence spatial regeneration trajectories at the mesoregion level using a random forest model. The shape of the trajectories (flat, decreasing, V-shape and increasing) indicates the type of restoration interventions needed, such as passive restoration or active restoration by increasing connectivity, controlling invasive species, or introducing native species. In all mesoregions in Hungary, the regeneration capacity declines from local habitats to old fields due to landscape transformation by humans. Environmental proxies correspond to the trajectory shapes thereby helping to adapt this method to other habitat types. In our case, the main environmental predictors determining the spatial regeneration trajectories of sandy vegetation were the seasonality of temperature and precipitation, topographic variation, the mean level of groundwater and the proxies for naturalness. Better restoration results can be achieved in the vicinity of larger (semi-)natural areas in good condition, but the specific site conditions must also be taken into account during the prioritization. We also propose large-scale grassland restoration on abandoned agricultural fields instead of industrial forest plantations and afforestation with non-native species.

Keywords: ecological restoration, prioritization, sandy grassland, regeneration capacity

S12.2
Grassland Restoration II

Chair: Melinda Halassy

Costs and benefits of grassland reconstruction in an industrial area

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ABSTRACT

The restoration of unused industrial areas has been largely neglected despite their great conservation potential. In addition to the natural benefits, the reconstruction of semi-natural grasslands in industrial areas is also economically advantageous, especially due to lower maintenance costs. In our research, we studied the costs and benefits of creating semi-natural grasslands on the outskirts of a factory compared to traditional park grasslands. The study area is located around the factory buildings of an international company at Nyíregyháza, NE Hungary. Three types of grasslands were considered: an intensive park lawn (regularly fertilized, irrigated and mowed), an extensive grassland (non-fertilized, non-irrigated and less regularly mowed), and reconstructed semi-natural grassland (non-fertilized, non-irrigated and mowed only once a year). All grasslands were established between 2014 and 2015. On the cost side, we collected the costs of design, plant material, construction and maintenance. On the benefit side, we evaluated the species richness, cover and naturalness of the vegetation. As expected, the reconstructed grasslands proved to be the richest in species with adequate vegetation cover and the closest in naturalness to primary grasslands. The intensive lawn was closed, but species poor and the extensive grassland was weedy with the lowest vegetation cover. The installation costs of the semi-natural grasslands were less than 10 % of the intensive grassland, but four times that of the extensive grassland, because of the high prices of native plant material. The reconstruction of a semi-natural grassland pays off immediately compared to an intensive lawn and is cheap to maintain. Compared to an extensive grassland, it pays off in 12.5 years, but provides a greater diversity and a better vegetation cover. We conclude that the reconstruction of semi-natural grasslands is a viable alternative to traditional landscaping in industrial areas and creates a win-win situation for nature and the economy.

Keywords: biodiversity, grassland restoration, return of investment, urban-industrial restoration

Spontaneous grassland recovery in an open alkali landscape - restoration of a former military area

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ABSTRACT

Former military areas offer a great opportunity for biodiversity restoration. In our study we investigated spontaneous recovery of alkali grassland vegetation in a former bomb field in Hortobágy National Park, East Hungary. After the removal of approximately 40,000 unexploded ordnances the bomb-craters have been soil-filled, resulting in a matrix composed by large unvegetated surfaces and intact grassland patches on 4000 hectares. After the technical restoration (i.e. removal of ordnances and grading the surface) of the area we monitored the vegetation changes during spontaneous vegetation recovery in four sites using 45 1×1 metre-sized permanent plots/sites. The monitoring started in 2018 and involved four consecutive years. We found that by time there was a significant increase in the total vegetation cover and in the species richness and cover of grasses and grassland specialist species (Generalised Linear Models). The cover and species richness of weeds decreased considerably due to the high competitive pressure by grass species and because of the high level of environmental stress posed by the high salt content of the soil. Species composition of the four studied years show a directional trend from a weed dominated initial year to the fourth year that was characterised by several salt tolerant species typical to the neighbouring intact grasslands (NMDS ordination). Interestingly total species richness was constant in the four studied years. The reason for that is the high number of weed species were gradually replaced by high number of specialist species during the vegetation development. Our study pointed that even in the case of large disturbed soil surfaces spontaneous grassland restoration can be a feasible cost-effective option when proper seed sources are still available in the landscape.

Keywords: alkali grassland, grassland restoration, grassland specialist plants, military area, spontaneous succession

Reintroduction of mowing on steep slopes increases species diversity of a grassland after abandonment

Authors: Susumu YAMADA, Wakana YOSHIDA, Minori IIDA, Yoshiko KITAGAWA and Jonathan MITCHLEY

ABSTRACT

Semi-natural grasslands on steep slopes often show high plant species diversity probably due to the limitations of water availability and nutrients which prevent the growth of dominant species and decrease interspecies competition. Traditional management practices like mowing also help maintain species diversity. Land abandonment reduces diversity by increasing competition from dominant species and reducing seedling recruitment. Reintroduction of management can reverse the decline in species diversity, but suitable restoration programs are scarce in Japan. To study the effect of short-term abandonment on seedling ecology, we monitored vegetation of a grassland on a steep slope (ca. 50º) in Japan. The study grassland was located on the lower hill-side adjacent to paddy fields and had been abandoned for three years. We monitored the vegetation before abandonment, in the 3rd year of abandonment, and in the 1st and 2nd years after restoration of mowing management. Emergence and survival of seedlings was monitored for 18 months after reintroduction of management. After mowing was reintroduced most grassland species reappeared or increased in the 1st and 2nd year. We monitored 1183 seedlings in a 10 m^2 plot and they included grassland species and non-target weedy species. Few seedlings of perennial plants and no seedlings of annuals flowered. Perennial exotic species generally showed lower survival rates (10%) than grassland species (>30%). Weeds and exotic species were either small seeded or with small root systems, traits which tend to increase the mortality of seedlings due to drought. About one third of the seedlings were lost largely due to erosion from the upper slopes and surface soil runoff. Despite this, the results demonstrated that all but one grassland species survived over the 18 month period. The steep slope acted as a strong 'filter' that inhibits the establishment of non-target species, while enhancing persistence of target grassland species.

Keywords: reintroduction of mowing, seedling emergence, seedling establishment, semi-natural grassland, survival rate

Recovery of plant-bumblebee interactions in restored semi-natural grasslands

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ABSTRACT

Monitoring schemes of restoration success usually concentrate on only few organism groups, most often vascular plants, birds or specific insect groups. However, the recovery of entire ecosystem functionality depends on the interactions between different organism groups and these are rarely studied in monitoring schemes.

When large areas of dry calcareous grasslands were restored in 2016/2017 with the help of LIFE project (LIFE13 NAT/EE/000082) in Estonia, we studied the recovery of plant-bumblebee interactions after the restoration. The study included four different treatments: 1) abandoned but still open, 2) abandoned and overgrown by shrubs, 3) afforested with pine in 1960s, 4) control areas (abandoned, not restored). In treatments 2 and 3, shrubs and trees were removed during restoration and in treatments 1, 2 and 3, grazing was reintroduced. The diversity of all vascular plants was characterised within 4 m2 scale plots, the bumblebee flower visits were recorded during time-limited transect walks both before and 2/3 years after the restoration.

The results show a fast recovery of both plants and bumblebees after the restoration with significant increase in their richness and in the number of plant-bumblebee interactions in overgrown and afforested sites. The change was the most pronounced in afforested sites where, before restoration, we did not record any bumblebees in ca 60 % of the sites but after the restoration, bumblebees were present in all sites. In afforested sites, the number of interactions increased significantly both for plants and bumblebees. However, in overgrown sites, the number of interactions only increased for plants and in the case of bumblebees, the number of interactions was already relatively high before the restoration and did not significantly increase. This indicates that in overgrown conditions with fewer flower resources, bumblebees are visiting several plant species but plants get visited by only few bumblebee species.

Plant establishment during the restoration of species rich grasslands

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ABSTRACT

Despite the current progress in our theoretical understanding of community assembly, we often fail to restore natural or semi-natural communities. Several general principles in interactions between plant individuals have been identified to be important for community assembly. However, the human impact on the environmental conditions can be tremendous and particularly the soil conditions can be altered for long time in response for agricultural practice. Such modification can be then imprinted in plan to plant interactions and disable the formation of communities similar to preserved reference. We studied plant establishment in contrasting conditions of preserved highly species rich grasslands and their versions restored on formerly tilled soil in Bílé Karpaty Mts. (Czech Republic). The commonly observed elevated productivity caused by high amount of residual soil nutrients and resulting into too intense competition for light (which suppresses uncompetitive rare species) does not seem to be the case. We found that plant biomass of restored grasslands is generally lower and that species rich restored communities have higher vegetation cover. The reduced productivity of restored grasslands can be attributed to the altered soil conditions of formerly tilled soil, namely to higher soil compaction, the lower soil organic matter content, lower nitrogen content and lower biomass of soil bacteria and fungi. Soil conditions were also imprinted in the plant biomass nutrient content indicating higher limitation by nitrogen and lower limitation by phosphorus of restored grassland communities. Although it is not clear yet, which of those parameters is crucial, the altered soil conditions seem to be the main reason for reduced diversity of restored grasslands.

Keywords: Grassland, Succession, Colonization, Tillage, Former arable land

Long-term assessment of restored species-rich grassland in Germany

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ABSTRACT

Species-rich grasslands are one the most threatened ecosystems in Europe. During the last decades, restoration efforts increased considerably but assessment of long-term success is scarce. In addition, grassland restoration success depends not only on restoration methods and appropriate management but also on socio-economic parameters during and after restoration.

We evaluated several sites within three restoration projects, implemented in 1999, 2009, and 2010, restored by sowing of native wild plants and green hay transfer. The diversity level of introduced plants ranges from 20 to 97 species. All sites were regularly mown or grazed. It became evident that even after 11-19 years, a high percentage of the introduced species was still present on the site. The correlation between the number of introduced species and the number of successfully established species, as well as their share of total vegetation cover was highly significant. Very species-poor mixtures promoted, while species-rich mixtures suppressed, the immigration of species from the surrounding area. This can have varying effects, depending on the availability of target or undesired plant species in the surroundings. However, we concluded that introducing 40-50 species combined with suitable management is most effective in maintaining diversity of target species on grassland restoration sites over longer periods.

In addition, the influence of socio-economic parameters on restoration success will be studied in an inter- and transdisciplinary approach within our new *Grassworks* project. By investigating 120 already restored grassland sites across three different regions in Germany we hypothesize that restoration success is related to the extent to which both ecological complexity and stakeholder diversity are considered in the restoration process. The overarching goal is to reverse the current trend of continuing loss of species-rich grasslands by improving restoration guidelines and deriving recommendations for policy and management. First results related to grassland governance will be presented.

Keywords: grassland, restoration, long-term, success, management

The LIFE programme: Practical examples of EU funding supporting Nature Restoration

This session will briefly outline what is the LIFE programme and present the main funding priorities related to nature restoration. Key information on where to find relevant information to submit a proposal will be also shared with the audience (link to the LIFE Info Day sessions, call documents, FAQs...).

A number of LIFE projects showcasing restoration successes in different contexts will feature. A Q&A session will allow the audience to inquire more information in view of potential future applications, gathering first-hand intel from both representatives of the EU Commission and actual LIFE beneficiaries.

The event is addressed at any entity registered in the EU working in the field of nature restoration, especially practitioners (wildlife biologists, restoration ecologists, site managers, etc.), scientists and NGOs, but also academics and other professionals that may be interested in this topic.

LIFE success stories on ecological restoration - LIFE N2K revisited.- *Broumova, Radka*

LIFE success stories on ecological restoration - LIFE TECMINE.- *Olmo, Beatriz*

LIFE success stories on ecological restoration - LIFE to Alvars.- *Helm, Aveliina*

Coordinator(s):

BAROVA, Sylvia (European Commission – Climate, Infrastructure and Environment Executive Agency | CINEA)

NAVA, Ana (NEEMO – Monitoring LIFE projects and communicating about the LIFE programme)

Chair: Ana Nava; Sylvia Barova

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E1.

Commonland. Landscape Restoration as a means of delivering the EU Green Deal: Recommendations.

Victoria Gutiérrez; Amanda del Rio; Yurena Lorenzo; Jordi Cortina.

E5.

Land Life: examples and challenges in nature restoration through Voluntary Carbon Markets.

Francisco Purroy

E6. Ecoembes. "Los Sistemas Colectivos de Responsabilidad Ampliada del Productor (SCRAP) y las experiencias de restauración ecológica".

Esperanza Alvarez Garcia

E7. CEMBUREAU's vision for biodiversity in and around quarries over the coming decades.

Alexandra Silva

Thursday,

8th

September 2022

Mid conference field tours

#1 Restoration of a highly transformed semiarid landscape.

#2. Promoting resilience through restoration actions in Mediterranean fire-prone areas.

#4. Coastal restoration.

#5. Restoration of Mediterranean rivers and flood management.

#6. Wetland restoration for birds – Birdwatching.

#7. The restoration of coastal shores and marine habitats.

#8. Restoration of metalliferous mining sites in the Cartagena-La Unión mining district.

#9. Quarry restoration.

#10. The environmental crisis of the Mar Menor coastal lagoon: The great challenge of ecological restoration in the coming decades.

#11. Experimental restoration of semiarid degraded lands.

#12. Conservation and restoration of Mediterranean landscapes.

Past, present and future directions in marine restoration

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ABSTRACT

Over the last few decades, the success of ecological restoration efforts in terrestrial habitats has improved dramatically, with successful examples of enhancing ecosystem structure and function, and the provision of ecosystem services. In the marine realm, however, restoration approaches have generally been successful only at very small spatial scales and continue to present many challenges. In fact, there is still a poor understanding of the drivers underlying successful actions in most marine organisms and habitats. Filling knowledge gaps on the processes underlying marine restoration success is therefore crucial to ensure meaningful planning and success over larger spatial and temporal scales. In this sense, linking life-history and functional traits to marine restoration can help to anticipate the expected dynamics and timescales of different restored ecosystems from shallow to deep waters. In addition, the lessons learned from the past highlight: i) the need to include holistic and long-term monitoring programs focusing on the species restored but also on community changes, ii) the combination of active and passive restoration such as the implementation of Marine Protected Areas and iii) the involvement of local stakeholders to ensure the long-term viability and success of any restoration action at the sea.

Friday, 9th September 2022

(Sala d'actes Aulari II -Auditorium General Lecture Hall II, University of Alicante)

Large-scale rewilding across Europe – Can we overcome challenges to achieve a historic opportunity?

The essential role of large linked natural ecosystem areas (AKA wilderness and wildlands) in addressing the twin crises of climate change and biodiversity decline is an important feature of the EU's Biodiversity Strategy, Forest Strategy, New Green Deal, and the UN's Decade of Restoration.

With 10% of the EU's terrestrial and marine area prospectively earmarked for strict protection (and a further 20% for restoration), there is strong support for ensuring non-intervention is a key element here. Clear principles are also needed for implementation of a strategy for large-scale ecological restoration or 'rewilding' of these areas, ensuring this is underpinned by principles of sound science and linked to the forthcoming Restoration Law.

This Symposium aims to:

1) Demonstrate the role of protected large natural ecosystems, strictly protected and involving management by natural processes ('non-intervention'), in addressing climate change and biodiversity loss
2) Establish clear principles and targets for implementing a rewilding/restoration strategy, in EU and non-EU countries
3) Clarify requirements for a strong supporting framework
4) Identify appropriate funding sources
5) Incorporate feedback from participants, refine the Strategy and subsequently promote it

Main coordinator: Toby Aykroyd

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Underlying principles for a strategy – drawing solutions from past challenges. *Ladislav Miko, Lead Environmental Advisor to the 2022 EU Presidency and EU representative at COP15 in Montreal, former Head of Natural Environment at the European Commission, Wild Europe Trustee*

Large scale natural process restoration – planning for the benefits & challenges *- Kris Decleer, Board Member, Society for Ecological Restoration, Senior Researcher INBO*

A supporting framework for successful rewilding strategy (video) - *Erika Stanciu, Chair of World Council for Protected Areas (WCPA) Europe, former Secretary of State for Forests in Romanian government, Chair of Wild Europe*

EU & wider European restoration strategy - insights from a global perspective *- Cara Nelson, Chair of the Ecosystem Thematic Group for IUCN CEM*

Funding the strategy, the need for extensive reforms- *Toby Aykroyd, Director of Wild Europe Foundation*

Open Session

Friday, 9th September 2022

(Sala d'actes Aulari II -Auditorium General Lecture Hall II, University of Alicante)

Building a successful restoration strategy, the session will hear opinions from the audience

Led by Ladislav Miko, with Toby Aykroyd moderating, Kris Decleer and Cara Nelson.

W5

Friday, 9th September 2022

(Sala d'actes Aulari II -Auditorium General Lecture Hall II, University of Alicante)

Coordinator(s):
Diana Colomina Pérez, Forest Programme Coordinator, WWF Spain

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Chair: Cagide Elmer, Natalia J.

Introduction to the WWF-SER Standards for the Certification of Forest Ecosystem Restoration Projects

In recent years, ecological restoration has continued to evolve towards interventions that apply recognised quality standards in projects based on best management practices, from the design phase and up to the evaluation, in order to certify their quality and effectiveness. The WWF-SER standards for certification of forest ecosystem restoration projects, designed within a working group of experts in the field of restoration, represents an opportunity for public and private entities to implement their restoration practices to the highest quality performance.

This workshop will offer a focused participatory session to refine and develop the *Standards for the Certification of Forest Ecosystem Restoration Projects*, which is currently being applied to Mediterranean forest restoration pilot studies. This event will be targeted for European forestry professionals and ecological restoration experts, who will provide and receive valuable insight involved in the professional review of the current Standards.

The long-term goal is to extend its application beyond Mediterranean forests to European forest ecosystem restoration projects in general, and these technical dialogues are a valuable tool to engage with experts in the field, while developing further the current Standards with this broader application in mind.

This proposed workshop is deeply connected to the theme of the Conference, given its focus on fostering discussion and connection between professionals to participate in the production on a set of Standards which are being developed with the future of a European Forest Ecosystem Restoration Certification system in mind.

Session supported by SER-E and WWF.

Restoration of the fire degraded area of Las Peñuelas and practical considerations in the application of the WWF-SER Standards for the Certification of Forest Ecosystem Restoration Projects.- *Miguel Ángel Maneiro Márquez (Regional Governmental Representative, Junta de Andalucía)*

Restoration plan of public forests affected by the forest fire in "Las Peñuelas", in 2017: western sector of the Doñana Natural Park, Coto Mazagón and Ordenados de Moguer.- *Juan Gorostidi (Technical project auditor, SER-E)*

Evolution and Future of the WWF-SER Standards for the Certification of Forest Ecosystem Restoration Projects.- *George Gann (International Policy Lead, SER)*

Plenary 6 Closing plenary

Organizers(s): Orr, Barron Joseph[1]; Semplici, Vittoria[1]

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Ecological Connectivity: An Essential Component of Ecosystem Restoration

ABSTRACT

Ecological connectivity – the unimpeded movement of species and the flow of natural processes that sustain life on Earth – plays a key role in addressing habitat fragmentation and biodiversity loss, while promoting healthy lands that ensure successful restoration in the long term. At the same time, restoration measures are needed to maintain connectivity across landscapes facing increasing degradation and destruction. The second edition of the Global Land Outlook (GLO2) emphasizes that connectivity needs to be maintained, enhanced, and restored to achieve global conservation goals. The role of ecological connectivity in ecosystem restoration is the theme of a GLO2 working paper that will be published later this year. The working paper has four main components:

- The many dimensions of ecological connectivity
- Ecological connectivity and restoration
- Measures and approaches for addressing connectivity in restoration efforts
- Key messages

It also includes several illustrative case studies what the concepts introduced look like when put into practice.

The working paper concludes that to achieve maximum socio-ecological benefits, ecosystem restoration must be approached from two directions. On the one hand, it is necessary to "connect to restore" or include ecological connectivity requirements in integrated land use planning to support wider interconnected ecological processes and maximize the benefits of restoration for the entire landscape. On the other hand, it is necessary to "restore to connect" through green infrastructure and more broadly, ecological networks to strengthen the connectivity of ecosystems and landscapes, and guide priorities for restoration.

This side event will explore the interdependencies between ecological connectivity and ecosystem restoration interactively with the audience, providing the opportunity to incorporate what is learned into the final draft of the working paper.

Keywords: ecological connectivity, ecosystem restoration, land degradation, resilience

Restoration in the Mediterranean Sea: are we ready for scaling up?

Chair: Bianchelli, Silvia

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Restoration is a key action in the Aichi Biodiversity Target and in the UN Sustainable Development Goal 14: "conserve and sustainably use the oceans, seas and marine resources for sustainable development" by addressing target 14.2 to "by 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration, to achieve healthy and productive oceans". Ecosystem restoration in marine ecosystems has made its first steps in the last years, within research projects dedicated to the restoration of marine ecosystems from shallow soft and hard bottoms to the deep sea. Today, new scientific results and technologies are available, but a concerted effort is required to scale up the effort on a wide geographical area and at basin scale, across different marine ecosystems, from the coastal vegetated habitats to the dark deep ocean. Yet, to obtain most benefits from ecological restoration, we must promote its practice and strive to increase the quality of restoration programs, to preserve the Marine Natural Capital. This cannot be achieved without the engagement of society, to produce a shared vision of needs and challenges of conservation and restoration of marine ecosystems. Under the *UN Decade of Ecosystem Restoration (2021-2030)* and the *EU Biodiversity Strategy for 2030*, we have the chance to build bridges between science, practice and policy, based on scientific excellence, to better understand socio-ecological systems and to bring nature back into our lives (*EU Green New Deal, 2019*).

Keywords: marine ecosystems, Mediterranean sea, upscaling, engagement of society

The challenge of marine ecosystems' restoration in a changing ocean

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ABSTRACT

We are setting ambitious conservation targets by 2030, yet a conservation strategy alone could be insufficient reverse the loss of natural capital is the short-medium term. We must then be able to accelerate marine ecosystem recovery through the implementation of restoration actions. It is indeed increasingly evident that marine habitat conservation coupled with restoration of degraded habitats is the most promising approach to guarantee the ecosystem goods and services. The UN General Assembly declared 2021-2030 the "Decade on Ecosystem Restoration". This call to action has the purpose of recognizing the need to massively accelerate global restoration of degraded ecosystems, to fight the climate heating crisis, enhance food security, provide clean water and protect biodiversity on the planet. The declaration on Ecosystem Restoration also coincides with the UN Decade of Ocean Science for Sustainable Development and the launch of EU Biodiversity Strategy 2030 (a core section of the Green Deal) which aims at mobilizing the ocean community behind the ideas of sustainable development and to focus the research and technological development on existentially important issues to protect nature and reverse the degradation of ecosystems. Climate change, intensive exploitation of marine resources and other effects of human usages are largely responsible for the alarming degradation and loss of marine ecosystems, including the deep sea. Solutions are urgently needed and will require leadership, trans-disciplinary approaches, international frameworks and national roadmaps, political and financial commitments, and strong governance. Only with healthy ecosystems we can enhance people's livelihoods, counteract climate change, and stop the collapse of biodiversity. Here we summarise the status of the ecological restoration in marine ecosystems along the Mediterranean Basin and we compare these findings with European seas and beyond.

Keywords: seagrass meadows, macroalgae forests, transplanting, artificial structures, marine ecosystems

Setting restoration targets under climate changes: the case study of Mediterranean macroalgal forests

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ABSTRACT

The process of spatial planning has received scarce attention in marine restoration. However, site prioritization to identify where restoration should be undertaken is critical to guide restoration interventions.

In this study, for the first time, the consequences of adopting different restoration targets and criteria on spatial restoration prioritization have been assessed at a regional scale, including the consideration of climate changes. We applied the decision-support tool Marxan, widely used in systematic conservation planning, on Mediterranean macroalgal forests since, in the last 20 years, forests loss has been largely documented, with limited evidences of natural recovery. Spatial priorities were identified under six planning scenarios, considering three main restoration targets to reflect the objectives of the EU Biodiversity Strategy for 2030.

Results show that the number of suitable sites for restoration is very limited at basin scale, and targets are only achieved when the recovery of 10% of regressing and extinct macroalgal forests is planned. Increasing targets translates into including unsuitable areas for restoration in Marxan solutions, amplifying the risk of ineffective efforts.

Our analysis supports macroalgal forests restoration and provides guiding principles and criteria to strengthen the effectiveness of restoration actions across habitats. The constraints in finding suitable areas for restoration are discussed, and recommendations to guide planning to support future restoration interventions are also included.

Keywords: Marine Spatial Planning, site selection, restoration, *Cystoseira sensu latu,* Marxan

Fig. 1 Graphical representation of Marxan inputs and outputs

Large-scale rewilding of European landscapes: concepts, monitoring and scenarios.

Invited oral presentation. Session - W4.

Rewilding: challenges and opportunities.

Chair: *José M. Rey Benayas*

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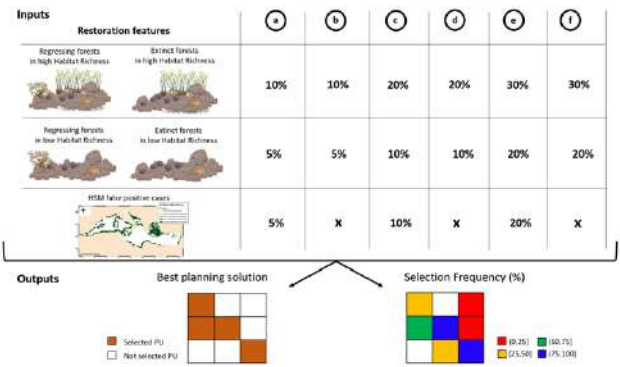
ABSTRACT

Concepts of rewilding are increasingly promoted as large-scale restoration solutions while, at the same time, debates are growing around the societal and ecological convenience and implications of such approaches. Much of the debate has been shaped by: contrasting perspectives around what specific actions should contribute to rewilding; the use of reference ecological conditions for defining rewilding targets; and the interference with traditional and cultural uses of the landscape. In this talk, I will discuss how rewilding concepts that pursue the recovery of ecosystem complexity and resilience can be translated into specific implementation and monitoring actions at different spatial scales. Using European-scale and local-scale case studies I will describe progress and challenges in quantifying baseline conditions and outputs of rewilding. At local rewilding sites, restoration progress has often been constrained by regulations and policies that enable competing practices such as the removal of carrion and deadwood, while incentivizing agriculture to the detriment of ongoing passive restoration. I argue that rewilding priorities and projects need to be re-framed according to their potential contribution to meeting the EU-level biodiversity and restoration targets, to which large-scale rewilding has much to offer. For this, I will illustrate the development of a "wildness" indicator aimed at supporting ecological status and rewilding progress assessments. Furthermore, the development of quantitative scenarios for the future of nature that include rewilding indicators emerges as an important research priority.



Following the roadmap for Mediterranean Macroalgal forests restoration: a case study from the Adriatic Sea

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ABSTRACT

In the Mediterranean Sea, the algal forests composed by fucalean brown seaweeds *Cystoseira*, *Ericaria*, and *Gongolaria* form complex, productive and vulnerable shallow-water ecosystems. These forests are rapidly regressing with negative impact on the associated biodiversity and ecosystem functioning. Hence, active restoration emerges as the most promising strategy to rebuild disappeared forests. However, recent research indicates that the recovery of macroalgal forests requires synergistic interventions, starting with the mitigation of human impacts to restore the most degraded populations, since the viability of large restoration actions is compromised by ongoing human pressures (e.g., pollution, eutrophication, overgrazing, and climate change). A roadmap for Mediterranean macroalgal restoration was recently proposed to assist researchers and stakeholders in decision-making, considering the most effective methods in terms of cost and cost-effectiveness. Following this roadmap, we carried out a pilot restoration intervention of *Gongolaria barbata* along the Conero Riviera (Western-Central Adriatic Sea), selecting the most suitable sites to implement the restoration action with the adoption of different techniques. We measured the success by monitoring the effectiveness of the intervention, including the consideration of the associated biodiversity recovery, and estimating also the costs. The experiment is still ongoing, and the first results confirms that, under mitigated conditions, restoration is cost effective and successful.

Keywords: macroalgal forests, Mediterranean Sea, associated biodiversity

AFRIMED and algal forest restoration in the Mediterranean: stakeholder beliefs on feasibility, acceptance and barriers

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ABSTRACT

As a result of the COVID 19 worldwide pandemic, a renewed deep appreciation of nature and all of its blue and green spaces and their unique value and contributions to our collective well-being has emerged. This included powerful messages we can all agree with such as “we need nature in our lives” and “Making nature healthy again is key to our physical and mental wellbeing” and more importantly calls for action through the EU biodiversity strategy 2030 and the Green Deal for “Bringing nature back into our lives”. Various emblematic examples from the terrestrial world emphasize clearly the necessity, the feasibility and the socio-economic benefits of investing in, and restoring, nature. With the exception of some specific coastal and shallow reef habitats, marine restoration is generally less well developed and not well implemented, even though it has been targeted in numerous regional and EU policies. In order to interconnect science, management and business in the framework of the restoration of marine forests, AFRIMED http://www.afrimed-project.eu/ is engaging with stakeholders, creating a Business Club and organising dedicated knowledge sharing events. The development of a shared vision of the management of marine forests will help create acceptance and a sense of ownership within new partnerships willing to support marine restoration. A second anonymous survey was designed, aiming to get stakeholders insights https://forms.gle/TB7R9v2FU89vDBbG8 on ways forward. Information collected concerned country and stakeholder type. Questions were related to reasons to save/restore an underwater forest, ways to increase awareness, beliefs on the feasibility of marine restoration, and if restoring 30% of a degraded habitat, in line with the UN Decade on Ecosystem Restoration and the EU Biodiversity Strategy for 2030 aspirations, is feasible? As well as on perceived opportunities and barriers to macroalgal forests large scale restoration in the Mediterranean.

Keywords: Marine forests, Cystoseira, stakeholders, policy, Mediterranean

The LIFE SEPOSSO proposal for the planning, implementation, and monitoring of Posidonia oceanica transplantations

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ABSTRACT

Posidonia oceanica (L.) seagrass meadows are in regression in various areas of the Mediterranean basin, and it is estimated that their surface area has decreased by more than 30% over the last 50 years. Human activities and related forms of pollution are among the main threats to this habitat, causing loss or fragmentation of the meadows. The EU Strategy for Biodiversity for 2030, has formulated a plan for the restoration of terrestrial and marine ecosystems, mainly with a high potential for carbon capture and storage. The restoration of *Posidonia* meadows through sustainable and effective transplantation activities will not only contribute to the achievement of EU objectives for biodiversity and climate change but will also favour the maintenance and sustainability of fundamental activities for the coastal areas, such as fishing, tourism, and blue growth. Our work shows the specific procedural process for planning, implementation, and monitoring of *P. oceanica* transplantations providing detailed information and executive methods on the different phases of *P. oceanica* transplants. Each phase includes the main activities and their purposes for the acquisition of essential data to characterize and select the donor and receiving meadows and to select suitable areas for transplant. Specific parameters and sampling frequencies are explained to efficiently monitor the performance of transplantation over a long period (10 years). The procedures described refers to any transplant such as the restoration of degraded meadows, the reconnection of portions of damaged meadows, the compensation of sectors of *Posidonia* completely lost due to marine coastal works. The accuracy of the information provided is guaranteed by the analyses of 39 transplants carried out in Italy and 32 Environmental Impact Assessment decrees of marine infrastructural works affecting *P. oceanica* meadows, which allowed to select the best practices and the most efficient governance approaches for an effective *Posidonia* restoration.

Keywords: seagrass, habitat restoration, Mediterranean Sea, best practices, *Posidonia*.

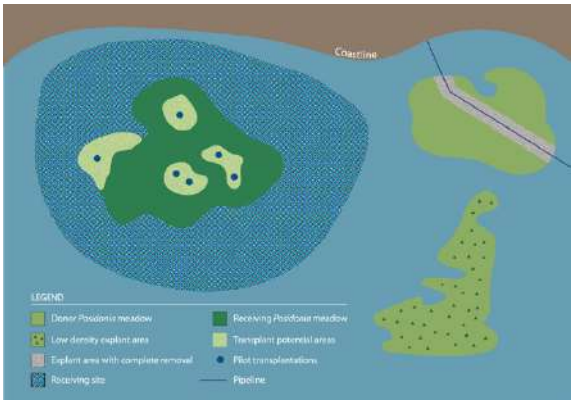

Fig. 1 Example diagram of the different areas involved in the planning, implementation, and monitoring of *Posidonia oceanica* transplantation

Exploring the timescales needed to recover the functioning of Mediterranean coralligenous assemblages through active restoration

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ABSTRACT

Active restoration initiatives are being promoted globally to halt and reverse the degradation of marine ecosystems. Most efforts are placed in habitat-forming species, such as corals and seagrasses, with the goal to recover the structural complexity needed to sustain ecosystem functions and services. However, the success of these initiatives is mostly based on the short-term survival of restored transplants, which has been criticized to be unsuitable to assess full ecological recovery. Here, we explore the long-term success of an active restoration of a key Mediterranean octocoral combining population and community approaches to assess the recovery of ecological functions. To achieve this, a coralligenous assemblage with a restored *Corallium rubrum* population was monitored over ten years in the Medes Islands Marine Reserve to quantify the temporal changes in its functional community structure through multi-taxa trait-based analysis. Moreover, a nearby site with a *C. rubrum* dominated coralligenous community was monitored, to assess the population and community structure of a local native assemblage. Preliminary results, show a significant growth of the transplanted colonies, which is followed by a significant shift of the coralligenous functional identity, mainly caused by an increase on the traits that facilitate the 3D-habitat provisioning. When comparing these results to the natural assemblage, the restored coral population has surpassed the control values in terms of size and biomass of the colonies, while the assemblage functionality is approaching what is observed in a natural population. Our results highlight how a restoration through transplanting adult colonies of key long-lived octocorals bypassing sensitive early life stages can be an effective tool to restore the functionality of this habitat in relatively “short” timescales. These results are crucial to design future restoration actions of coralligenous assemblages at larger scales.

Keywords: Functional recovery, coralligenous, active restoration*, Corallium rubrum,* colony transplantation

Quantifying the ecosystem service benefits of Mediterranean Cystoseira macroalgal forests

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ABSTRACT

Cystoseira macroalgal forests provide valuable and important ecosystem services to coastal Mediterranean communities relating to tourism, aquaculture, coastal protection and habitat for biodiversity. However, these benefits are not widely documented, and *Cystoseira* species face ongoing loss and degradation due to human pressures and climate change. Restoring these ecosystems could provide benefits to both people and nature from enhanced ecosystem services.

Restoration of marine habitats is a key element within the UN Decade for Ecosystem Restoration, which aims to catalyse ecosystem restoration action globally and across all ecosystems. Demonstrating the benefits of ecosystem restoration to people, nature and climate is key to ensuring long-term success through adequate funding and support. AFRIMED, an algal forest restoration project, focuses on the habitat restoration of *Cystoseira* ecosystems, a brown macroalgae located within intertidal regions of the Mediterranean Sea with research located across Europe and North Africa. AFRIMED's key objectives are to develop innovative habitat restoration methodologies; provide a vital framework to up-scale current approaches; and develop knowledge on *Cystoseira* ecosystems.

This study presents results of a systematic literature review which was carried out to develop an evidence base of the ecosystem services which are provided by *Cystoseira* Macroalgae forests in the Mediterranean. The principal ecosystem services were regulation of water quality and maintenance of lifecycles with habitat provision, alongside primary production and nutrient cycling. The largest number of studies from the 80 papers reviewed were in Italy, where several *Cystoseira* restoration projects were linked to the ROC-POP Life project. Evidence for these benefits is generally at the site level, there is little understanding of these benefits at larger spatial scales. These findings can be used to advocate for the importance of restoring degraded *Cystoseira* habitats, raising their profile at the political level, and to understand where vital research is required to fill knowledge gaps.

Keywords: Cystoseira, Ecosystem Services, Restoration, Mediterranean, AFRIMED

Towards the restoration of macroalgal forests in the Mediterranean Sea: major challenges and wins

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ABSTRACT

In the Mediterranean Sea, marine forests constituted by brown algae of the genus *Cystoseira sensu lato* (s.l.) play a valuable role as foundation species. Currently, most of the their populations are suffering a decline largely due to anthropic impacts, climate change and the increase of extreme climatic events (e.g., exceptional storms, floods, heat-waves). Due to the evidences of regression/loss of these habitats, active restoration techniques are encouraged by European legislation and in the last years, a large effort for developing *Cystoseira* forests restoration has been implemented by EU projects (MERCES; Afrimed; ROC-POP Life). In the framework of ROC-POP Life, the *ex situ* outplanting restoration technique was applied in the Mediterranean to repopulate two different *Cystoseira* s.l. species: *Ericaria amentacea* var. *stricta* and *Gongolaria barbata*.

This technique consists in three main steps: i) collection of the fertile apices during the reproductive season, ii) culturing juveniles under laboratory conditions and, iii) outplanting, i.e., the deployment of the cultured juveniles in the field.

Since the two target species thrive in different habitats (midlittoral for *E. amentacea* and subtidal for *G. barbata*), these species are differently subjected to environmental factors. Therefore, the implementation of the *ex situ* restoration action was designed, both for the lab culture and the deployment in the filed phase, according to the requirements of each species and the specifical threats posed by the different habitats. Yet, unpredictable challenges as thermal anomaly and huge storms were also tackled during the grow out phase implementation. Nevertheless, these restoration actions obtained relevant results encouraging further studies of this novel approach to guarantee and preserve marine biodiversity and providing evidence of potential for up-scaling.

Keywords: algal forest restoration, outplanting, *Cystoseira* s.l., Fucales, Mediterranean

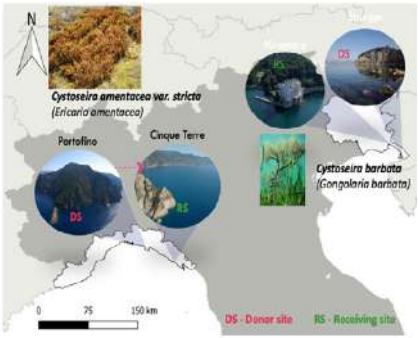

Fig. 1: ROC-POP Study sites.

Posidonia oceanica transplantation: insights and lessons from Italy

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ABSTRACT

Italy has invested more than other countries in research and experiments on *Posidonia oceanica* transplanting in the Mediterranean basin. Numerous experiments and extensive transplantations, some of which are in progress, have been carried out in Italy both to restore degraded meadows and to compensate for the damages caused by coastal works and infrastructures. Our study, implemented in the framework of the LIFE SEPOSSO project, takes into account the Italian case studies, with 39 transplantations carried out between 1994 and 2021. A number of anchoring modules, such as concrete frames with metal mesh, different types of metal grids and stakes are among the most frequently used techniques to fix *P. oceanica* cuttings to the substrate. Over time, additional anchoring methods, such as mats and mattresses of various types, bioplastic anchoring modules, and even the transfer of *P. oceanica* clods, have been developed and tested, with increasing focus on the environmental sustainability of the technique used. The transplantations carried out in Italy are very different from each other, in terms of technique, surface, receiving substrate (sand, *matte*, rocks), bathymetry and monitoring duration. Most of transplantations (89.7%) were carried out between 6 and 15 m depth and the most frequent transplanting substrate among case studies (53.9%) was dead *matte*. Only 20.6% of transplantations were carried out on a large spatial scale (> 500 m^2), with a maximum area of 1 ha. 20.5% of transplantation had a medium-term (> 5 years) and 17.9% a long-term monitoring period (> 10 years). The performance of transplantation will be analyzed and discussed in order to better understand its effectiveness and its use in environmental decision-making and management.

Keywords: *Posidonia oceanica*, transplantation, seagrass, management, Italy

S14

Friday, 9th September 2022
(Sala d'actes Aulari II -Auditorium General Lecture Hall II,
University of Alicante)

Hydrological Restoration

Chair: Patricia Rodríguez

Estimating the value of newly restored riparian and tidal marsh areas to recreational hunters

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ABSTRACT

Hunters are uniquely important stakeholders for ecological restoration, because their ability to access public lands for sport is more strictly limited than that of other recreational users. We studied the value to hunters of restored riparian floodplain and tidal marsh sites, formerly exploited for agriculture or salt production but made suitable by habitat restoration for hunting of deer, upland gamebirds, and waterfowl. We used three approaches to understand hunter demand and value for these newly available sites. First, we used a travel-cost method to estimate the net economic benefit of having access to the sites, based on self-reports of travel distances and visitation frequency collected during in-person intercepts (n=1,109). Next, we performed a choice experiment via online survey to measure hunter preference for site attributes, including vegetation density, management approach, crowding, size, and distance (n=645). Finally, we asked hunters in both groups about their satisfaction with habitat quality and how they perceive factors affecting the quality of their hunting experience at restored and non-restored sites in the region. We found that hunting access is viewed as scarce, and that hunters perceived habitat quality in restored sites as equivalent to, or better than, nearby public access sites that had not undergone habitat restoration. Hunters differed by prey type (deer, turkey, waterfowl, other gamebirds) in their preferences for site attributes, with all hunter types significantly preferring closer sites and a prey-specific vegetation density, and some groups showing significant preferences for a management approach (e.g. water management or hunt regulations) or particular level of crowding. The dollar value of an individual hunting trip for deer hunters was estimated at USD$63, and for waterfowl hunters, USD$155. Our analysis concludes that habitat restoration increases economic value for hunters, and we provide insights into how this stakeholder group's interests can be served by future restoration efforts.

Keywords: ecosystem services; valuation; wetlands; stakeholders; coupled natural-human systems

Global assessment of the biological condition of rivers via fish and macroinvertebrate assemblages

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ABSTRACT

Rivers suffer from strong pressures driven by the impacts of increasing human consumption, urbanization, economic growth, and climate changes. Yet, the biological condition of rivers globally is still unknown because of the unbalanced implementation of river bioassessments together with unpublished or inaccessible results or outdated information. We gathered macroinvertebrate- and fish-based assessments from 72,275 and 37,676 sites, respectively, from 64 study regions across six continents, and 45 nations. Globally, 50% of macroinvertebrate sites and 42% of fish sites were in Good condition, whereas 21% and 29% were Severely Impaired, respectively. Poorest biological conditions occurred in Arid and Equatorial climates and the best conditions occurred in Snow climates. Severely Impaired conditions were correlated with higher Human Development Index scores, poorer physico-chemical water quality, and lower proportions of protected freshwater areas. Conversely, Good biological conditions were associated with good water quality and increased forested areas. Yet, within continents and nations there are also different levels of impairment. Our results showed that it is essential to implement government-enforced bioassessment programs in Asian, African and South American countries to fill the information gaps, and continue biomonitoring programs in Oceania, Europe and North America to produced updated information. It is also important to invest in quality assessments based on fish, because there is less information globally and fish were more sensitive to river degradation (probably reflecting the losses of river longitudinal connectivity). Our study highlights the importance of increasing the extent and number of protected river catchments, preserving natural forested areas in the catchments, including riparian zones, treating wastewater discharges, and improving river connectivity. Involving citizens in the governance of rivers, generating comparable data and establishing global partnerships are keys solutions for the successful implementation of such measures.

Keywords: anthropogenic degradation, climate, protected areas, forest change, human development

River-human connections and affinity for nature of local populations to regulated rivers

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ABSTRACT

Rivers are natural connectors for people, aquatic and riverine flora and fauna, and support a myriad of goods and services for environmental, economic and social health. Numerous European Mediterranean rivers have been altered to serve human purposes, following the need for freshwater and hydropower energy, and adjacent territories for agriculture, forestry or urban settlements. These regulated rivers have altered stream flows, fragmented aquatic and riparian ecosystems, and modified floodplains, which promote altered connections to the nature of local populations.

This work addresses how river regulation affects the affinity for nature and the perception of local populations of the ecological changes across space and time. We used two case studies in Portugal, regulated since 1993 and 1985 by the dams Touvedo (run-of-river), and Fronhas (storage reservoir), respectively. The affinity for nature and perceptions were assessed via 402 telephone-assisted questionnaire surveys in 2020 using randomly selected numbers of local human communities living nearby the area influenced by dams. Data were analyzed with descriptive statistics and multivariate analysis.

Our study showed that despite river regulation, communities remain connected to the rivers. Nonetheless, these relationships have changed due to socioeconomic and cultural changes over time. Overall, significant differences were found in educational attainment, age and gender regarding the affinity for nature. The lower education level of women and less frequent use of the river acts as a barrier to their perception of river ecosystems and the regulation effects. The affinity for nature and the perception of changes differed significantly concerning the regulation type, where residents near the run-of-river dam present less affinity for nature. This work draws attention to the need to deliver environmental education by providing conditions for dedication and time to nature and promoting environmental knowledge through direct experience.

Keywords: dams; changes; ecosystem services; perception; socio-hydrology

Fig. 1 Flyover image of the case study run-of-river Touvedo, Lima River, Portugal: landscape downstream of the dam

River regulation induces functional alterations in the aquatic communities

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ABSTRACT

Globally, dams are one of the major pressures affecting rivers, leading to alterations in flow, sediment, water quality, and constituting physical barriers to the movements and drift of fish, invertebrates and other animals and plants.

In this study, we investigated the potential of dams to also affect the ecosystem functioning, through analysis of the community biological traits of benthic invertebrates and diatoms (microalgae). We sampled macroinvertebrates in riffles, runs and pools of river sites downstream of the dams (i.e., regulated; n = 24) and in sites without the influence of the dams (i.e., unregulated; n = 7), assessing a total of 64 mesohabitats, following late spring-early summer regular flows. And we used 15 trait categories of diatoms related to size, form and attachment to substrate, while for macroinvertebrates we selected 42 trait categories related to feeding habits, locomotion, respiration, maximal size, resistance, number of generations per year and type of reproduction.

The analyses showed that dams affect the biological trait composition of both macroinvertebrate and diatom assemblages (Permanova test, $p<0.001$). Diatom traits showed significant differences between regulated and unregulated sites for all mesohabitats, while the effect of flow regulation was detected only in run-type mesohabitats for invertebrates. Motile, small biovolume and adnate diatoms become dominant in regulated areas while for macroinvertebrates the traits respiration mode, attachment form and type of reproduction were affected by regulation.

These results indicate the strong effect of large transversal barriers in the rivers ecosystem functioning, with modifications at different trophic levels, from primary producers to invertebrate herbivores and predators. These changes have the potential to induce alterations in relevant processes, such as decomposition of organic matter and primary production, leading to changes in the transference of energy from land to water and over the river longitudinal gradient with potential impact in a variety of ecosystem services.

Addressing the climate emergency through citizen-driven forest restoration projects.

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Commonland is a not-for profit foundation that believes that large-scale and business-driven landscape restoration offers tremendous untapped opportunities for revitalizing communities and regenerating ecosystems. We are a system developer of integrated landscape management and restoration initiatives worldwide, bringing solutions relating to biodiversity, climate change, regenerative agriculture, and communities. To make this happen we have developed the 4 Returns Framework aiming at value creation through return of inspiration, natural returns, social returns and financial returns.

In the context of this Workshop, we will present our approach and discuss opportunities and challenges relating to:

1. Education: together with business schools we develop a curriculum to train a new kind of CEO: the Chief Ecosystems Orchestrator and together with the 1000 Landscapes partnership we develop educational offerings for landscape leaders involved in landscape partnerships worldwide;

2. Technology/Implementation: we are developing new ways for data collection (MEL) with our landscape partners and we are designing tailor-made ways for carbon modeling and valuation of ecosystem services in order to enhance blended finance mechanisms and make landscapes “investable”.

The 4 Returns Approach to Landscape Restoration: opportunities & challenges.

Moolenaar, *Simon Willem*

Building environmental awareness and addressing climate change through forest restoration in a fire-prone landscape (North-eastern Spain)

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ABSTRACT

Ecosystems and landscapes of the mediterranean basin have been deeply degraded for millennia through intensive exploitation. Over the last decades, extensive rural abandonment in southern european landscapes led to dramatic increases in fuel load and continuity, and periodic outbreaks of large forest fires. More recently, land use changes combined with global warming caused an increased risk of megafires; i.E. Fires of extraordinary intensity seriously threatening lives, property and ecosystems.

In dry mediterranean areas, or in particularly vulnerable ecosystems, such fires have high impacts (biodiversity loss, decrease of c sequestration)

It happened in our study area (maials, north-eastern spain), with a continental dry mediterranean climate, where land abandonment resulted in fuel build-up and loss of the traditional mosaic-type landscape. It was affected by the largest wildfire recorded in catalonia in 2019.

The event boosted a collaboration between forest administration and our research group, focused on studying the fire ecological impacts and the need of post-fire restoration treatments, while exploring management approaches for low-productivity ecosystems (open *pinus halepensis* forests) threatened by climate change. Field work showed that *juniperus phoenicea* disappeared in burned areas, as this shrub species does not present any adaptation trait in response to fire.

This fire impact combined with an increasing concern of the population about the high risk of large fires enabled to start a participatory process with local stakeholders aiming to increase community engagement with sustainable forest management and promote citizen-driven initiatives.

The two working axes are: i) building environmental awareness among locals (workshops with schoolchildren and tree-planting events were implemented), and ii) addressing the threats posed by climate change promoting a sustainable forest management and restoration actions among land owners.

In relation to the latter, plantations of *j. Phoenicea* are planned. Several seed collection events were organized this winter and the production of seedlings has started.

Keywords: climate change, increasing fire risk, citizen-driven forest restoration, biodiversity conservation, environmental awareness

Restor.

A Science Based Platform to Enable and Accelerate the Restoration of Earth's Ecosystems

ABSTRACT

Restor is a non-profit open-data platform designed to support and accelerate the conservation and restoration of earth's ecosystems for people, biodiversity and climate. Today, Restor provides ecological insights, monitoring data, and visibility to 120,000 conservation and restoration sites across 110 countries. These sites are managed and supported by a diverse range of users, including practitioners, funders, governments and more.

Restor's theory of change is that transparency and connectivity are key to unlocking the incredible potential of nature-based solutions. Transparency is critical for building trust/accountability, driving investment, tracking impacts, avoiding double counting, and raising awareness. Connectivity ensures the latest scientific data informs action, facilitates knowledge exchange to improve outcomes, and pairs worthy projects with funding.

In order to drive transparency, Restor makes a range of best-in-class global monitoring products easy to view and use by anyone. In parallel, based on user-collected field survey data, site managers can easily access enhanced analysis combining Restor global monitoring with local data.

In order to facilitate connectivity, we leverage our position at the interface of science, technology and sustainable development to create unique value for our to users. Our in-house product development team is currently working on new features that will enhance connectivity between users, allowing projects to easily learn from and collaborate with one another, identify new funders, and compare progress across many sites.

The development of the Restor platform is driven by the input and feedback of its (potential) users. We aim to provide exactly the data and digital tools that the broad range of users on Restor need. In this proposed workshop contribution we aim to share the current status of the platform and its future direction, as well as discuss and get feedback on it from the participants.

Species selection for sustainable tree planting under a changing climate

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ABSTRACT

Life Terra is an EU co-financed project (LIFE19 CCM/NL/001200) that aims to plant 500 million trees sustainably, combining professional and citizen planting events. Planting sustainably means that ecological restoration or rehabilitation must be compatible with the livelihoods of local people—creating synergies when possible—and integrate climate change projections and conservation principles in the decision-making process.

The static concept of reference ecosystem is questioned under a rapidly changing environment. Is looking at natural habitats in lower latitudes for reference enough to grow climate-resilient forests? Do new assemblages, novel ecosystems, need to be conceived? And, if so, to what extent and in what circumstances? The approaches adopted to address the impositions of climate change must then be translated to the unique setting of each planting site, considering land use, dispersal, and abiotic and biotic filters. Selecting species is an especially delicate task in areas with very limiting conditions in the Mediterranean region, which are prone to degradation and desertification. However, high tree mortality and bark beetle outbreaks related to some forestry practices and increasing drought in Central Europe also highlight the need for a more sustainable approach, trying to reconcile high productivity and conservation. We present these challenges in the context of the Life Terra project and open a space for a discussion on best approaches and solutions for species selection for sustainable tree planting in Europe.

Keywords: sustainability, tree plantings, climate change, livelihoods, conservation

How to support educators from different countries with teaching sustainability, and evaluate the programme's success

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ABSTRACT

Terra Mission is Life Terra's sustainability Educational Pack. Designed with 8 themes, an introduction, and a closure lesson, it can be taken partially as all themes are independent but interlinked. Using inspiring sources and examples, Terra Mission challenges teachers and students to investigate and learn about the natural environment, both inside and outside of school. Terra Mission can easily be integrated into school curricula. It has increasing difficulty levels: from issues close at hand (in and around the school) to issues looking at the bigger picture (nationwide versus global). It also promotes teaching sustainability by combining scientific knowledge, critical thinking, active citizenship, and connecting STEM education with arts, humanities, and social sciences.

To equip teachers and school leaders to teach about sustainability, Life Terra has created a massive open online course (MOOC) on how to adapt the Terra Mission Educational Pack to fit their school's situation, culture, and needs. There are many challenges in teaching sustainability and adapting the materials to multiple curriculums. *How can we better support educators to adapt the materials to their curriculums and needs to teach sustainability?*

Moreover, teaching sustainability for action requires students to reflect on their attitudes and to experience environmental changes that impact their immediate surroundings. While knowledge is relatively easy to measure, it is a challenge to track competences and attitudes, let alone environmental improvements which can only be observed in a more distant future (e.g., air quality in the community). *How can we evaluate the success of a sustainability programme and behavioural change in students?*

In this workshop, we will discuss these aspects and exchange knowledge and good practices and will set the grounds for new partnerships and collaborations.

Keywords: education, training, climate action, sustainability, assessment.

Empowering individuals and organisations to lead climate action through tree planting: Terra Leaders

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ABSTRACT

Volunteers are key for Life Terra. To achieve the large-scale vision both geographically -across all Europe- and numerically -number of trees-, citizen participation is essential. Life Terra volunteers, or *Terra Leaders,* are individual volunteers and volunteering organisations who take the lead in tree-planting activities, supporting people to plant correctly and raising environmental awareness. Terra Leaders are motivated and empowered people who make a difference in their communities while gaining knowledge, skills, and hands-on experience in tree planting and climate action.

During its first two years, Life Terra has provided training materials and opportunities to prepare volunteers. A manual with technical details about how to lead planting activities was developed, including an educational section on climate change, the environment, and biodiversity. Life Terra has also organised training sessions, both online and in the field. In total, 113 individuals and one entity were trained and certified as Terra Leaders in five EU countries. Life Terra's first attempt to evaluate volunteer engagement included an online self-evaluation test and a feedback form.

The challenges for empowering, managing, and engaging volunteers in the long term are diverse. Terra Leaders might have varied profiles and provide different contributions to support the scale up of Life Terra's actions. Ensuring high quality in Life Terra's planting activities to achieve meaningful climate action (*the right tree in the right place and in the correct way*) might be compromised when volunteers are involved.

How to empower individuals while ensuring planting quality*?* Which information, training, and tools do Terra Leaders need? ***How to effectively manage and keep them engaged* in the long term**? How to create synergies with volunteers and environmental organisations to roll-out Life Terra actions and create a green movement for climate action?

Keywords: volunteers, tree planting, climate action, participation, empowering.

Engage citizens to take positive climate action by developing tools for measuring their climate impact

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ABSTRACT

The Life Terra Foundation (LIFE19 CCM/NL/001200) aims to plant 500 million trees. But Life Terra also aims to address the climate emergency through citizen involvement and educational outreach. Empowering citizens to take climate action and change their behaviours to more sustainable ones requires a multi-faceted approach.

In order to change their behaviours, individuals need three factors to be present: individuals must be capable, motivated and opportunities must be presented to them to engage them in positive behaviour change. For this to be implemented, individuals need to firstly be made aware of the environmental impact of their actions, both categorically and specifically (i.e. the impacts of their diet overall, and the individual carbon footprint of each item they consume). To enable this level of engagement, we conducted a review of available carbon footprint calculators to gauge their accuracy and the breadth/depth of data collection. We then formulated an approach to developing our own carbon footprint calculator.

The UB team developed a battery of questions and their respective equations for calculating the users carbon footprint according to their activities. Each question and potential answer have a quantifiable calculation methodology associated with them, to obtain a representative estimate value for a user's overall carbon footprint. These questions and their calculation methodology were based on an extensive literature review, and a review of other available carbon footprint calculators.

Now we ask the questions: How do we encourage individuals use the newly developed tool, and how do we measure the level of behaviour change (if any) after engaging with the tool? During this discussion, we will brainstorm ways to ensure useful data are extracted from empowering citizens to engage with tools for measuring their climate impact.

Engaging citizens to gather useful data regarding tree plantings (tree-tagging)

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ABSTRACT

The importance of planting trees and its role in restoring ecosystems, increasing biodiversity, and fighting climate change is already well stablished in our society. However, every tree planting initiative struggles to provide transparency of their activities. Additionally, land restoration/tree planting is not an exact science, especially with the constant change in the climate and local conditions. Therefore, the importance of a reliable record of what is being planted and their results are a key factor to ensure funding, constant learning and, ultimately, increase project's success. On top of that, Life Terra (LT) - LIFE19 CCM/NL/001200- aims to not only provide for citizens, but also act with citizens. The "decentralised" and small-scale planting events organised by LT adds one more layer of complexity as LT deals with completely different conditions (people, land, resources, etc.) in every single event. To tackle all those challenges, LT has been developing a tool to engage citizens to gather information about all our plantings. Through an easy-to-use and highly accessible online tool citizens can register their trees and, in the future, monitor all LT plantings. In that way, LT can keep a track record of what was done in the field and what is happening afterwards. This data can be used to provide useful and insightful feedback to our external stakeholders (citizens, governments, donors) about our plantings, as well as providing important information to our internal stakeholders (planters, subcontractors, landowners), empowering them to act in case something goes wrong, and learn for future projects.

Estimation of live carbon storage in a continental-scale plantation

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ABSTRACT

The Life Terra Foundation (LIFE19 CCM/NL/001200) intends to plant 500 million trees. Trees, forest stands, and forest ecosystems provide several essential benefits to humankind and nature; carbon fixation is one of these benefits. A major challenge in the Life Terra project is to quantify the carbon sequestered by planted trees. As the project compromises landowners to a minimum 40-year maintenance of trees, IFER (Institute of Forest Ecosystem Research) designed a methodology to assess the carbon storage of trees and plantations at age 40 years. This methodology was designed in a way to use the minimal input information while targeting realistic—however approximate—results. Estimates of live tree biomass are obtained for each species based on yield tables differentiated by biogeographical region, species-specific allometric equations and belowground biomass expansion factors. In the case of species for which specific equations were not found, an average value of a related group of species (generally their genus or functional type—broadleaves, conifers, shrubs, other tree shape plants, and others) was used to estimate live tree biomass. To estimate live biomass at the stand level, long-term mortality assumptions are required, with a resolution that responds adequately to different environmental and management settings.

During its first two seasons, Life Terra has planted over 400 thousand trees in 4 different biogeographical regions in Europe (Continental, Atlantic, Mediterranean, and Alpine). Preliminary results without accounting for mortality show that all trees currently planted in Life Terra represent a potential CO_2 uptake of approximately $7.0 \cdot 10^4$ t, if environmental conditions allow tree growth according to their expected growth performance, which we assumed to be the average site index from the yield tables for each region.

Keywords: live carbon storage, allometric equations, ex-ante estimation, large-scale planting

SUPERB – Systemic solutions for upscaling of urgent ecosystem restoration for forest-related biodiversity and ecosystem services

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ABSTRACT

SUPERB is a Green Deal H2020 funded project that studies and brings to large-scale application practical and scientific knowledge on successful forest landscape restoration. We demonstrate best-practice restoration in 12 large-scale demonstrators in different biogeographic regions and in different socio-economic contexts across Europe in response to various major restoration challenges. SUPERB focusses on the restoration and protection of biodiversity and the provision of ecosystem services including carbon sequestration and the supply of low-carbon materials and non-wood forest products for the bioeconomy. At the same time, SUPERB applies a forward-looking restoration concept that includes the need for climate change adaptation (= prestoration) to increase the resilience of forests and forest landscapes. Achieving transformative changes and delivery of large-scale forest ecosystem restoration requires many actors from different sectors and disciplines to behave in synergistic and mutually reinforcing ways. We aim to enable restoration upscaling and transformative change through innovative stakeholder involvement aiming at sensitisation and broad scale support, exploring pathways for innovative and sustainable funding, governance and regulatory options, and the provision of easily applicable and comprehensible tools and materials that support restoration. Further upscaling beyond the large-scale demonstrators to regional and national scale will be enabled through (i) developing multi-disciplinary scalability plans, (ii) a stakeholder-targeted, multi-language online Forest Ecosystem Restoration Gateway, including a restoration project Marketplace, and (iii) boosting the impact through using the vast project consortium network including in the 12 demos and key stakeholders communities that will be systematically and professionally expanded and involved to ensure the relevance of the project outputs and their positive and large-scale uptake.

Key words: forest restoration, biodiversity, adaptation, upscaling, transformative change

LIFE TECMINE Project. Innovative Techniques for Landscape Recovery after Clay Mining under Mediterranean Conditions

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ABSTRACT

Open-pit mining results in profound modifications at different environmental scales that may persist for very long time periods, or even indefinitely. Considerable research efforts in mine reclamation strategies have been made, although reclamation failures are still common. In dry climates, such as in the Mediterranean Basin, successful actions may depend on features related to proper species selection and restoration techniques, which may substantially contribute to provide substrate stability and facilitate the regeneration of the main ecological processes. In this context, we developed the LIFE TECMINE project.

The restoration strategy planned in TECMINE was designed at the landscape level with two main goals: the recovery of the natural geomorphology and the ecological restoration, including vegetation recovery and soil quality, based on suitable reference ecosystems. The implemented actions included: (i) surface remodelling to improve substrate stabilization and minimize the visual impact; (ii) an accurate species selection according to the microhabitat characteristics; (iii) high-quality plant production; and (iv) the implementation of low-cost techniques to enhance resources availability, soil fertility and the amelioration of abiotic conditions for the introduced seedlings. Within TECMINE, we developed a monitoring program to assess the success of the implemented restoration techniques over time and a dissemination program to ensure knowledge transfer to a wide variety of actors (including citizens, students at different levels, mining companies, policymakers, and scientists).

Keywords: Dissemination, low-cost techniques, mining reclamation, monitoring program, restoration units.

Society and Restoration

Chair: Alice Nunes

The potential socioeconomic impact of the forest restoration chain in a basin of high social vulnerability in South-eastern Brazil

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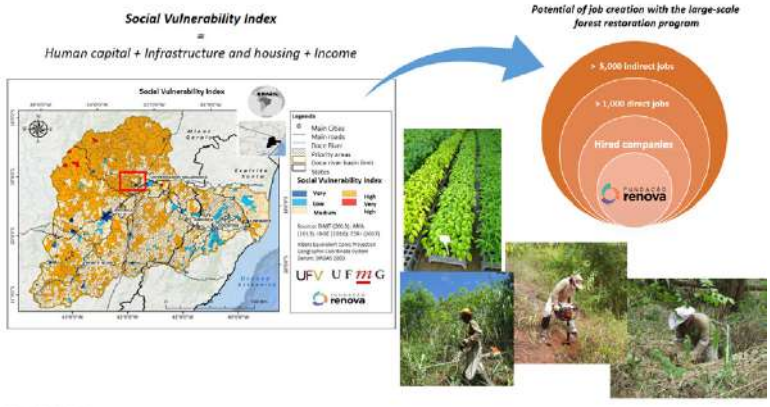
ABSTRACT

Forest restoration can provide ecosystem services, create jobs, reduce poverty and stimulate market chains. An increasing number of robust multidimensional models based on socio-economic indicators have been created aiming to support decision-making processes. One poorly explored dimension is the creation of direct, indirect, and induced jobs within restoration economics. We aim to present, with a case study, the potential of a big restoration goal in generating several jobs. The study region is a micro basin of the Doce river, in south-eastern Brazil. In November 2015, 56 million cubic meters of mine tailings spread off, after the rupture of the Fundão dam, in the municipality of Mariana, Minas Gerais, which was considered the largest environmental disaster in Brazil. To deal with this complex scenario, a Foundation called Renova was created to repair the damages. Two of its largest programs aim to restore 40,000 hectares and 5,000 water springs. A study carried out with the Federal Universities of Viçosa and Minas Gerais, aimed to explore the social vulnerability of the municipalities that could receive the programs of forest restoration. One of the regions, covered by the city of Guanhães and its neighbours, has an ongoing investment of € 1,600,00 (BRL 9,000,000) to restore 300 ha. The study shows that the cities have presented indexes of high vulnerability in human capital, infrastructure, and income. To this moment, one, from a total of 14 companies currently working for Renova Foundation, generated 25 direct jobs and 135 indirect jobs from the service sector. Considering that this represents only 10% of the string water recovery goal, it is estimated that over 1,000 direct and at least 5,000 indirect jobs can be generated. These investments in forest restoration can help change the economics of some municipalities in the basin.

Keywords: Large-scale restoration, decision-making, social vulnerability, tropical forest restoration

Fig. 1 Scheme representing the potential of the socio-economic impacts of a large-scale forest restoration program in Doce river Basin, south-eastern Brazil.



Implications of social preferences in a restoration planning based on cost-effectiveness.

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ABSTRACT

Mediterranean landscapes show high risk of degradation and biodiversity loss due to the overexploitation of natural resources and climate change. Ecological restoration in these areas is urgently needed to guarantee the well-functioning of ecosystems and the provision of Ecosystem Services (ES). Prioritizing areas for restoration in a cost-effective way is needed because of limited resources available. Social participation in the planning process is important to guarantee success in the long term. However, addressing all those objectives and constraints requires adequate planning. Here we evaluate how accounting for constraints derived from social preferences affects the spatial distribution of priority areas for restoration in a heterogeneous landscape in southeast Spain. Through a participatory process, we obtained social preferences for allocating restoration efforts and ranked ES importance. We mapped each ES and estimated the effectiveness of restoration as the difference between the mean of the percentile 95 and the actual value of ES. We evaluated five scenarios: considering 100%, 75%, 50%, 25%, and 12% of social preferences, selected by order of importance for stakeholders. We established three zones to increase the supply of ES to maximize co-benefits between compatible ES, and minimize potential trade-offs: ECO zone to restore ES related to the maintenance and regulation of the ecosystem, PROD zone for marketable ES, and a mixed zone focused on cultural and other compatible services. We used Marxan with zones to prioritize the allocation of these zones, under each scenario for different targets. We found that in any scenario all ES achieved the target, even asking for low values. The scenarios considering all and 12% of social preference were alike, but the 12% achieved more effectiveness in fewer areas, at a lower cost. With this approach, we integrate trade-offs between social preferences, cost, and effectiveness of restoration, allowing a more integrative and holistic planning.

Keywords: Ecosystem Services, Cost-effectiveness restoration, participatory process.

What influences public attitudes toward river restorations?

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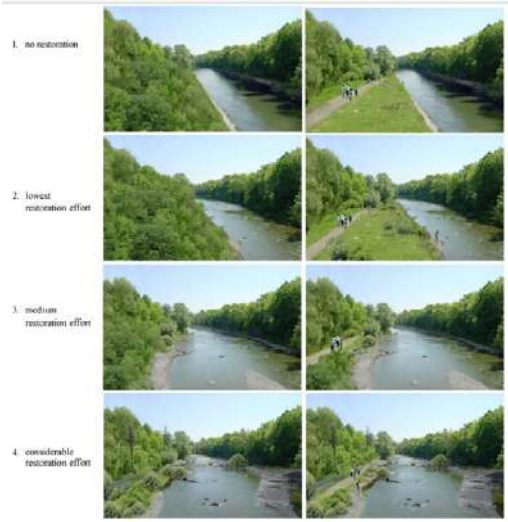
ABSTRACT

To restore river corridors has become an increasingly common practice to improve both their ecological quality and flood protection in Switzerland, as in many other countries. However, there is a lack of knowledge as to why the wider public approves or rejects river restoration projects. In order to examine the factors underlying public attitudes towards river restorations, we conducted a representative Switzerland-wide survey (N=1005). Statistical analysis of the data was used to test a conventional attitude-model consisting of three types of factors - cognitive, affective and behavioural factors. In a second step, the model was extended by social, procedural and flooding risk evaluation factors to examine their influence on attitude formation. We found that the three conventional model factors were relevant, but that social and procedural factors also make a significant contribution to predicting attitudes toward river restorations. Interestingly however, social and procedural (and flooding risk evaluation) factors seem to only be additional predictors for negative attitudes, and not for positive attitudes. Overall, all factors used in this study were much more capable of explaining variance in negative attitudes than in positive attitudes toward river restorations. The findings of this study help to better understand the formation of attitudes toward river restorations as an important part of landscape development. They also enhance managers' ability to avoid conflicts in regard to river restoration projects, and to promote their active public support.



Keywords: integrated water systems management, public perception, river rehabilitation, conflict

Source: Junker & Buchecker (2008). Aesthetic preferences versus ecological objectives in river restoration. Landscape and Urban Planning 85: 141–154.

Theatre to promote public awareness for the rehabilitation of urban streams

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ABSTRACT

One of the keys for the rehabilitation or restoration of urban freshwater ecosystems is to promote citizen awareness and their engagement in nature preservation. The environmental educational project CresceRio was created in 2018 in the city of Coimbra, Portugal, assuming the urgency to promote the preservation and rehabilitation of urban streams, to reconnect the population of the city with nature, and the importance of children as present and future agents of transformation of societies. During their four primary school years, a group of 23 children (6-10 years old) participated in field trips and laboratory activities aiming to show them 1) the unknown urban stream ecosystems near their schools and homes, their biodiversity (e.g., benthic invertebrates, algae, amphibians, birds, riparian vegetation, macrophytes), and services; and 2) the problems of these streams resulting from anthropogenic pressures, and 3) plan solutions. One of the outcomes of the project is a theatre play, co-created with the children, about river ecosystems and their main threats and the experience they add during those activities with the river ecologists. The main aim of the play is to use it as a vehicle for the children to share the knowledge they gained, about the river close to their homes, with the other children, their relatives, their community, and eventually influence stakeholders to promote urban rivers rehabilitation. Here, we present the project, discuss the theatrical processes used to build the play together with the children, and the impact the play had, both on the children who participated and on the audience.

Keywords: theatre play, urban streams, river rehabilitation, citizen awareness, nature preservation

Management towards multiple ecological and socio-economic functions in rainforest transformation systems: An agent-based modelling approach

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ABSTRACT

Land use changes have dramatically transformed many tropical landscapes from forest-dominated to agricultural landscapes. Agricultural land uses, such as rubber and oil palm plantations, increase the economic benefit at the cost of reduced ecological functions. Questions arise on how to manage these systems in a way that economic benefits are sustained while restoring the ecological integrity. Due to the system's complexity involving different socio-economic and ecological aspects, it is still unclear what combination of management options minimizes trade-offs among functions and thereby improves multiple functions simultaneously. Moreover, it is difficult to test more than a few options via field work alone, thus a modelling approach is needed.

To tackle these knowledge gaps, we developed the integrated ecological-economic land-use change model EFForTS-ABM that follows a combined agent- and grid-based approach. The model simulates the impact of land use change decisions made by smallholder farmers on the economic outcomes from oil palm and rubber plantations as well as on ecological functions such as carbon sequestration. EFForTS-ABM is based on socio-economic and ecological field data from the Jambi province in Sumatra (Indonesia). We ran model scenarios on different landscape settings (i.e. different spatial settings of the plantations as well as different environmentally friendly management options). We assessed which setting improved an ensemble of ecological functions and economic functions. Further, we quantified synergies and trade-offs among functions at farm and landscape level.

Here, we will demonstrate the usefulness of ecological-economic models such as EFForTS-ABM for supporting sustainable management of degraded rainforest systems where both socio-economic and ecological functions are the goals. The model is able to assess relationships among functions at different spatial and temporal scales, and identify major trade-offs and synergies. These results are an important basis for identifying management options that minimize losses in ecological functions while still allowing for economic benefits.

Keywords: rainforests, multifunctionality, ecological and socio-economic functions, trade-offs, agent-based model

Restoration in Wetlands

Wetlands, a key ecosystem to tackle climate change

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ABSTRACT

The project LIFE Wetlands4Climate will validate a methodology for quantifying greenhouse gas (GHG) exchanges and establish guidelines for managing Mediterranean wetlands to operate as carbon sinks while maintaining their ecological integrity. Ten pilot wetland (inland saline, inland freshwater, and coastal) have been selected. The ecological characteristics of each wetland type are decisive when planning restoration actions, since their metabolic rates and carbon balances differ, and show contrasting responses to different management actions. We analyse the response of biogeochemical processes involving Carbon-GHG to different management/restoration actions on vegetation, soil and water. The detailed study of the microbial processes and the structure/function of microbial communities allows for the understanding of the biogeochemical changes induced by restoration actions, whereas other biological indicators inform about the maintenance of the ecological health. Reduced C-GHGs emissions in wetlands, both CO_2 and methane, are achieved by formulating protocols and guidelines with specific, replicable measures to restore wetlands with a high carbon sink capacity, improving biodiversity, water security and socioeconomic indicators. Main actions are:

1. Characterisation and measurement of carbon flows in wetlands, as well as the microbial communities and their functioning using -omics
2. Design of a practical sampling and assessment protocols.
3. Implementation of management/restoration actions (vegetation, soil and water) tailored to the ecological characteristics and conservation status of wetlands with the aim of maximising their carbon capture/ storage capacity.
4. Development of new methodologies in the voluntary carbon market to compensate the carbon footprint.
5. Creation of a guide to manage Mediterranean wetlands with a climate perspective.
6. Development of training materials for wetland managers.
7. Communication, transfer and networking campaigns.

The results will assist wetlands ecological restoration projects by providing suitable data, tools, methodologies and indicators maximizing its climate change mitigation capacity.

LIFE Wetlands4Climate is supported by the European Commission through the LIFE financing instrument.

Keywords: Climate change; wetlands; carbon flows; voluntary carbon market; assessment protocols

Restoration of formerly extracted raised bogs – vegetation succession and recovery of other trophic groups

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ABSTRACT

Central European raised bogs are unique and fragile ecosystems inhabited by specialists of higher plants, fungi, insects, etc., so-called tyrphobionts. The respective specialists and their abundances can serve as good indicators of restoration processes after the disturbance. Various taxonomic groups may differ in the response to the processes. After three decades of spontaneous succession in a complex of formerly extracted bogs, the species composition did not reach the reference site for any taxonomic group, despite about half of these specialists occurring at the reference sites were able to colonise the disturbed sites but usually at low abundances. It seems that habitat limitations, especially low water table, play a more important role than dispersal limitations in the restoration process. More successful restoration might be possible by substantially increasing the water table in the disturbed raised bogs. At a broader, country scale, we earlier described spontaneous vegetation succession in 11 differently aged industrially harvested raised bogs and suggested that spontaneous recovery gradually proceeded towards the reference state of natural raised bogs. However, when we repeated vegetation analyses after 10 years we revealed that spontaneous recovery of plants does not proceed towards the reference sites. An alternative, near-natural woodland developed. Repeated analyses may give more reliable signs of a restoration process than one-time analyses.

Keywords: peat land, plants, fungi, insects, chronosequence, passive restoration

Peatlands under pressure? Hidden side-effects of aeolian dust dispersal in Iceland

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ABSTRACT

Soil erosion at natural scales and dust redistribution serve important ecological functions. However, human land use practices have accelerated erosional processes manifold. This can have various, and sometimes poorly understood implications. Iceland may serve as an extreme example here. Rapid land degradation was initiated after the country´s settlement in c. 870 AD, leading to shifts in, and destruction of vegetation, and escalating soil erosion. Today, Iceland belongs to the most active aeolian environments worldwide, owing to a potent combination of sparse vegetation cover, erosivity of the remaining dryland soils (Andosols), a harsh climate with frequent strong winds and a globally unmatched extent of volcaniclastic deserts. Lushly vegetated wetlands, surrounded by sparsely vegetated or barren drylands, may appear like pristine oases of resilience in an otherwise disturbed landscape. But as dust-receiving ecosystems, they are certainly also impacted by erosional processes. Here, we introduce a study on the impact of aeolian deposition on the pedogenic environment of Icelandic Histosols (soils from peatlands) and its interaction with carbon (C) characteristics. Three peatlands containing varying amounts of mineral deposits were investigated. By analysing vegetation characteristics, C structure as derived by ^{13}C NMR spectroscopy, andic soil properties, and several complementary soil properties, we provide evidence that pedogenic minerals impact C dynamics of the peatlands, particularly in post-settlement soils. Decomposition of soil organic matter in Histosols with clear andic properties appears relatively slow, with C characteristics dominated by labile C compounds, opposed to more rapid degradation and comparatively great accumulation of recalcitrant C compounds in Histosols without notable andic properties. Projections of the effects of environmental change on C cycling in peatlands of highly aeolian environments like Iceland should therefore not only take interactions between climatic variables like temperature and precipitation, and vegetation- and C characteristics into consideration, but also the effects of mineral soil constituents.

Keywords: Peatlands, soil erosion, dust dispersal, andic soil properties, carbon characteristics

Restoring Mediterranean wetlands in Corsica: Methodology, field results and challenges

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ABSTRACT

Since 2017, the MedIsWet project created a network of partners working for the documentation, conservation and restoration of Mediterranean Island Wetlands. The authors work since 2019 on Corsica's wetlands. The first part of the work consisted of inventorying all Corsican wetlands of more than 0,1 hectares. At a second stage, the authors started advocacy for enhancing the protection and the restoration of wetlands. A restoration action is ongoing.

The first part of the presentation focuses on the latest achievements and the restoration fieldwork in Corsica. Restoration activities concern the lagoon of Santa Giulia in the south of Corsica. This coastal wetland is a property of the French coastal authority but presents land-related issues and challenges. The first action towards the restoration of the lagoon had to be a preliminary geometrician study, that examines the ways to restore the lido. The goal of this ongoing study is to regain the coastal and landscape environment while continue offering a coastal path for pedestrians outside of the vehicle traffic.

The second part of the presentation explains the advocacy strategy put in place to mobilize local resources to protect and restore wetlands. The goals were to identify priority wetlands to restore and to advocate before local authorities for the protection of these wetlands. The prioritization of wetlands occurred through a methodology taking into consideration risks and opportunities relevant to the social and political context. It allowed focusing on approximately 50 wetlands, out of 531 total areas inventoried.

Keywords: Corsica; wetlands; restoration; advocacy.

Restoring mediterranean wetlands part II: methodology, field results and future challenges

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Keywords: wetlands; restoration; mediterranean; islands.

ABSTRACT

Since 2017, MedIsWet project created a network of partners working for the documentation, conservation and restoration of Mediterranean Island Wetlands. A workshop organized during the SERE 2021 explained the goal and methodology of MedIsWet. This 2nd presentation focuses on the last achievements and the restoration work done on the ground by the MedIsWet network. The goal of this presentation is threefold.

The first goal is to present the results of the restoration activities implemented by the MedIsWet network. Information will be provided and lessons learned shared through the 8 wetland restoration projects that are running on the different pilot sites. These actions have led to the restoration of more than 405 ha of wetlands in 9 countries (Cyprus, Croatia, Italy, France, Greece, Spain, Malta, Turkey and Tunisia).

The second goal of the presentation is to explain the methodological tool the MedIsWet network used to select the wetlands to restore, aiming to replicate restoration activities in the future. Based on a multi-criteria approach, combining social and natural challenges, the MedIsWet partners have prioritized the island wetlands to restore.

The third goal of the presentation is to focus on the future action of MedIsWet. A third phase of the project would start from sharing the knowledge gained and the methodological tool created by the network, so that practitioners can prioritize wetlands to restore in the framework of new biodiversity and restoration international and EU targets. This methodological tool will be presented and shared with the public attending the conference.

Restoring Akrotiri salt lake in lady's mile, Cyprus: field results, lessons learned and future challenges

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ABSTRACT

Since 2020, Terra Cypria has been working on the restoration, emergence and protection of the most touristic part of the Akrotiri Wetland system (The Lady's Mile Area), in the framework of MedisWet (II) project. All actions at the area are carried out in consultation and cooperation with the Sovereign Base Areas Authorities (SBAA). It is noted that the Akrotiri Wetland System, is the most important wetland of the island and one of the two Ramsar Areas of Cyprus. However, this wetland is under direct and imminent threat from various pressures.

The field results of the restoration/conservation activities implemented during the project will be presented. Information regarding the actions carried out that contributed mostly to the protection of the most environmentally sensitive parts of Lady's Mile will be provided. These actions have led to the restoration, protection and management of more than 100 ha of wetland.

Also, the presentation will explain the lessons learned and the problems faced during the restoration project. The main actions, including garbage mapping and cleaning, sensitive access points mapping and blockage, reed cleaning, installation of surveillance cameras and renovation of an existing bird-hide will be analysed. Other issues will be discussed, like the need for better law enforcement.

Finally, future actions will be discussed aiming to more and continuous on the spot conservation and management actions. Also, the need for more public sensitization will be touched as well as the need to secure more conservation and management funding routes.

Keywords: wetland; restoration; Mediterranean; Akrotiri Salt Lake; Lady's Mile.

A network for wetland restoration in Brittany (France)

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ABSTRACT

In order to address a lack of local knowledge on both wetland restoration methods and the effect of restoration on wetland functions, a network on wetland restoration was set up by the Forum des Marais Atlantiques and the Council of the Department of Finistère (western France) in 2013. This network is composed of a number scientific and technical partners working on wetlands and aims to bring together experts and practitioners to promote wetland restoration projects in Brittany. Its ambition is to enable practitioners to act on their own initiative, through a variety of actions: coordination of research projects and sharing of the knowledge acquired, promoting best practices and common monitoring protocols, organising training courses … The network also directly assists project managers at different stages of their restoration projects.

A first research program focused on the study of 5 sites in Finistère (France), monitoring wetlands before and after restoration. On these sites, assistance was procured to the project managers to design and implement restoration protocols. Monitoring (biogeochemical, hydrological and biological functions) was fully financed and carried out by the network experts. The network was then widened to the whole of Brittany to increase the transferability of results by broadening the variety of sites studied. The new resulting research project is based on the synchronic study of 14 restored wetlands, which had been either filled in or drained.

The practical organisation of this network will be presented, illustrated by the example of a restoration project followed and assessed by this network.

Keywords: Wetland restoration, network, practitioners, research, governance

Characteristics of vegetation of formerly dyked marshes. Analysis of composition and spatial organization in comparison to reference sites.

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ABSTRACT

Saltmarshes present a specific vegetation, which has a key role in the functioning of coastal systems, notably due to their high productivity and their action of tidal force attenuation. Historically, salt marshes have been the object of many polderization operations in order to establish anthropic activities that have sometimes disappeared today, especially in the case of small polders. Various restoration projects concerning small marsh systems are currently being implemented with the objective of restoring biodiversity, but also in the framework of NBS for adaptation to global change. These projects must be based on a good knowledge of the restoration processes of structural and functional characteristics of ecosystems.

The proposed communication focuses on the restoration of plant assemblages. Data were collected in different sites in Brittany (Western France) accidentally or voluntarily depolderized from 70 to 5 years ago and on natural marshes (reference site). Fine mapping of vegetation as well as measurement of the topography were notably realized. Thus, a total of 2221 patches of vegetation were mapped and characterized in terms of vegetation composition. The surveys were dispatched in 30 groups by statistical analysis.

At site scale, differences in the diversity of groups and vegetation surfaces were observed according to the type of marsh. Two categories of reference sites were observed according to the frequency of submersion: exposed (NAT-E) or unexposed natural marsh (NAT-U). Vegetation assemblage diversity appeared higher for the depolderized sites. Spatial heterogeneity is more pronounced on depolderized and exposed marsh with more patches of vegetation and a smaller average area per patch than on natural sites. At natural sites studied the topographic gradient is more pronounced than on the restored sites.

Keywords: Restoration ecology ; Saltmarsh ; Vegetation; Spatial organization

Ecological integration and restoration of solar parks

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Research topics:
(1) Restoration of semi-natural and agricultural ecosystems
(2) Functional biodiversty and ecosystem services in agroecosystems
(3) Local plant adaptation and the question of seed origin in ecological restoration

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PhD student in Ecology analysing plant-soil interactions in solar parks since 2019

ABSTRACT

The search for renewable energy sources that can replace fossil energy has resulted in a massive construction of solar parks in Europe. Although contributing to reduction in environmental pollution and CO2 emissions solar parks need large areas and have thus a strong impact on ecosystems, in particular if constructed in semi-natural habitats. The construction usually destroys the vegetation and degrades the soil. However, the subsequent management for solar energy production potentially allows the restoration of semi-natural habitats during the construction period. For example, Mediterranean solar parks are often managed by extensive sheep grazing corresponding to the traditional management of dry grasslands. Our symposium evaluates the ecological impact of solar park construction, shows possibilities to restore semi-natural habitats and discusses management recommendations. A particular focus will be on the effect of solar panels on restoration and ecosystem functions. Solar panels reduce light availability and changes microclimate which may compromise restoration approaches. Solutions to cope with potential negative effects of solar panels are discussed. Finally, the symposium will also discuss possibilities to reduce the ecological impact of solar park construction to facilitate restoration. The invited speakers present the quite young field of research on the topic and provide insights on current challenges for impact studies, mitigation and compensation measures involved in the planning of solar park construction. The five session speakers are coming from the UK and France. They will discuss possibilities of ecological integration (talk 1), the restoration of semi-natural grasslands in solar parks (talk 2), potential ecosystem services linked to novel land use (talk 3), the ecological impact of construction and potential compensation (talk 4) and the combination of vegetation and solar panels on urban roof tops (talk 5).

A decision support tool to improve solar park management for ecosystem services

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ABSTRACT

Land-use change for solar parks has accelerated in more recent years with uncertain impacts on the hosting ecosystem. Whilst land-use change is often associated with declines in nature, there is potential to design and manage solar parks to enhance the hosting ecosystem. Consequently, we co-developed the Solar Park Impacts on Ecosystem Services (SPIES) decision-support tool with a range of industry, policy, and nature conservation stakeholders. The SPIES tool provides insight into the potential impacts of different solar park land management practices, for example vegetation management, on the full suite of ecosystem services. The SPIES tool is underpinned by 704 pieces of scientific evidence from peer-reviewed academic journal articles, collated through a systematic review. The SPIES tool demonstrates the strength, direction, and consistency of land management practice impacts on ecosystem services, as well as where evidence is lacking. We evaluate the SPIES tool using field data from solar parks within the UK and consider the implications of its application. We detail usage in the UK and internationally, and potential consequences for the solar industry, including operational cost savings and contributions to emerging policies that seek to enhance ecosystem service provision and natural capital stocks. Given the growing land-use change for renewable energy technologies, decision support tools that promote the co-delivery of ecosystem benefits, such as SPIES, are critical to ensure that climate change impacts of fossil fuels are not swapped for local-scale ecosystem degradation.

Keywords: environmental impacts, renewable energy, natural capital, land management, solar photovoltaics

Photovoltaic power station : an opportunity to restore semi-naturel European grassland.

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Abstract: The increasing demand of renewable energy sources has resulted in th construction of numerous photovoltaic parks in the framework of the European Gree Deal. Although involving degradation or even destruction of pre-existing vegetatio photovoltaic parks may allow the creation or restoration of semi-natural grasslands sinc this vegetation type does not hamper electricity production. However, solar panels ca shade, divert precipitations, and decrease evapotranspiration, creating uniqu microclimatic conditions and soil moisture patterns changing vegetation and sc functioning. The effect of solar panels on biodiversity and soil ecosystem services a expected to be highest in regions with high summer temperatures and drought. Here w first present a study on the effect of solar panels on plant-soil relationships of solar parl distributed along a solar radiation gradient in Southeastern France. In each solar par vegetation and soil physico-chemical and biological properties were analyzed outsid between and below the solar panels. Typical dry or semi-dry grassland species we less abundant under than outside solar panels. In a second study, tested the restoratic of plant communities following solar park construction. We applied three methods restore semi-natural Brachypodium retusum grasslands: vermicompost amendment, l retusum sowing, seed material transfer from a reference community. After four year hay transfer was the best method to initiate plant succession towards the referenc community. Solar panels hampered restoration success and strongly reduced pla species richness, in particular of species from the reference community. In conclusio semi-natural grassland restoration or creation in solar parks need to consider differe microclimatic conditions of zones covered by solar panels and open areas.

Ecosystem responses to solar park development in the UK

Authors: Carvalho, F.[1]; Montag, H.[2]; Sharp, S. P.[1]; White, P.[3]; Clarkson, T.[2] and Armstrong, A.[1, 4]

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ABSTRACT

In the rush to decarbonise energy supplies to meet greenhouse gas emissions targets, solar parks (SPs) have proliferated around the world, with uncertain implications for the provision of ecosystem services (ESs). SPs necessitate significant land use change due to low energy densities that could significantly affect the local environment. In the UK, SPs are commonly built on intensive arable land and managed as grasslands. This offers both risks and opportunities for ecosystem health, yet evidence of ecosystem consequences is scarce. There is an urgent need to understand how ESs respond to land use for SPs to promote SP development that simultaneously addresses the climate and biodiversity crises. We aim to provide some of the first scientific evidence from the UK on the SP provision of ESs (e.g., biomass production, soil carbon storage). Through a Knowledge Transfer Partnership project between Lancaster University and Clarkson & Woods Ecological Consultants, 35 SPs in England and Wales were surveyed in summer 2021. Soil and vegetation data were collected from 420 sample plots (900 cm2) under different types of land use: underneath solar panels, between and outside rows of solar arrays, and control sites (e.g., arable land, pastureland, areas set-aside for conservation). Total plant cover and aboveground biomass were significantly lower underneath solar panels and between solar arrays than on land set-aside for conservation, while land outside solar arrays showed higher aboveground biomass of monocotyledons and forbs than on land underneath solar panels. Some measures of soil fertility (e.g., nitrogen) and soil organic matter, fractioned into particulate and mineral-associated organic matter, also varied significantly between these different land uses. These results have implications for land management within SPs and will enable optimisation of SP design and management to ensure the long-term delivery of ecosystem services within this fast-growing land use.

Keywords: aboveground biomass, ecosystem services, land use change, nutrient cycling, soil carbon

Solar park construction - evaluation of ecological impact, compensation and restoration strategies

Authors: Armin, Bischoff

ABSTRACT

Solar park construction usually involves the partial destruction of vegetation cover representing habitats for different animal taxa. In most European countries, an impact study is required to evaluate ecological degradation of the construction site and to develop suggestions to avoid, reduce or compensate ecological damage. After solar park construction, extensive management allows the restoration of ecological functions or even an increase of biodiversity compared to the pre-construction habitats. So far, the ecological impact of solar park construction and management is not well known and there is an urgent need for ecological monitoring. The project PIESO (2015-2020) aimed at (1) developing appropriate protocols for ecological monitoring, (2) providing management tools to mitigate ecological impact and (3) testing methods to restore biodiversity.

We present guidelines for monitoring focusing on plant communities, soil organisms, butterflies (lepidoptera), grasshoppers (orthoptera) and birds. We further show how solar park construction affects these groups of organisms in Southern France and we provide suggestions to improve the ecological integration of solar parks. The results of ecological restoration tests will be discussed in the talk by Lambert et al. in the same session. The results of the project PIESO are completed by the presentation of recent impact studies including management plans developed by the ecological consultancy ECO-MED.

Study of ecosystem services generated in an experimental design combining green roofs and photovoltaic panels

Author(s): Belin, M.[1,2]; Lata, J-C.[1]; Gendreau, E.[1]; Marcangeli. Y.[1,3]; Carmignac.D.[1,3] Birot, J.[4]

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ABSTRACT

The increasing of urbanization in already big cities lead to increasing loss of natural environment and the decrease of associated ecosystem services, and increasing pressure such as pollution and soil sealing. All those elements have significant consequences on biodiversity and human societies. Roofs, as space, became more and more attractive to be used as production space or for vegetated roof. The development of green roofs is associated by bunches of ecosystems services they may provide such as air quality, regulation and quality of runoff water, or pollination. One of the key parameters to be estimated is the extent to which these green roofs can be multifunctional, and to what extent the services are not antinomians.

In this study, we combined on a model site photovoltaic panels and green roofs to increase roofs multifunctionality. In particular, we are trying to understand how this combination will play on the ecosystem services provided such as quantity and quality of runoff water, carbon storage, pollination and electricity production, and the interactions between them. We intend to better understand the interactions between both elements. We want to know if adding a solar panel on a vegetated roof can influence and change the plant population and pollinators population and if the plant population can cool the panel and help produce more electricity.

We created multiple systems to test theses hypotheses, 2 different green roofs: one with 10 heliophilous plants and 10 shadow plants and another one with 5 heliophilous plants and 5 shadow plants. Green roof with panel, green roof without panel, substrate only with solar panels and substrate only.

In this context, the key parameter at the interface is the vegetation, which influences all parameters either directly or indirectly through feedbacks. Adding a solar panel on a vegetated roof can impact plant populations and pollinators.

Keywords: Green roof, Biodiversity, Solar Panel, Urban Ecology, Plant Diversity.

Assessing the impact of solar parks on vegetation, microclimate and soil properties

Author(s): Obriejetan, Michael [1]; Blecha, Mirjam [1]; Stangl, Rosemarie [1]; Doerfel, Lioba-Luzinde [1]

Affiliation(s): *[1] Institute of Soil Bioengineering and Landscape Construction, University of Natural Resources and Life Sciences, Vienna, Austria*

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ABSTRACT

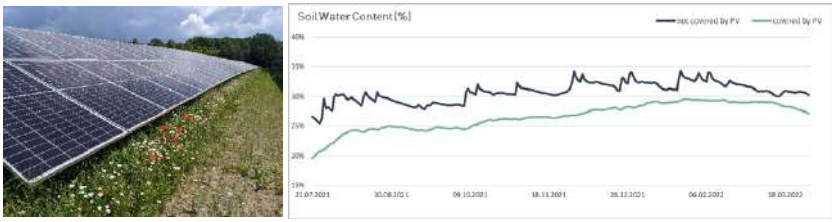
Energy strategies at different levels pursue ambitious goals towards renewable energy production that can only be achieved through an enormous expansion of sustainable energy systems. In this context, solar photovoltaics (PV) represents a significant energy source for renewable energy transition. The expansion of large-scale solar parks is considered controversial (land-use conflicts, loss of habitat, impacts on scenery) but on the other hand can represent a huge opportunity for uses beyond the primary task of energy production (multifunctional land use). Solar parks obviously have a considerable impact on environmental factors that have not yet been sufficiently studied and understood.

As part of an integrated research project, strategies and specific restoration measures for ecological integration of a photovoltaic power station in Austria were implemented. For continuous recording of local climate data and soil parameters, a dense monitoring system was set up. Local climate data, soil parameters and plant development are monitored and collected continuously in the main module area as well as between the rows and boundary areas. The implementation of different maintenance measures (sheep grazing, mowing) will help to derive optimized management strategies for PV plants over the life cycle.

The measurements are essential to assess the extent to which plant-specific site factors and microclimatic conditions are influenced by the PV system. Preliminary data series shows significant differences in soil water content, solar radiation, vegetation height, but also on the predominant plant species. With regard to soil water content, a deviation between 3.6 % and 13.5 % was observed during the first vegetation season, whereby the soil water content in the non-covered area was consistently higher than in the area under the modules. Further data and analysis will serve as a basis for deriving adapted measures for improved evaluation and integration of complementary aspects such as ecology, biodiversity or combined agricultural use (Agrivoltaics).

Keywords: photovoltaics (PV), multifunctional use, monitoring, microclimate management strategies

Fig. 1 Vegetation development after first vegetation period and soil water content data in 30 cm soil depth – covered vs. not covered by PV modules



E3.

Sylvestris: Carbon offsetting through reforestation: how can society enable a great opportunity for sparsely populated areas. *Francisco Manuel Martínez Sanz*

E8.

SER: International Principles and Standards for the Ecological Restoration and Recovery of Mine Sites.

George Gann

Carbon offsetting through reforestation: how can society enable a great opportunity for sparsely populated areas

Author(s): Martínez Sanz, F.[1]; Enciso Encinas, E.[1]; Rábago Marín, J.
Affiliation(s): [1]*Managing Partners in Grupo SYLVESTRIS, Spain.*
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ABSTRACT

The demand of carbon credits from removals (CO_2 captured from the atmosphere to be stored) is expected to be enormously increased due to the international commitments concerning with carbon neutrality. Fortunatelly we can use some very evolved devices that are able to separate the carbon from the carbon dioxide molecules and storing it inside: trees. In Spain there are 9 million of hectares available to be planted, where trees can be introduced with the appropriate technics, boosting the environmental impact, but social too. Most of these lands are located not only in the rural areas, but in areas currently not covered with agriculture or other profitable uses. Therefore the future big carbon sinks to be created will be carried out with absolute certainty in “empty” areas where usually there is a lack of opportunities for developing.

On the other hand, there are some voices, most of them from some civil servants, suggesting that since it is always advisable more investment in forest management, this kind of CO_2 absorption projects should not be undertaken. Taking into account that reforestation and forest management are, and must be, compatible activities, these messages can create a confusion than can block very important investments on the forest sector and the rural areas. Right now, when it seems than Society (big corporations, SME and citizens) finally are willing to pay for a service from the forests, beyond timber products: the capacity to offset CO_2 emisions.

It is clear that an active dialogue and coordination at all levels is necessary to make feasible and on an appropriate technical way the development of these projects, avoiding too academic attitudes that can hinder one of the solutions that Society require on its way towards carbon neutrality.

Keywords: offsetting, reforestation, rural development, investment, social impact.
Fig. 1. Extract from the 3 Billion Trees Factsheet, as part of the European Green Deal
Fig. 2. Headline of the news where the President of the Spanish Forest Engineers Association is obstructing a potential huge investment on reforestations


LA VANGUARDIA

Ingenieros de Montes rechazan dedicar el 15% del impuesto sobre hidrocarburos a reforestación a gran escala en España

• El Colegio Oficial de Ingenieros de Montes ha asegurado en un comunicado que "no es buena idea" dedicar el 15 por ciento del impuesto sobre hidrocarburos a programas de reforestación a gran escala en España.

International Principles and Standards for the Ecological Restoration and Recovery of Mine Sites

Author(s): George D. Gann.
Affiliation(s): *Society for Ecological Restoration*
Core author team: *Renee E. Young[1,2,3], George D. Gann[4], Bethanie Walder[4], Junguo Liu[5,6,7], Wenhui Cui[5], Kingsley Dixon[2,4]*

ABSTRACT

Mining has been, and remains, an integral part of human existence from stone age quarries through to the iron and coal that fueled the industrial revolution, to the new materials needed to support the shift to renewable energy. As of 2020, the global mining footprint was 57,000 km^2 and growing at a faster rate now than any other time in human history. Much of this footprint is operational, but in many areas where mining is now complete, the sites represent major environmental liabilities. However, the challenges of mine site restoration, closure and relinquishment are felt across the industry. As a part of the closure process, mining companies are often required to return or transfer land impacted by their activities to government agencies, communities, or other landowners in a condition that is suitable for the next agreed upon land use to commence, generally in accordance with written regulatory agreements. In many cases this is the same general land use that was present prior to disturbance, and often consists of a natural or semi-natural ecosystem. In these instances, ecological restoration approaches are required.

To be released in 2022 and adapted from the 2019 SER International Principles and Standards, the International Principles and Standards for the Ecological Restoration and Recovery of Mine Sites present the first international framework for the delivery of socially and environmentally responsible ecological restoration after mining, regardless of whether restoration is legally mandated. The mining standards are designed to inspire and drive higher and better outcomes in post-mining landscapes by both guiding and encouraging the highest level of restoration achievable that supports the global need for protecting and restoring nature. This workshop will provide an early view of the mining standards and a timetable for release, as well as facilitate a discussion of applicability to Europe.

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Workshops

Forest and Landscape restoration in Lebanon

A case study on post fire restoration

Lebanon is a country of 10.452 sq Km, on the Eastern part of the Mediterranean, with a forest cover of 13% and 11% OWL.

Due to many factors (climate change, human activities) land degradation became an urgent challenge to be dealt with.

In 2012 Lebanon launched its National Afforestation and Reforestation Program with an objective of reaching 20% of forest cover (Also known as the 40 million trees program).

The Forest and Landscape Restoration Mechanism was the triggering tool to find balance between restoring ecosystem services (biodiversity, soil and water conservation) and productive land functions for agriculture.

The first part of the FLRM financed by the Republic of Korea aimed at restoring abandoned agricultural terraces that are a very important cultural and natural heritage in the mountainous areas of Lebanon.

The second part funded by Germany (IKI) focused on large scale national FLR plans/programs implemented to maximize the contribution of FLR options to achieve the Paris Agreement and the Bonn Challenge. Restoration of rangeland areas was an important achievement.

Forest fires in the Mediterranean are becoming a major disaster. In Lebanon this is one of the greatest causes of land degradation.

Post fire restoration is a crucial issue that is often done without any scientific background leading to negative impacts thus hindering the success of the operation.

A case study on a post fire action in Akkar region (North of Lebanon) in 2021 showed the importance of setting a work methodology using satellite maps along with field reports in order to develop a model for the prediction of post-fire degradation (GIS).

Production of data on fire distribution according to landscape and forest types, allowed to develop a land degradation risk map helping orienting restoration activities by priorities.

Field activities were oriented into three objectives:

- Assisting post-fire vegetation recover
- Post-fire reduction of soil erosion
- Preservation of soil fertility

Addressing the climate emergency through citizen-driven forest restoration projects

Coordinator(s):
Moore, Chrystal (Junior representative: Universitat de Barcelona); Sabate, Santiago (Senior representative: Universitat de Barcelona); and potentially other project representatives

Coordinator(s) E-mail:
chrystal.moore@ub.edu; santi.sabate@ub.edu;

Draft program: Given the urgent need for actions to face global climate change, there are ambitious initiatives that promote land restoration, not only to capture CO2 to mitigate anthropogenic emissions, but also to restore degraded land and promote the maintenance of socio-ecological systems. In addition to acting scientifically and technically to provide solutions, we must also involve citizens in the process. Public participation in climate action initiatives plays an important role in addressing the climate emergency through the transference of ecological knowledge to society, participants lending local expertise to climate-action projects, and the potential of citizens to influence policy-makers.

This workshop is organised by Life Terra, a project with a mission to enable people to take impactful climate action now. We facilitate tree planting, educate future generations, and develop tree monitoring technology. Life Terra is founded on the knowledge that tree planting is regarded as the most cost-effective nature-based solution to capture carbon.

During this dynamic and collaborative workshop, participants will discuss opportunities and challenges of restoration initiatives, including biodiversity conservation and provisioning of socio-ecological systems. As set in Life Terra, we are thinking to embrace four interconnected pillars that while facing different challenges need integration.

- Education (bridging ecological knowledge to society through schools and engaging citizens);
- Technology (monitoring trees, carbon uptake, plant material);
- Implementation (strategies for planting the right tree in the right place, and finding suitable land, connecting with Landowners);
- Communication (proper dissemination of project goals and actions)

Supported by LIFE

Soil and Water Bioengineering, a Nature based discipline between grey and green Infrastructures

Coordinator(s):
Paola Sangalli (EFIB SCIA)
Rosie Stangl (EFIB BOKU)
Daniel Arizpe (AEIP CIEF)

Coordinator(s) E-mail:
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The European Union is promoting Nature-Based Solutions (NBS) because they can help mitigate global environmental challenges while creating jobs and promoting economic growth and innovation. This new concept promotes nature as a more sustainable and efficient solution to environmental problems Soil and Water Bioengineering, as Nature-based Solution, is able to both mitigate and restore lost ecosystems and to avoid the degradation of our environment. It must work hand in hand (in parallel) with ecological restoration.
The application of combined techniques of Gray-green structures and NBS are becoming more important worldwide to protect a generalized increasing erosion risk due to climate change.

Soil and Water Bioengineering as a hybrid discipline The term “Engineering” refers to the knowledge-based use of technical and scientific techniques and solutions for building, stabilization and erosion control and “bio” because these functions are related to living organisms, mainly native plant species, with appropriate biotechnical characteristics and for the purpose of rebuilding ecosystems and increasing biodiversity. It includes technical functions (e.g. soil protection and slope stabilization), ecological objectives (ecosystem restoration), landscape objectives (improvement of landscape value and integration) and also takes into account several socio-economic aspects (efficiency and employability). The fact that it is a hybrid discipline makes it sometimes mistrust both those who must project from traditional engineering and those who deal with restoration.

In this workshop starting from a selection of some examples (3 or 4 Projects) in roads construction, urban rivers or mining areas, and then open the discussion on the different approaches and possibilities of Bioengineering as NBS and as a a meeting point between the world of traditional engineering and that of ecological restoration

Supported by the European Federation of Soil and Water Bioengineering and the Spanish member Asociación Española de Ingeniería del Paisaje AEIP

6 - Posters List

6
- Posters List

P1- | A new international MSc program in Restoration Ecology within the Agricultural University of Iceland

Aradottir, Asa Lovisa. *Agricultural University of Iceland*

P2- | Assessing wetland restoration using vegetation and spiders as indicators

Armel, Dausse. *Forum des Marais Atlantiques*

P3- | Different stakeholders' perceptions on species diversity in tree plantations: a global review

Bulascoschi Cagnoni, Leticia. *University of São Paulo*

P4- | Restoring degraded landscapes using fog capture ecotechnologies

Carabassa Closa, Vicenç. *CREAF*

P5- | REST-ART: RESToration of Marine Forests on ARTificial Reefs

Cimini, Jacopo. *University of Genova-DISTAV*

P6- | Analyzing ecological and sociological process among restoration of dyked marshes, the DPM project.

Dauvergne, Xavier. *Université de Bretagne Occidentale*

P7- | Is there ecological harmlessness of dromedary camel meat Production?

Djenane Djamel. *UMMTO*

P8- | Biodiversity in Solar Farms - Challenges and requirements for seed mixtures in near-natural greening

Dullau, Sandra. *Anhalt University of Applied Sciences*

P9- | Reassessment of McNaughton's grazing lawn paradigm: a synthesis of functional characteristics shaping grazing ecosystems

Eshelman, Mary Susan Elizabeth. *University of Edinburgh, Royal Botanic Garden Edinburgh, Royal Botanic Garden Kew*

P10- | Soil carbon stocks increase in oak forests along an afforestation chronosequence: not only time matters

Espelta Morral, Josep Maria. *CREAF, Universitat Autònoma de Barcelona*

P11- | Identification of potential wetlands to be restored in Mediterranean countries

Gil, Teresa. *WWF*

P12- | Remediation of copper-polluted soils as a first step for active restoration in non-productive orchards´ areas

Ginocchio, Rosanna. *Center of Applied Ecology and Sustainability (CAPES), Pontificia Universidad Católica de Chile, Santiago, Chile*

P13- | Biodiversity and Ecology of soil invertebrates of Machakhela National Park (Georgia)

Gratiashvili, Nana. *Ilia State University*

P14- | Restoration and rewilding of the Nephin Forest in Wild Nephin National Park

Guilfoyle, Colin. *Atlantic Technological University Galway*

P15- | Ecological restoration within Hraunhreppur, W-Iceland. Case studies.

Hauksdottir, Idunn. *The Soil Conservation Service of Iceland*

P16- | Conservation of an ancient leguminous tree and archaeological artifacts on Marco Island in southwest Florida

Heinz, Alexis K. *University of Michigan*

P17- | Wetland restoration in Iceland – how to speed up the establishment of wetland vegetation in disturbed margins that follows restoration?

Helgadóttir, Ágústa. *Soil Conservation Service of Iceland*

P18- | Effect of restoration practices on water erosion in a locality of Northeastern México

Hernández García, Carolina Guadalupe. *Facultad de Ciencias Forestales, Universidad Autónoma de Nuevo León*

P19- | Sustainable tourism along Danube by evaluating and improving the cycling infrastructure

Ilieva, Lucia Ilieva. *CSDCS*

P20- | Look back on 30 years of evolution of a restored site: the megalithic site of Carnac.

Irien, Corentin. *Université de Bretagne Occidentale. Laboratoire Géoarchitecture. Territoires, Urbanisation, Biodiversité, Environnement, Brest, France.*

P21- | Evaluating acorn provenance for reforestation by direct seeding in the face of climate change

Jiménez Morales, María Noel. *University of Granada*

P22- | Native vegetation and soil fauna as spontaneous colonizers favour ecosystem restoration of metal(loid) mine tailings

Juan-Ovejero, Raquel. *University of Granada*

P23- | Restoration of semi-arid savannah rangelands after the control of encroachment by woody species in southern Africa

Kellner, Klaus. *North-West University, South Arica*

P24- | Managing ecosystem services in a Mediterranean forest as a Climate Change adaptation tool

Maturano Ruiz, Adrián. *Multidisciplinary Institute for Environmental Studies (IMEM) "Ramon Margalef*

P25- | The International Network for Seed-based Restoration (INSR): A SER Section

Ladouceur, Emma. *German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig*

P26- | Knowledge Sharing for Shared Success in the Decade on Ecosystem Restoration

Ladouceur, Emma. *German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig*

P27- | Seeding vs. planting with Quercus: A collaborative, continental-scale experiment

Levy Guillen, Laura. *University of Granada*

P28- | Quantifying the biodiversity economic value of green roofs: A case study applied to Lisbon, Portugal

Liberalesso, Tiago. *CERIS, Instituto Superior Técnico, University of Lisbon, Av. Rovisco Pais, 1049-001, Lisbon, Portugal.*

P29- | EcoGrid – countrywide sampling framework to assess soil properties and ecological condition of ecosystems

Liiv, Elvi. *University of Tartu*

P30- | Plant functional traits and their intraspecific variability differ in restored grasslands compared to old fields

Lillipuu, Epp Maria. *Institute of Botany of the Czech Academy of sciences*

P31- | Analysing reciprocal feedbacks between relational values and social networks for grassland restoration

Lukas, Kuhn. *Leuphana University Lueneburg*

P32- | Birch woodland expansion from discrete seed sources – implications for large-scale restoration

Mariager Behrend, Anna. *Agricultural University of Iceland*

P33- | Survival and habitat characterization of Pinna nobilis in the Mar Menor coastal lagoon

Martínez Martínez, Pilar. *University of Alicante*

P34- | Influence of raptors and land-use on birds present in vineyards: bases for biological control

Monteagudo, Navila. *Forest Ecology and Restoration Group (FORECO), Universidad de Alcalá*

P35- | Monitoring passive restoration of burned lands through remote sensing tools

Montero, Pau. *CREAF, Universitat Autònoma de Barcelona*

P36- | Mining sites as a new habitat for endangered species of aquatic vegetation

Müllerova, Anna. *Jihočeská Univerzita v* Českých *Budějovicích*

P37- | Effects of microclimatic shelters and maternal origin on directly sown acorns vs. outplanted seedlings

Navarro Reyes, Francisco Bruno. *IFAPA (Junta de Andalucía, Spain)*

P38- | Effects of nursery-root manipulation, acorn mass and seed provenance on field response of Holm oak

Navarro Reyes, Francisco Bruno. *IFAPA (Junta de Andalucía, Spain)*

P39- | Large acorns, early sowing, weed control, but also locality, keys to the successful acorn seeding

Navarro Reyes, Francisco Bruno. *IFAPA (Junta de Andalucía, Spain)*

P40- | Prioritizing areas for conservation and restoration of nature in Denmark

Nicolaisen, Hanne. *Aarhus University*

P41- | Restoring and promoting a long term sustainable management of wooded meadows in Estonia and Latvia

Öövel, Heidi. *Estonian Environmental Board*

P42- | Afforestation of reclaimed oil shale quarry – production and phytoremediation potential of hybrid aspen plantations

Ots, Katri. *Estonian University of Life Sciences*

P43- | Afforestation of organic soils - effect of wood ash on the biomass formation and leaching of heavy metals

Ots, Katri. *Estonian University of Life Sciences*

P44- | Delayed storm and salvage logging effects on understory vegetation recovery and development
Palm, Kristiina. *Estonian University of Life Sciences*

P45- | Insect pests of newly planted urban trees in the city of Nitra (Slovakia)
Pástor, Michal. *National Forest Centre*

P46- | Understanding the barriers for forest restoration in the Brazilian Amazon, Pará: a comparative stakeholder survey
Pedrollo, Camilo. *University of Copenhagen*

P47- | Prioritizing restoration areas thanks to green-blue infrastructure
Peña López, Lorena. *University of the Basque Country (UPV/EHU)*

P48- | Giving LIFE to grasslands – restoring biodiversity and ecosystem services
Prangel, Elisabeth. *University of Tartu*

P49- | Adaptive maintenance of the Nemunas river waterway for effective conservation of Little and Common terns
Raudonikis, Liutauras. *Lithuanian Ornithological Society*

P50- | Marker-trait associations in Alnus species – from genotyping to riparian restoration decision-making
Rodríguez González, Patricia María. *Forest Research Centre, School of Agriculture, University of Lisbon*

P51- | To plant or not to plant? Drivers of native woodland creation in the United Kingdom.
Roel Bellot, Alvaro. *Centre for Environmental Policy, Imperial College London*

P52- | Restoration under climate change: seeding versus planting of two oaks.
Sampere Medina, María. *University of Granada*

P53- | Water infiltration in restored birch woodlands ecosystems in Iceland
Sánchez Arnardóttir, Sólveig. *Agricultural University of Iceland*

P54- | Impact of landscape-scale invasion level on sand grassland restoration
Sáradi, Nóra. *Institute of Crop Production, Hungarian University of Agriculture and Life Sciences*

P55- | The first-year results of natural landscaping initiative in Moscow, Russia
Sheliagina, Elena. *Moscow Circular*

P56- | Ecological restoration in areas under desertification: experiences from the LIFE Desert Adapt project
Silveira Bueno, Rafael. *University of Palermo*

P57- | Use of species-habitat relationships to assist for effective restoration actions
Tetelea, Cristian Demostene. *Invisible Nature*

P58- | Evaluating Quercus ilex afforestation success on former agricultural land under increasing aridity.
Tormo, Jaume. *Universidad de Zaragoza, Escuela Politécnica Superior de Huesca*

P59- | A low-cost device to measure soil water content and conductivity in field
Tormo, Jaume. *Grupo de Restauración Ecológica, Departamento de Ciencias Agrarias y del Medio Natural, Escuela Politécnica Superior, Instituto de Investigación en Ciencias Ambientales (IUCA), Universidad de Zaragoza, Spain*

P60- | Application of natural processes in restoration of mining sites
in the Czech Republic
Tugushev, Gleb. *Department of Urban and Landscape Planning, Czech University of Life Sciences*

P61- | Identifying reference ecosystems for restoration of Icelandic birch woodlands
Valsdottir, Katrin. *Soil Conservation Service of Iceland*

P62- | Effects of afforestation of Mediterranean agricultural land and forestry management on vegetation establishment
Vieco Martínez, Amaia. *Forest Ecology and Restoration Group (FORECO), Universidad de Alcalá*

7 - Posters Abstracts

A new international MSc program in Restoration Ecology within the Agricultural University of Iceland

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ABSTRACT

Ecological restoration and the academic field of restoration ecology, are increasingly considered crucial for combating environmental degradation such as desertification and loss of biodiversity, promote sustainable land use and mitigate climate change. The United Nations have declared 2021-2030 as the Decade of Ecosystem Restoration and the 2022 UNCCD Global Land Outlook has identified ecological restoration as a major path towards the recovery and resilience of Earth's natural, social, and financial capital.

Iceland holds a unique position as a place of study within this rapidly growing field. Iceland's ecosystems have undergone severe degradation since its first human settlement, due to unsustainable land use in combination with harsh climatic conditions and volcanic activity. Nationally coordinated efforts to combat soil erosion and restore lost and degraded ecosystems span more than 100 years. Iceland thus offers substantial expertise and practical experience on the subject, with restoration projects spanning various scales and diverse ecosystems. The Agricultural University of Iceland (AUI) has had a major role in scientific research, education, and training of professionals within the field for a long time. AUI also hosts UNESCO's GRÓ Land Restoration Training programme in cooperation with the Icelandic Soil Conservation Service. The programme trains working professionals in developing countries faced with severe land degradation in methods and theories of sustainable land management and restoration of degraded land. AUI has now organized an interdisciplinary two-year MSc programme in Restoration Ecology. Based on the extensive experience of restoration practice, education, and training in Iceland, the program will offer innovative insights and international knowledge from within this rapidly growing and increasingly urgent environmental discipline. It will provide advanced, specialized training in restoration science and a hands-on approach to addressing pressing practical problems. Set to launch in the fall of 2023, the program opens for international applications in December 2022.

Keywords: Restoration ecology, Iceland, education and training, interdisciplinary MSc program.

Assessing wetland restoration using vegetation and spiders as indicators

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ABSTRACT

Wetlands have been massively degraded in Brittany (France) mostly due to the extension of urbanisation, the building of roads and railways and intensive farming. Restoration projects can afford an opportunity to regain ecosystem functions lost due to these forms of land use, such as the purification of water and flow regulation, but also to regain biodiversity, which is particularly vulnerable in wetlands.

However, few wetland restoration projects have been monitored in France and many questions remain as to how to decide which wetlands to restore depending on the stakes at hand on the watershed, on which techniques work best and to what extent it is possible to regain lost functions.

The ETREZH project (Evaluating the effect of restauration projects on wetland functions in Brittany), led by the Forum des Marais Atlantiques and involving both researchers and practitioners, aims at answering these questions. It is based on the study of 14 restored wetlands, restored at different dates either by the neutralisation of till-drainage or by landfill removal. In these sites, the hydrological and biogeochemical functions were monitored over a hydrological year. Biological functions were assessed by studying composition of vegetation and of different insect groups including spiders, odonatans and orthoptera.

The data presented, which focus on vegetation and spiders, show a high rate of resilience these restored sites. However, restoration success seems dependent on land use around the sites, areas dominated by urbanisation being less favourable.

Keywords: Wetland, restoration success, spiders, vegetation

Different stakeholders' perceptions on species diversity in tree plantations: a global review

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ABSTRACT

Forestry is a promising activity to mitigate climate change, as forests have a high capacity of sequestering carbon in a short period of time. Increasing the species diversity in tree plantations for restoration can be a viable, scalable, and economically strategy to reconcile economic and environmental benefits. However, despite the clear scientific advantages of the mixed tree plantations, conventional monocultures are still prevalent in some countries and mixed forest not fully accepted by stakeholders. Our aim was to understand how the perceptions of different stakeholders about species diversity in plantations can help to create policies that expand and make mixed plantations a viable strategy to mitigate the effects of climate change, based on forest restoration. For that, we considered 15 research articles that included their perceptions, and we analysed what these ideas can show us in the current climate change and sustainable development scenario. Our finds helped to (1) explain where there is more and less social research effort linked to forest plantations diversity in the world, (2) analyse how political engagement and governance systems can be positive in the case of ecosystem services, forest management and restoration, and (3) understand how these definitions help to create possibilities and opportunities for sustainable development in forestry. We concluded that these new strategies will only be widely applied if there is political and institutional interest, which can be strengthened by the presence and performance of governance systems, including land governance.

Keywords: Forestry, Mixed tree plantations, Biodiversity, Climate change.

Restoring degraded landscapes using fog capture ecotechnologies

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Abstract: The impacts of climate change are becoming increasingly perceptible and severe. Many semi-arid regions are suffering significant declines in water availability and temperature increases. This has led to faster desertification and more forest fires. It is necessary to implement adaptation measures aimed at reducing the vulnerability of these ecosystems and strengthening their resilience. LIFE Nieblas (LIFE19 CCM/ES/001199) aims to evaluate the mitigation of the different impacts and effects of climate change by testing innovative methodologies of reforestation. These innovative methodologies, based on the collection of fog water for watering the planted seedlings on restoration projects, do not significantly increase the carbon footprint, and in some cases, it could even reduce it compared with the traditional methodologies. Their effectiveness and their costs and benefits, including as far as possible the externalities they produce, will be taken into account. The main goals of the project are to demonstrate the effectiveness, efficiency and capacity of the innovative methodologies and the equipment linked to them in contrast to traditional methodologies, and to create synergies between the results of the Project and reforestation, environmental, agrarian, and energy and water management sectors and policies in the EU.

Keywords: biodiversity, climate change, drylands and desertification, ecosystem services, planting techniques

Fig. 1 Fog in El Anden area (Gran Canaria), and fog water collectors installed there for watering seedlings.

REST-ART: RESToration of Marine Forests on ARTificial Reefs

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ABSTRACT

Healthy rocky coasts of the Mediterranean Sea are dominated by macroalgal forests formed by brown algae (i.e., *Cystoseira sensu latu*). These species provide important ecosystem services, contributing to coastal primary production and nutrient cycling, providing food, shelter, nurseries, and habitat for many vertebrate and invertebrate species. Moreover, latest studies highlight how three-dimensional complexity of macroalgal habitats may play an important role as coastal defense structures against erosion.

Currently, most of the *Cystoseira s.l.* populations present in the Mediterranean basin are suffering a decline largely due to anthropic impacts, including coastline urbanization, habitat loss, overfishing, climate change and the increase of extreme climatic events (e.g., exceptional storms, floods, heatwaves). In the last years, a large effort for developing *Cystoseira* forests restoration has been implemented by EU projects (MERCES; Afrimed; ROCPOP LIFE).

A need for infrastructures (*e.g.,* piers, docks, protective walls) to protect the coastline has emerged because of the increasing threats caused by extreme climatic events. These bare substrates offer an opportunity for testing *Cystoseira s.l.* forestation in areas where the species were present but are very unlike to naturally colonize artificial reefs because of their very limited dispersal capacity.

The aim of the present study is to develop a nature-based approach, applying innovative restoration techniques (outplanting) used for macroalgal forest restoration on natural rocky shores. A stretch of coast in the Portofino neighbour area (Northern Ligurian Sea) has been selected as case study: herein a protective wall was built after a huge sea storm that putatively destroyed the natural rocky assemblage.

Different deployment approaches were tested to enhance restoration performance on bare substrates compared with neighbour natural reefs.

This restoration action will have the double benefit of restoring an ecologically fundamental habitat and its services and create a “natural-like” environment, enhancing ecological function and services provision.

Keywords: Macroalgal forest restoration, artificial reefs, outplanting, Mediterranean Sea, *Cystoseira s.l.*

Fig. 1 Restoration of *Cystoseira s.l.* on artificial reefs.

Analyzing ecological and sociological process among restoration of dyked marshes, the DPM project

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ABSTRACT

For centuries, coastal development has been dominated by dyking separating land from sea to protect people from sea flooding, to drain backshore marshes and to develop agricultural activities. The loss of these activities has led to the abandonment of many of these polders (especially the smaller ones). Depoldering is therefore a way of meeting the objectives of coastal management, both in terms of preserving natural coastal areas and combating the risk of flooding.

The restoration of these environments is an important issue in terms of biodiversity and functionality, but also in terms of adaptation to climate change and its consequences on the coast. Given the complexity of restoring large salt marshes, «small» marshes could have significant potential.

In a previous research program, we were interested in sites where the depoldering process has been going on for a long time. This enabled us to highlight the ecological trajectories and social dynamics in the medium and long term. This new programme (DPM - Programmed Depoldering of small coastal Marshes) focuses exclusively on recent depoldering. Indeed, the first years seem to be the main moments for the ecological dynamics and for the social representations of these transformations. We analyze the restoration dynamics according to the type of depoldering. The analysis included both ecological approaches (vegetation, fish and arthropod communities analysis, and: food web and connectivity analysis) and social approaches (representations, uses,…) . On the basis of a better understanding of the functioning of small coastal marshes and the social representations of depoldering, we wish to provide decision-making and management tools for future depoldering or reconnection to the sea, and thus support managers in the face of regulatory, societal and adaptation imperatives.

Keywords: depoldering, restoration, social practices and representations, coastal marshes functioning

Is there ecological harmlessness of dromedary camel meat Production?

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ABSTRACT

The growing demand for meat cannot be met by conventional meat production alone, because 80% of all arable land is already used directly or indirectly for livestock production and this is unsustainable as it is, due to its large ecological footprint. By 2050, the world's population will reach around 10 billion people, according to a new report published by the United Nations Department of Economic and Social Affairs. A great challenge awaits policy makers and ensuring food security without compromising the main pillars of sustainability is one of the main objectives of the United Nations for sustainable development. In this optical, the camel (*Camelus dromedarius*) sector must adopt sustainable practices in order to become more competitive. In comparison to other species such as goats, cattle and sheep, camel is less destructive for the fragile pasturelands, thus contributing to the environmental sustainability of the production systems. Camel meat is then an ecologically friendly food. Camels also have a very efficient feed conversion rate. Nowdays consumers, especially in rich civilizations, tend to favor produces that are environmentally friendly; as a result, this is a very important attribute that needs to be promoted in favor of camel meat.

According to FAOSTAT, the worldwide meat production has been projected to be double by 2050, due mainly to the increase in production and consumption, which is likely to intensify the freshwater crisis in the future. Quantification of the virtual water content for the camel production plays an important role in understanding the aspects of national water footprint (WFP) in arid regions and is highly needed to guide the allocation of livestock farming and optimize water use.

In Conclusions, camel is the animal of future. Without a doubt, the camel can be a tool to fight against the future challenges of climate change and their consequence on the earth.

Keywords: Dromedary camel, meat, ecologically friendly food

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Biodiversity in Solar Farms - Challenges and requirements for seed mixtures in near-natural greening

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ABSTRACT

The European Green Deal aims to achieve climate neutrality for Europe by 2050. In this strategy, photovoltaic (PV) is one of the key technologies to reduce greenhouse gas emissions, which has led to the promotion of solar farms across Europe. The BIODIV-SOLAR project will not only use these areas for energy production, but also make them available for the development of species-rich grassland vegetation to promote native biodiversity and pollinators and to contribute to biotope connectivity. Due to the special conditions in solar parks, e.g. changing light and moisture conditions, and the requirement for low-growing vegetation, commercially available seed mixtures are not suitable. As part of the project, we have developed site-adapted mixtures with seeds from regional seed propagation, which on the one hand promote pollinators and on the other hand require low maintenance. The mixtures were adapted to the specific site conditions (climate, soil type, nutrient content), and take into account the small-scale modified conditions (light, moisture) caused by the PV panels and the requirement not to shade them (growth height). We present the overall concept of the mixtures and highlight opportunities, challenges and limitations resulting from the specific project requirements, the availability of the species on the German seed market and economic considerations.

In six solar parks, after site preparation (disturbance of existing vegetation with a tiller), four variants were established: (i) seeding of a low-diversity seed mixture with high percentage of grass seeds (19-20 species, including 3 grasses), (ii) seeding of a low-diversity seed mixture with high percentage of forb seeds (19-20 species, including 3 grasses), (ii) seeding of a high-diversity seed mixture with high percentage of forb seeds (34-39 species, including 4 grasses), (iv) no seeding (control with spontaneous succession). Starting in spring 2023, the vegetation development and the occurrence of wild bees and butterflies will be monitored.

Keywords: PV, solar farm, site conditions, seed mixtures, native plants, pollinators

Reassessment of McNaughton's grazing lawn paradigm: a synthesis of functional characteristics shaping grazing ecosystems

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ABSTRACT

Through concentrated grazing, herbivores can create and maintain patches of quality forage, called grazing lawns, first described by McNaughton in 1984. McNaughton's definition is traditionally applied to tropical C4 grassland ecosystems with large mammal herbivores. However, the identification of grazing lawns in a variety of ecosystems indicates that our understanding of grazing lawns may be broader than the current convention. We aim to reassess the paradigm of grazing lawns by assessing the functional aspects of the McNaughton grazing lawn paradigm and determining if these functional aspects, independent of taxonomic descriptors, can be applied more generally across a range of temporal and spatial scales.

We conducted a review of grazing lawn literature, and from this we collated a set of characteristics that define grazing lawns in the broadest sense. We applied these characteristics to the wider literature to compile a database of case studies that focus on concentrated grazing in a variety of ecological and environmental contexts.

In total, we identified 108 grazing lawn case studies across six continents and in both terrestrial and aquatic systems. Case studies included a wide range of animal and plant taxa. Then through a meta-analysis of case studies, we determined that grazing lawns can occur across a variety of environments, acting as an alternate stable state when conditions allow. We found no significant difference between self-identified grazing lawn case studies and those identified using our grazing lawn characteristics. This indicated that our criteria essentially capture the same set of ecosystems as those self-identified as grazing lawns, supporting our characteristics as well as indicating more grazing lawns may be present globally than are currently being identified. Therefore our updated concept of grazing lawns devoid of taxonomy and environment better encapsulates the diversity of landscapes shaped by concentrated grazing maintaining a positive consumer-resource feedback loop.

Keywords: grazer, meta-analysis, herbivory, consumer-resource feedback, alternate stable state

Soil carbon stocks increase in oak forests along an afforestation chronosequence: not only time matters

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ABSTRACT

Increasing CO_2 uptake and sequestration by terrestrial ecosystems is considered a key nature-based solution to reduce atmospheric CO_2 and mitigate climate change effects. Several studies highlight the role that natural forest regrowth may play in carbon uptake after land abandonment following agriculture cessation in the aerial compartment (e.g. tree layer), while lower attention has been paid to soil carbon stocks, particularly those in deeper soil horizons (i.e. beyond 30 cm). In this study, five Mediterranean forest areas in Catalonia, each containing an afforestation chronosequence (10, 30, 50 and >80 years), including an agricultural soil as starting point (0), were selected. The plots within these areas were homogeneous in terms of climate, height, lithology, and topography. Carbon stocks were assessed in the entire profile. Our results showed that, carbon stocks were similarly dominated by topsoil and subsurface horizons, a general low importance of forest age, and local effects of soil properties and other environmental factors. These results suggest the potential existence of constrains for carbon acquisition associated to the intense disturbance regime occurring in Mediterranean-type forests (e.g. coppicing, drought events, wildfires) but also unknown managements during the long period of time considered in the study. Our results highlight i) the need of assessing carbon below 30 cm to avoid underestimating total carbon stocks; ii) the fact that important carbon stocks are built after agricultural cessation in the topsoil, but the concurrent effect of disturbances, management and other local environmental conditions can make this increase highly unpredictable.

Keywords: forest expansion, climate change mitigation, land use legacy restoration

Identification of potential wetlands to be restored in Mediterranean countries

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Abstract: In the framework of the project "Strengthening the Restoration of Mediterranean Wetlands for Nature and People" funded by the MAVA Foundation, between December 2020 and March 2021, an online survey was carried out in order to compile potential wetlands to be restored in the Mediterranean region.

The objective of this assessment was to obtain an ambitious and realistic target of the number of hectares that need to be restored across the Mediterranean. A second objective was to provide data to support policy and advocacy actions in favour of Mediterranean wetlands.

The target audience included any person or organization involved in wetland conservation, including site managers, technical staff, national and subnational government services, local authorities, scientists, NGO, individual experts, etc. In summary, anyone who can provide feedback to help identify potential wetlands for restoration in the region was invited to participate in the survey. Respondents were asked to answer the questions based on their own personal knowledge according to the wetland condition at the time of answering. The average time to complete the survey was five minutes.

265 responses were received corresponding to 224 wetland sites from 24 countries. The total wetland area identified in the 265 questionnaires is 399,912 ha. A number of questionnaires are duplicates since different respondents have answered about the same sites, often giving different wetland areas. The total wetland area in need of restoration ranges between 233,146 ha and 330,706 ha for the 224 sites identified. The methodology and the main findings will be shown in this presentation.

An online app has been development and it allows access to the data collected during this assessment:

https://www.wwf.es/nuestro_trabajo/agua/humedales/potential_wetlands_to_be_restored_in_mediterranean_countries/

Keywords: Wetlands, restoration strategy, Mediterranean.

Remediation of copper-polluted soils as a first step for active restoration in non-productive orchards´ areas

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ABSTRACT

Agricultural soils of central Chile may become enriched with copper (Cu) from different sources (i.e. Cu smelter emissions, mine tailings dispersal, excessive applications of Cu-based pesticides in orchards), posing risks of soil degradation and phytotoxicity, particularly when bioavailable Cu concentration is elevated. The same problem has been described in vineyards and orchards of other countries (i.e. France). Therefore, the objective of this study was to evaluate the suitability of gypsum and calcite as soil amendments to alleviate Cu-toxicity in Cu polluted agricultural soils of central Chile. Seven soils were selected and collected in the Bernardo O´Higgins region, ranging from 51 mg kg^{-1} (control soil) to 1,245 mg kg^{-1} of total soil Cu (six polluted soils), representing a Cu soil gradient. Batches of soils were mixed with either gypsum or calcite and a not-amended batch of every soil was also saved. Experimental pots (800 mL) were filled with amended and not amended soils, allowed to equilibrate for 1 week under controlled conditions and irrigation, and then sown with seeds of *Lolium perenne* (bioindicator). At the end of week 1 and 4 pore water soil samples were taken and after 4 weeks of cultivation plants were harvested. Results showed that aerial biomass of *L. perenne* was significantly affected by soil type (no amended soils), with a median effective concentration (EC50) of 0.44 mg kg^{-1} according to total dissolved Cu in soil pore water. Aerial biomass was also significantly influenced by the type of amendment incorporated, but the effect of each amendment was variable depending on the soil. However, no EC50 values were able to estimate in soils amended with either gypsum or calcite, indicating a loss of phytotoxicity. We conclude that both calcium-based amendments effectively reduce Cu-toxicity in soil, but their efficacy is soil type dependent. Funding from ANID PIA/BASAL FB0002 2014 and ANID Fondecyt Regular Project #1200048.

Keywords: calcium-based amendments, copper toxicity, polluted soils, rehabilitation, ecological intensification

Biodiversity and Ecology of soil invertebrates of Machakhela National Park (Georgia)

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ABSTRACT

Caucasus Ecoregion has appropriated the place among 36 hot spots of wild life in the World with a high diversity of species and ecosystems, high endemism level and risks of destroying the biodiversity. While considerable efforts are made to investigate numerous endemic vertebrates and protect their populations, much less is known about the invertebrates, which play important role in terrestrial ecosystems.

Machakhela National Park is one of the protected area in Georgia, Khulo Municipality of Adjara autonomous republic, which was established in 2012. Its main goal is preservation of the unique biological and landscape diversity and long-term protection of ecosystems created by the Colchis forests. The area of the protected territory is 12 739 ha, of which 86.2% is covered by forests. The national park is presented by mixed broad-leaved colkhic forests, chestnut forest, beech forest and dark-coniferous forest belts. There are registered 548 species of vascular plants, among which 55 species are endemics.

Reaserch target invertebrates: nematodes (Nematoda), mites (Oribatida), collembolans (Collembola), ants (Formicidae), beetles (Carabidae) and (Staphylinidae) are widespread above the ground, as underground. The study groups of the invertebrate animals play an important role in the functioning of ecosystems; they participate in soil forming process and most of them are bioindicators of polluted soils with heavy metals.

Before our research oribatida mites were poorly investigated in Machakhela National park and only 31 species were revealed, while there was no data about the distribution of the other groups' invertebrates (nematodes, collembolans, ants, ground and rove beetles).

Based on our data 100 species of Oribatida mites, 19 of Nematodes, 32 of ants, 22 of collembolans and 20 of beetles are detected.

With this presentation we will present primary data on the distribution of soil invertebrates in Machakhela National Park and surrounding area; also each investigated habitat dependence of species richness and number of individuals as dependence on the environmental variables, such as temperature, humidity, dew point, etc.

Keywords: Biodiversity, Machakhela, Habitat, Ecology, Invertebrates

Restoration and rewilding of the Nephin Forest in Wild Nephin National Park

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ABSTRACT

Wild Nephin National Park, located in northwest Mayo, Ireland, is comprised of 12,000 ha (120 km2) of predominantly active Atlantic blanket bog and remote upland habitat, along with 4,700 ha (47 km2) of coniferous forest. This coniferous forest, known as the 'Nephin Forest', is dominated by non-native pine and spruce, and has only recently come under the management of the National Park, previously being managed for commercial timber production. The forest was established during the mid to late 1900s during a period when it was common practice in Ireland to drain and afforest large areas of peatland in order increase forest cover and timber production while providing employment in rural areas. There now exists the opportunity for this plantation forest to be managed for biodiversity through the restoration of peatland habitats and rewilding of the remaining forest. Prior to this process taking place, the gathering of baseline ecological data will be crucial to measuring the future success of restorative actions. The aim of this ongoing research, therefore, is to conduct an initial baseline habitat assessment of the Nephin Forest, which would facilitate long-term monitoring of changes in the landscape over time, as well as to identify areas of particular value, in terms of biodiversity and ecosystem services. A broad-scale habitat assessment of the Nephin Forest was first carried out using GIS software, which identified the types and area of habitats present, followed by fine-scale assessments of each habitat type, using a field quadrat survey technique, which will allow for the vegetation communities of the forest to be analysed. Going forward, this work will contribute to restoration planning and decision making in the Nephin Forest, as well as acting as a baseline for the evaluation of restorative actions in the future.

Keywords: Ecological restoration, rewilding, peatlands, monitoring, biodiversity

Ecological restoration within Hraunhreppur, W-Iceland. Case studies

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ABSTRACT

Hraunhreppur covers 404 km^2 from sea level to the mountains located in W-Iceland. Its landscape ranges from flat lowlands to mountainous hills in the commons where sheep graze during summer. The most common habitat type in the lowlands is Common cotton-grass fens (Eunis classification D2.26) characterised by *Eriophorum angustifolium*, *Vaccinium uliginosum* and *Betula nana* and rich birdlife. Large part of the lowlands is identified as important bird areas. The dryland consists of lava field moss heath and remnants of birch woodlands and most of these are highly degraded. The wetlands have been altered by humans with ditches resulting in canalized streams and dried up lakes.

Many ecological restoration projects have been initiated within the area. Here, we will describe two new initiatives that aim at large-scale restoration of birch woodland and wetland that incorporate the historical mosaic of habitat types within the landscape.

First, the Soil Conservation Service of Iceland (SCSI) initiated in 2019 a wholistic approach for the Hítardalur valley area with the main goal to enhance local birch regeneration to increase birch woodland distribution. It builds on fragmented revegetation projects that local farmers in collaboration with SCSI have carried out since the 1990s, as a part of the project *Farmers Heal the Land*. Second, SCSI and the Agricultural University of Iceland initiated in 2020 a project with the main goal of restoring peatlands with emphases on restoring natural streams to improve migration routes for freshwater fish, European eel (*Anguilla anguilla*) and salmonids, especially brown trout (*Salmo trutta*). Most likely, habitat reduction and degradation has had most severe impact on live cycle of freshwater fishes in small streams by cutting off migration.

With these initiatives the hope is restoring habitats within the area, increase biodiversity and reclaim former ecosystem services.

Keywords: Birch woodland restoration, erosion, peatland restoration, freshwater fish, migration barriers.

Fig. 1. Canalized stream in South Hraunhreppur.

Fig. 2. Degraded birch forests in Hítardalur valley in North

Conservation of an ancient leguminous tree and archaeological artifacts on Marco Island in southwest Florida

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ABSTRACT

The purpose of this poster is to elucidate and strengthen the ecological and cultural factors contributing to the continuation of an island's ancient leguminous tree.

Marco Island is on the southwest coast of Florida, the northernmost island of the 10,000 islands that are part of the Everglades. Marco Island is also southeast of Sanibel Island, a location supporting many wildlife preserves and diversity. Four of Florida's sixteen National Wildlife Areas are on Marco Island.

Twelve thousand years ago, the Calusa Indians resided on Marco Island. Artifacts have been identified at eleven archaeological sites on the island. On the property of a local, small, coastal recreation business grows an ancient six-foot diameter leguminous tree that is purported to be of the same genetic lineage as similar trees on the nearby historical Winter Estates of Thomas Edison and Henry Ford.

In the form of a case study to potentially inform future research, ecological and cultural information was reviewed via conversations with local business owners and municipal employees, interviews with historical society employees, island historic tours, and an examination of municipal files.

Relevant information was: 1) Stakeholders and societies plus aesthetic preferences and signage; 2) Parcel maps, the City's comprehensive plan, municipal zoning regulations, and problematic changes after 2009; 3) Ecological records of threated and endangered species lists, National Wildlife Area designations, historical plant lists, and hotspot species lists; and 4) Historic maps, land use history, locations of archaeological sites, and historic names. In sum, cultural preferences of people, planning and municipal decisions, information on local wildlife, and archaeological and historical knowledge are the interconnected factors that continue to bolster the ancient leguminous tree.

Wetland restoration in Iceland – how to speed up the establishment of wetland vegetation in disturbed margins that follows restoration?

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ABSTRACT

When carrying out wetland restoration, considerable disturbance on the vegetation cover often follows when the soil is moved. How quickly and what combination of vegetation covers these wounds varies greatly. A comparative study was set up at drained wetlands in Sogn, Ölfus (S-Iceland) and at Ytri-Hraundalur, Mýrar (W-Iceland) to test three methods to speed up the establishment of wetland vegetation at the margins that were disturbed following restoration (implemented in 2019): (i) transporting turfs with wetland vegetation; (ii) spreading green hay from local wetland vegetation patches and (iii) sowing annual grass seeds to facilitate the establishment of local vegetation (figure 1). The disturbance state of the margins was measured in 2019, the vegetation and surface measurements where then repeated in 2020 and 2021. Preliminary results indicate that good workmanship during restoration actions, successful raising of water table and slowing down surface water flow facilitates the establishment of wetland vegetation in the disturbed margins and there is a difference between the three methods how they speed up the establishment of wetland vegetation.

Figure 1. disturbed margins after wetland restoration, seeded with annual grass seeds in 2019 (left), same transect photographed in 2021 (right).

Effect of restoration practices on water erosion in a locality of Northeastern México

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ABSTRACT

Considerable efforts and resources have been dedicated to the restoration of semi-arid ecosystems, but their success is rarely evaluated. Knowledge of the erosion rate is a key aspect for evaluating the response of an ecosystem to restoration actions. In this study, the effect of restoration practices on water erosion was evaluated using the RUSLE equation. The area is a rangeland with microphyllous desert scrub vegetation and clay-sandy soils in Northeastern Mexico. Restoration actions were carried out five years ago in the area and consisted of fencing off the area, trench ditches and reforestation. An adjacent area with similar soil and climate characteristics was used as a control. Another objective of the study was to analyze the magnitude in which the erosion rates differ depending on how the R factor of the RUSLE equation is calculated. The hypotheses were: i) Restoration practices contribute to reduce water erosion, ii) Soil loss is greater in deep than in shallow soil subareas, iii) Erosion figures differ by up to 10 times depending on the approach used to estimate the R factor. RUSLE equation was calculated for deep and shallow soil subareas, both in the restored and in the control areas, with three replicates each. Erosion rates were lower in the restored area than in the control. Erosion rates ranged from 0.23 to 2.00 ton ha^{-1} for the restored area and from 0.98 to 8.56 ton ha^{-1} for the control, depending on the R factor. Erosion values obtained with the rainfall kinetic energy variant were 8.7 times higher than those obtained with the Fournier index. Despite the fact that RUSLE is a worldwide used equation and erosion figures notoriously differed with each R approach, there is no set rule regarding the environmental conditions to which each approach of the R factor is best suited.

Keywords: trench ditches, water erosion, RUSLE equation.

Sustainable tourism along Danube by evaluating and improving the cycling infrastructure

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ABSTRACT

The Danube bicycle road offers an ideal way to view the region. It's flat or slightly downhill all the way, passing through picturesque towns and villages and across lush farmland. Along the majestic river, the tourists pass nature protection areas to unique cultural landscapes and impressive historical buildings. By bike visitors get more time to explore the area and enjoy the nature in a sustainable way.

The project SABRINA aims to tackle cycling infrastructure safety issues on existing, missing and planned cycling corridors crossing the Danube region. Cycling infrastructure in this target region is largely in an early stage of development, especially outside of the major urban areas. Given the benefits that cycling has on environment, tourism, transport multimodality, health etc. this fact is both a development opportunity and a substantial safety risk if not properly addressed. Improvement of data on cyclist-related fatal and serious injuries makes this problem apparent everywhere, especially where cycling provision don't exist or are poor, like in Danube region.

A Danube-wide transnational cycling safety intervention is necessary since transnational cycling traffic is growing exponentially and there are significant differences in road safety performance on routes across the region that will be identified through the safety performance rating using unified methodology.

The maintenance of good cycling infrastructure significantly contributes to the ecological restoration of the Danube region. It is known that there are many protected areas with unique flora and fauna that may be threatened by the tourist flow. When tourists move along well-built infrastructural corridors, with special corners for recreation and places for bird watching, they do not endanger the environment. On the other hand, the increased revenue from cycling tourism is used to maintain and restore wetlands and reserves along the Danube.

Keywords: Sustainable tourism, Cycling infrastructure, Danube riverside preservation

Look back on 30 years of evolution of a restored site: the megalithic site of Carnac

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ABSTRACT

The megalithic site of Carnac, is worldwide known for its alignments of more than 2500 standing stones. Freely accessible and unmanaged until the early 1990's, the site suffered from a strong tourist pressure that reached about 600,000 visitors per year in the 1980s. This frequentation, concentrated both in space (around the largest stones) and in time (summer), has led to significant degradation with 4 hectares (25% of the site) dominated by bare soil. Thus, after a dramatic period of degradation, the site was fenced in 1991-93, allowing a spontaneous restoration process. Then, various types of monitoring, mapping, observations and experiments were set up between 1991 and 2001 in order to define an adapted management of the site and its vegetation. Thereby, restoration process took place in parallel of the implementation of new management action, based notably on sheep grazing and frequentation control. Management was regularly adapted according to the evolution of the vegetation but also of the management framework and available human and technical means. After nearly 30 years, a new management plan is nowadays being established. In this framework, an analysis of the vegetation dynamics and of management practices evolution since the beginning of restoration was conducted and a global assessment of the site's biodiversity was implemented. Nowadays the site presents a variety of ecosystems (heathlands, grasslands but also small ponds) which can be considered in good conservation state according to standardized conservation evaluation process. Nevertheless, traces of the former degradation are still present and some areas remain only partially restored, notably due to the trampling pressure that inhibits restoration process.

This quite symbolic example shows that restoration does not end with restoration operation and that the equilibrium between restoration process, management and uses of the site must be thought of in a long term and adaptive way.

Keywords: heathlands, spontaneous restoration, management, long terms surveys, megalithic

Fig. 1 Menec alignements in 2021

Evaluating acorn provenance for reforestation by direct seeding in the face of climate change

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ABSTRACT

In this study we analyze the performance of holm oaks (*Quercus ilex* subsp. *ballota* (Desf.) Samp.) from acorns collected from ten provenances and directly seeded in the field. We tested the proportion of variability in plant emergence, survival, and growth explained by the population of origin, the maternal tree, the difference between acorns, and the place of sowing (four sites with six blocks divided in half), also controlling the effect of acorn mass. The probability of emergence was more conditioned by the location of the seeding point than by the acorn origin. Heavier acorns from more arid populations showed the highest emergence rates. Plants developed from heavier acorns were more likely to survive after the first year. There was also a positive effect of acorn mass on growth, including the number of leaves, plant height, and root collar diameter in the first year. For all growth variables, seeding location explained a higher percentage of the variance than acorn origin. Irrigation increased plant diameter and height but not survival or number of leaves. High acorn mass and the adequate selection of the seeding site are the main factors to guarantee the initial establishment of the oaks via seeding and the effects of maternal variability are more pronounced than those of variability between populations.

Keywords: assisted regeneration, emergence, maternal tree, Holm oak, SE Spain

Native vegetation and soil fauna as spontaneous colonizers favour ecosystem restoration of metal(loid) mine tailings

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ABSTRACT

Abandoned mine tailings in semiarid Mediterranean areas show adverse abiotic conditions (e.g. high metal(loid) levels, extreme pH values, nutrient and carbon deficits, low aeration, etc) for the establishment of above- and below-ground communities. Fertility islands (i.e. vegetation patches formed by plants that spontaneously colonize the tailings) can act as potential nucleation spots fostering beneficial plant-soil-microbial interactions. However, little attention has been paid to the soil invertebrates living beneath these patches and their functional role. Here, we studied the legged microarthropod communities (i.e. mainly Acari and Collembola but also small species of Myriapoda, Insecta and Chelicerata) under patches differing in plant species composition, relative to forests outside of the tailings. We selected four environments within the mine tailings and two in the surrounding forests: 1) bare soil, 2) patches formed by small groups of *Pinus halepensis* individuals, 3) patches formed by isolated *P. halepensis* trees with scattered shrubs and herbs under the canopy, 4) dense patches of *P. halepensis* with shrubs and herbs under the canopy, 5) forest areas next to the mine tailings with *P. halepensis* trees and understory, and 6) far away (1600-1800 m) forest areas with *P. halepensis* trees and understory. We randomly collected 4 intact soil cores at each one of these six environments for microarthropod extractions and identified all individuals to either order or suborder levels. Our results showed that invertebrate abundance at the environment devoid of vegetation was significantly lower when compared with those communities living under vegetation patches and in surrounding forests. Moreover, microarthropod community structure and composition in the patches was similar to that in the forests. Hence, natural recruitment of native vegetation synchronically promotes the colonization of soil invertebrates, thereby showing that spontaneous colonization of metal(loid) mine tailings favours positive associations between plant and microarthropod communities and thus enhances soil functionality.

Keywords: Fertility islands, microarthropods, natural recruitment, soil functionality

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Restoration of semi-arid savannah rangelands after the control of encroachment by woody species in southern Africa

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ABSTRACT

Large parts of savannahs in southern Africa are degraded due to the densification of woody species. This phenomenon (commonly referred to as bush encroachment [BE]) contributes to land degradation, resulting in the reduction of productivity and biodiversity, and is mostly caused by fire suppression, mis-management (e.g. over-grazing) and climatic impacts. To restore the biomass of herbaceous palatable species and to increase production capacity, several restoration techniques can be employed to control BE. Nevertheless, the outcome of these techniques may vary depending on land use (e.g. livestock and/or game ranching) and could result in a variance in species composition and the abundances of palatable grasses and forbs. For example, when well-managed over several years, chemical control can improve the abundance and diversity of palatable herbaceous vegetation and reduce the density and coppicing of woody species. However, several studies found that a combination of manual and chemical control followed by brush-packing can result in creating a micro-environment conducive to the growth and recruitment of herbaceous species given that the seed bank is protected. This technique involves clearing the encroached area manually before applying arboricides to prevent re-growth and then covering the resultant bare areas with branches (i.e. brush-packing). Brush-packing protects herbaceous seedlings against further grazing, improves moisture retention and increases soil fertility. Undoubtedly, improvement of herbaceous richness and diversity after restoration is dependent on land management strategies and rainfall events, but it can be more effective when brush-packing is applied in bare, denuded areas. As a low-cost, effective restoration method, brush-packing can increase the above-ground biomass of grasses by more than a 100% and have a positive effect on trophic levels, thereby contributing to insect abundance and diversity. Furthermore, this technique contributes to job creation in rural communities and the realisation of several Sustainable Development Goals.

Keywords: brush-packing, bush encroachment, biomass, species diversity, herbaceous species, job creation

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Managing ecosystem services in a Mediterranean forest as a Climate Change adaptation tool

The International Network for Seed-based Restoration (INSR): A SER Section

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ABSTRACT

The International Network for Seed-Based Restoration (INSR) is a thematic section of SER. We foster understanding and advancement of seed ecology, conservation and seed-based restoration of degraded systems. We bring together professionals, scientists, practitioners, students, industry, government and organisations such as botanic gardens from the international community who have an interested in promoting and enhancing seed-based solutions in restoration. Becoming a member of INSR is so easy, you need to be a member of the Society for Ecological Restoration and then check the box indicating you wish to be an INSR member! We are actively looking for INSR Ambassadors who are involved in seed-based restoration in their region. You can sign up for our newsletter, get involved, promote your seed-based research and events on our blog and website, and learn about others. Come find our poster, visit our website (https://ser-insr.org/), follow us on Twitter (@InfoInsr), and meet our attending Director-at-large (Author of this abstract) to chat and find out more. Share knowledge about native seeds worldwide with us. We look forward to meeting you!

Keywords: SER Section, INSR, Seed-based restoration, seeds, network

Knowledge Sharing for Shared Success in the Decade on Ecosystem Restoration

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ABSTRACT

Ecological restoration has rapidly evolved from a local action taking place on a site-by-site basis, to a major component of the United Nations Sustainable Development Goals, and at the centre of the 'Decade on Ecosystem Restoration'. Hundreds of millions of hectares of land are to be restored with billions of dollars spent. However, restoration outcomes are notoriously unpredictable making reliably meeting goals difficult. Setting and meeting these goals may be especially difficult when they focus on biodiversity. This difficulty may arise because compositional re-organization of ecological communities due to global change pressures interact metacommunity processes across space and time, which are also affected by anthropogenic disturbance. The paths to efficiently and effectively manage for or accelerate biodiversity recovery after anthropogenic disturbance and degradation remain unclear. We present the Global Restore Project (GRP) (globalrestoreproject.com), a major data synthesis project collating data worldwide from existing restoration projects. We are collecting vegetation community monitoring data from restoration projects globally that applied active seeding or planting treatments, from sites that are recovering on their own, and from reference vegetation to build a comparable framework. We will make these data completely open access for the restoration community to be able to use. We point to how this project will help us to advance knowledge sharing for shared success in the United Nations Decade on Ecosystem Restoration. We highlight our metacommunity approach to ecological restoration data synthesis and explain how this approach will help us to better understand and predict restoration outcomes and possibly plan restoration actions to better benefit biodiversity and people.

Keywords: The Global Restore Project, data synthesis, knowledge sharing

Seeding vs. planting with Quercus: A collaborative, continental-scale experiment

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ABSTRACT

Revegetation is key to ecological restoration, but it often fails due to environmental stress factors. The choice of revegetation method (direct seeding in the field or planting nursery-grown seedlings) can influence the response of plants to stress factors such as drought. The balance between both methods may depend on how the species and functional traits, such as seed size and root depth, interact with environmental conditions. To estimate the effect of seeding *versus* planting on plant development at the European scale and the extent to which differences in environmental conditions, functional traits, and phylogenetic relationship between species can explain differences in this effect, we are conducting an experiment replicated by researchers across Europe. It focuses on the genus *Quercus*, widely distributed across the Northern Hemisphere and resilient to disturbance due to the ability to resprout. Currently, 73 participants from 16 countries have established 51 experimental sites for seeded and planted individuals of one or more oak species native to their area (Fig. 1). All participants received seed shelters for acorn seeding and followed a published open access protocol for seed collection, direct seeding, nursery cultivation, outplanting, herbivory protection, maintenance, and seedling measurement. In addition, participants sent back acorns and soil samples, used for a germination test, acorn weighing and soil analyses, respectively. Seeding and nursery cultivation is in progress at all sites. The experiment will contribute to solving an issue of high relevance in the UN Decade for Ecological Restoration. The experimental design is also a major advantage over existing studies to date, as it will reveal large-scale patterns and it avoids several sources of potential bias between the two revegetation methods. Finally, the international and voluntary character of the experiment contributes to the strengthening of relationships and the transmission of knowledge between cultures.

Keywords: oak, reforestation, nursery, forest ecology, assisted regeneration

Quantifying the biodiversity economic value of green roofs: A case study applied to Lisbon, Portugal

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ABSTRACT

Restoring biodiversity and ecosystem services (ES) in densely urbanized centres is an important measure to increase urban resilience and mitigate climate change effects. Green roofs (GR) are a type of green infrastructure solution that incorporates vegetation over rooftops or other paved and impermeable surfaces, transforming them into areas with the potential to partially restore the pre-existing ES. When properly designed, GR provide several ES for environmental and social well-being. However, many of these ES rarely receive a monetary value in conventional markets and therefore their values are not yet known. The potential to enhance biodiversity is one of the ES of green roofs that still lacks a standard quantification method. In this regard, the study proposes a monetary quantification procedure (€/m²) to measure the contribution of GR to enhancing urban biodiversity based on the proportion of existing green space areas (natural, restored, and naturalized areas). To this end, micro-scale analyses were carried out using neighbourhoods as working zones. Firstly, the overall economic value of biodiversity was estimated based on the Lisbon budget for the promotion of biodiversity enhancement techniques in the municipality area, being equivalent to 0.54 €/m². The contribution of GR was then assumed to be equivalent to 15% for extensive GR and 30% for intensive GR, representing an avoided cost of 0.08 €/m² and 0.16 €/m², respectively. Subsequently, the GR biodiversity value of each working zone was computed as being inverse to the proportion of green spaces. Consequently, the contribution to increasing biodiversity through GR was higher in neighbourhoods with green space scarcity. This allowed measuring the impact of installing GR in different neighbourhoods of the city and consequently identifying the areas where green roofs have the greatest impact on the recovery of urban biodiversity.

Keywords: Green Roofs, Nature-based Solutions, Economic Analysis, Monetary Value.

EcoGrid – countrywide sampling framework to assess soil properties and biodiversity in different ecosystems

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ABSTRACT

Climate change and land use changes have increased pressure on natural and semi-natural habitats and their capacity to sequester carbon. There is need for good quality and standardized measurements across habitat types. In Estonia there is little data about semi-natural grasslands and natural ecosystems and that's why we created standardized sampling framework (EcoGrid). EcoGrid project aim is to give easy comparability through different habitat types and get better overview of Estonian natural and semi-natural habitats ecological condition and carbon storage.

EcoGrid framework has 500 sites, covering 6 different habitat groups in different conditions – forests, wetlands, agricultural grasslands, semi-natural grasslands, road verges and other natural habitats. It covers evenly all Estonian mainland and bigger islands. First aim of our fieldwork was to sample soil DNA, fatty acids, bulk density, and geochemical properties. Secondly, we assessed habitat structure by visually assessing site properties based on field form. During 2021 first round field work 169 sites were sampled, and soil samples were analysed for total organic carbon content (TOC), pH, phosphorus (P), potassium (K), and dissolved nitrogen (DN) content.

In combination with already existing data about TOC in agricultural grasslands, our preliminary results indicate that there is significant difference between TOC content between forests and agricultural grasslands and also between semi-natural grasslands/wetlands and agricultural grassland on mineral soil. Peat soils doesn't show significant difference in TOC between different habitat groups. Also, the significant differences of TOC were between sites considering DN and K levels. EcoGrid project results are promising and are in great value to solve challenges that we face in coming decades.

Keywords: framework, total organic carbon, Estonia, forest, semi-natural grassland, agricultural grassland

Plant functional traits and their intraspecific variability differ in restored grasslands compared to old fields

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ABSTRACT

Grasslands in White Carpathian region contain highly species-rich plant communities and diversity hotspots. Because of agricultural use during last century exist notable differences in soil properties and vegetation even after restoration in comparison with old grasslands. Restoration projects have shown to be partially successful, however better understanding of ecological requirements and restraints of community and target species establishment is still needed. Plants have the ability to modify their traits in response to environmental changes, helping to learn which parameters (lack/surplus of nutrients or increased competition) affects them the most. To explore the differences in traits and their variability in species on ancient and restored grasslands a large-scale experiment was conducted. In this study five functional traits (specific leaf area, leaf dry matter content, leaf height, leaf area and turgor loss point) were measured on 9 old and 16 restored grasslands on community and fine scale for majority of species. Traits of six common grassland species were also measured from every site to analyse intraspecific trait responses. We found functional diversity to be lower on restored sites and average trait values for plant height and turgor loss point to be higher whereas leaf area and SLA to be lower on restored sites. However at intraspecific level SLA showed an opposite trend indicating higher stress tolerance of species on ancient grasslands. For plant height we found significant interaction between grassland type and species identity. While tall species like *Bromus erectus* were taller at restored sites, small statured species such as *Fragaria viridis* were smaller at restored sites. Trends of direction of traits showed that on restored sites on community scale most traits were convergent. For both community and fine scale turgor loss point showed significant convergence showing the strong selection of this trait during the formation of restored communties.

Keywords: functional traits, intraspecific trait variability, grassland restoration

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Analysing reciprocal feedbacks between relational values and social networks for grassland restoration

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ABSTRACT

As we live in a world of diverse and changing mutual influences and dependencies between humans and nature, restoration needs to recognise those complex interlinkages of human-nature systems for long-term restoration success. A social-ecological systems perspective is highly beneficial to understand and address this complexity. One critical step towards understanding social-ecological complexity is the investigation of human decision-making regarding interactions with and actions towards nature. In decision-making, personal and societal values, rules, and knowledge are key determinants for human-nature interactions. Thus, to address unsustainable land use changes of grasslands and restoration towards crucial species richness, the underlying values of grassland users and decision-makers require investigation. To this end, in my PhD, I aim to research three research objectives: (i) To identify the values underlying grassland restoration activities across Germany and relate them with the social-ecological characteristics of restoration, (ii) to explore how social networks in restoration projects of grasslands are articulated through the values, rules and knowledge of their participants, and (iii) to understand how value-systems permeate and are shaped by social networks of restoration activities. I will use a mixed methods approach to identify values related to grasslands to analyse and leverage diverse motives and goals for restoration. A comparison of values elicited by stakeholders engaged in restoration projects embedded in diverse social-ecological contexts will inform future engagement strategies for grassland restoration. Further, I seek to identify the transformation potential towards grassland appreciation in two transdisciplinary research settings, so-called real-world laboratories. To do so, I will apply the leverage points framework to understand the relation between values, rules, and knowledge and the potential for restoration. With my presentation, I would like to discuss my research design and accompanying methods, and argue for the transformative potential of using a transdisciplinary approach and real-world laboratories in restoration.

Keywords: grassland restoration, social-ecological restoration, values rules and knowledge framework, real-world laboratories, transdisciplinarity

Birch woodland expansion from discrete seed sources – implications for large-scale restoration

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ABSTRACT

Mountain birch (*Betula pubescens*) woodlands are key ecosystems in the subarctic north. Extensive land use and resource exploitation have led to depletion of birch woodlands in Iceland, with only a fraction remaining. Birch has great potential for rapid colonization, but studies have shown that this process is affected by many different factors. It can be inhibited by the lack of seed rain and safe sites for seedling establishment, livestock grazing and other disturbances, while abiotic factors including wind and precipitation shape seed dispersal and colonization patterns. Effective management of large-scale woodland restoration projects requires a mechanistic understanding of colonization processes. As part of the research project *EcoBirch – Restoration of birch woodlands in the 21st century*, this study aims to assess the potential of colonization and expansion of natural birch woodlands in the subarctic region. Field- and remote sensing data from 10 different sites around Iceland were used to construct models exploring which variables influence the rate and patterns of birch colonization. Such an extensive study on birch colonization patterns provides essential knowledge on what factors determine natural regeneration in woodland restoration projects in a rapidly changing environment.

Keywords: Birch woodlands, colonization patterns, ecological modelling, restoration

Fig. 1 * Measuring birch colonization along a transect in Steinadalur, South Iceland.**

Survival and habitat characterization of Pinna nobilis in the Mar Menor coastal lagoon

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ABSTRACT

Pinna nobilis is a Critically Endangered Mediterranean endemic bivalve due to a serious epidemic mainly caused by the parasite *Haplosporidium pinnae*. Currently, it's only Spanish living populations are found in the Ebro Delta (Cataluña) and in Mar Menor (Murcia). The Mar Menor coastal lagoon has been subjected to several crisis of eutrophication since 2016, due to the constant inflow of water with a high concentration of nutrients, organic matter, and sediment, which pose a threat to the survival of *Pinna nobilis*. An analysis of the mortality of *P. nobilis* in the lagoon after the last eutrophication episode in 2021, and a characterization of the variables that describe its current habitat in the lagoon have been carried out. With this aim, four sampling areas were selected from the east coast of the lagoon, where a survey of living and dead individuals was realized. In addition, a characterization of the macrophyte beds and the conditions of sediment near these individuals was carried out, comparing the differences between the sediment near dead and living individuals. It was detected that all the studied areas have similar mixed macrophyte beds of *Cymodocea nodosa* and *Caulerpa prolifera*. However, we observed that *Cymodocea* cover was lower in El Pedrucho locality, where the mortality of *Pinna nobilis* individuals was higher, and the sediment near dead individuals was also more altered (*Eh* more negative and higher percentage of organic matter). These results may help us to improve the understanding on the factors and habitats that affect the survival of this species, in order to identify potential survival habitats.

Keywords: *Pinna nobilis*, Mar Menor, eutrophication, mortality, habitat

Influence of raptors and land-use on birds present in vineyards: bases for biological control

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ABSTRACT

Millions of tons of pesticides are used annually for pest control and improvement of crop yields, with long-term implications for health, biodiversity, pollution of soil and water and the provision of ecosystem services. The ability of birds as natural enemies to regulate agricultural pests (*top-down effects*) as a sustainable practice that do not compromise the capacity of these environments to offer ecosystem services, remains poorly understood. The aim of this study is to analyze the potential role of raptors in the biological control of grape-eating birds in vineyards of Galicia, Spain. We hypothesize that forest cover in the study area favors the proximity of raptor's nests to vineyards and those vineyards that are closer to raptors nests have a lower abundance of grape-eating birds. Also, ornithophagous raptors (northern goshawk *Accipiter gentilis* and eurasian sparrowhawk *A. nisus*) will have a greater effect on the abundance of birds in vineyards than non-ornithophagous raptors (common buzzard *Buteo buteo*). We analyzed the abundance of birds in general and grape-eating birds in particular in 59 vineyards and explore their relationship to the proximity to active nests of a guild of forest raptors. We also studied land-use and its relationship with the abundance of birds in the vineyards. A total of 61 species of birds were detected and grape-eating birds represented 61% of the total bird abundance. Forest cover around the vineyards and the proximity of goshawk nests had a negative effect on the abundance of birds, supporting the hypothesis that raptors and the proximity to their nests reduce the abundance of birds in the vineyards. Our results highlight the importance of the surrounding natural and semi-natural vegetation for biological control of grape-consuming birds that contributes to reconcile forest and agricultural exploitations and the provision of ecosystem services provided by raptors.

Keywords: Ecosystem services, landscape, forest, raptors, bird predation, smallholder forestry

Monitoring passive restoration of burned lands through remote sensing tools

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ABSTRACT

Landscape degradation and potential desertification hampers ecosystem's services sustainability, becoming a substantial environmental and societal problem at a global scale. This work aims to identify and test indicators based on both Remote Sensing (RS) satellite images and field-based data, in order to monitor the restoration of degraded landscapes. These indicators, which describe soil conditions and vegetation status, have a great potential to improve desertification assessment by providing support for the monitoring and management of ecological restoration processes through Nature Based Solutions (NBS). The work presented here is part of a larger EU funded project (NewLife4Drylands (LIFE20 PRE/IT/000007) which includes a total of six study areas located in the Southern European region. Here we focus on testing the different indicators at two of these six areas: "El Bruc" and "Tifaracás", both affected by forest fires in 2015 and 2019 respectively. "El Bruc", with a major population of Aleppo pine (*Pinus halepensis*) is located in the Catalan region (NE Iberian Peninsula) next to the Natural Park of Montserrat (Natura 2000 Network). "Tifaracás" is a dryland with increasing desertification, located in the island of Gran Canaria (Canary Islands) between the Natural Park of El Nublo and Tamadaba (in Natura 2000 Network). At this site, desertification processes are aggravated by the decrease in rainfall, recurrent forest fires and herbivory caused by the abundant presence of wild goats. In this comparative study we present the quantitative and qualitative results based on the indicators tested at both sites (including land cover maps, vegetation indices, intensity of burnt surface, among others). These results allow a site-specific detailed assessment of the degradation processes at each particular study area.

Keywords: land restoration monitoring, Sentinel-2, Landsat8, Burned Areas Indices.

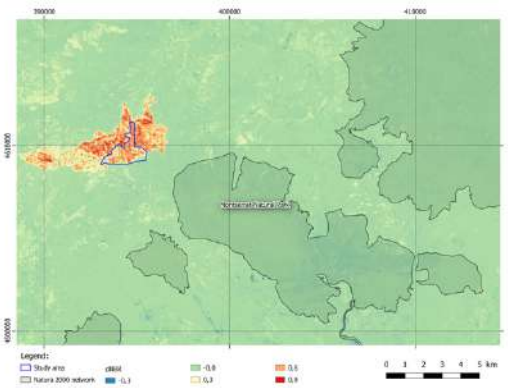

Figure 1. Severity level from fire (dNBR) El Bruc site.

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Mining sites as a new habitat for endangered species of aquatic vegetation

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ABSTRACT

The occurrence of threatened species in post-mining sites has previously been examined in terrestrial habitats. It was found that mosaic of various successional stages in post-mining sites often harboured endangered species of plants, especially in younger stages. However, vegetation in aquatic and littoral environments has deserved much less attention compared to the terrestrial habitats Differently aged spontaneous successional stages in sandpits (69), stone quarries (28), china clay quarries (23), black coal sinks (18) and brown coal spoil heaps (9) across the Czech Republic, Central Europe, were sampled. The age since the mining cessation in sampled sites ranged from 1 to 89 years. We asked how much threatened species occurred in these artificial habitats and whether the potential of post-mining sites is as promising for aquatic species as it is for terrestrial vegetation. Altogether 254 vascular plant species and 7 *Characeae* species were recorded, over 10% of determined species were considered endangered in the national flora. Successional seres in aquatic and littoral habitats did not differ in proportion of endangered species between the individual mining types. Proportion of Red list species did not differ between successional stages, the presence of species seemed to be stable during the succession. Importantly, the presence and cover of alien species was very low, and both was either unchanged or decreasing during succession. Spontaneous succession at aquatic and littoral sites represented valuable seminatural stages rich with threatened species and can be therefore generally recommended as a passive restoration option in disused mining sites.

Keywords: succession, mining, aquatic, vegetation, endangered

Effects of microclimatic shelters and maternal origin on directly sown acorns vs. outplanted seedlings

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ABSTRACT

Two sowings of 300 acorns of *Quercus ilex* subsp. *ballota* were randomly made following a 5-block design respectively in February 2017 (C1) and February 2018 (C3), as well as a 300-seedling outplanting in February 2018 (C2) in SE Spain. Tree shelters consisted in closed plastic tubes (Tubex®), Mixed tubes, Cork shelters, Tiles, and Control. Emergence, survival, and growth related parameters were monitored until 2022. Emergence was positively influenced by shelter Tubex (86%) with regards to the Control (64%) and by the initial acorn mass, while mother tree or year of sowing did not affect. Survival of emerged acorns (88%) was statistically the same that the outplanted seedlings (91%), and no effects of mother tree, tree shelter, and acorn mass were found. In terms of final planting success rate, it was found 64% of success for direct acorn sowing compared to 91% for the seedling plantation. All shelters with the exception of Tile showed higher Slenderness ratio (SR) than the Control, especially Tubex. Seedling growing depended on the sowing year (C1>C3), and outplanted seedlings resulted in higher RCD and lower SR than directly sown acorns. All growth related parameters were highly dependent of the initial acorn mass and the initial seedling features recorded after the first growing season. The resprouting rate after harvesting was highly depended on the initial acorn mass and the plant features at harvesting. Tree shelters did not show special differences with respect to the control, so its use does not seem recommendable (in terms of microclimatic conditions). The selection of certain mother trees and especially large acorns was highly relevant. The results of direct sowing *versus* outplanting depended on the meteorological year. Seedling plantation seemed more successful than direct acorn sowing, although it remains to analyze the efficiency in economic terms.

Keywords: Quercus ilex, tree shelter, slenderness, resprouting, SE Spain

Effects of nursery-root manipulation, acorn mass and seed provenance on field response of Holm oak

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ABSTRACT

Acorns of *Quercus ilex* subsp. *ballota* collected from three mother trees from different locations of SE Spain (Be, Ca, Fi) were grown in deep containers for two years under nursery conditions (36 cm depth, 6 L of volume). Half of them were seeded directly in the deep containers (D) and the other half were cultivated during the first year in forest trays of 18 cm depth and 350 cm^3 (T), and then transplanted into deep containers for their second year. Half of the acorns planted in both T and D had their radicle cut at the time of seeding (1) while the other half kept the radicle intact (0). In February 2019, 189 seedlings were outplanted to Mediterranean-field conditions and harvested after two growing seasons (February 2021). The resprouting capacity after harvest (resilience) was evaluated in February 2022. Survival at harvesting raised 98.4%. At this moment, treatment T surpassed treatment D in all growth related parameters. Cutting the radicle presented no advantage, in either treatment T nor D. Seedlings of acorns coming from Be site showed higher height and root-collar diameter (RCD) than seedlings from Ca and Fi sites (Be>Ca>Fi), despite having the smaller acorns, while the fractioned and total aerial biomass followed the sequence Be>Ca=Fi. The initial acorn mass was positively related to the height and RCD of the plants in all the samplings carried out throughout the experiment. Resprouting rate was statistically independent of root treatments, acorn mass and provenance ($p>0.005$), but was highly related to the previous seedling size and to the fractioned- and total-aboveground-dry biomass. In short, seedlings cultivated during the first year in forest trays showed better field performance. Acorn provenance could influence the field performance of the outplanted seedlings. Initial acorn mass influenced the field performance of seedlings up to four years after seeding.

Keywords: Quercus ilex, deep container, radicle, mother tree, SE Spain

Large acorns, early sowing, weed control, but also locality, keys to the successful acorn seeding

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ABSTRACT

A total of 2400 acorns of *Quercus ilex* subsp. *ballota* were sown in four contrasted localities of SE Spain. Acorns were systematically sown on December 2019, January, February, and March 2020, and weed competition was mechanically controlled over the study period in half of each block. Emergence and survival were registered over May, June, July, August, and November 2020, and November 2021. Acorn mass was registered before sowing and they were protected by a 'seed shelter'. Emergence and survival rate gradually decreased with the sowing date. Emergence varied from 53.7% of acorns sown in December to 29.4% of those sown in March while survival after two growing seasons was 27.1% for acorns sown in December with regards to the 9.2% of acorns sown in March. Emergence of acorns sown in subplots with weed control was the same (42.1%) than non-treated subplots (41.6%), but survival clearly decreased over time in a statistically higher rate at non-treated subplots (12.7%) with regard to the weed control (22.5%). Emergence and survival rate were highly dependent of the locality and the mother tree from which the acorn comes. Mass of the emerged acorns was higher (5.56 g ± 0.06 SE) than mass of non-emerged, although it was locality dependent. Non-emerged acorns showed less mass (4.47 g ± 0.05 SE) than emerged but dead acorns (5.37 g ± 0.08 SE), and both less than those emerged alive (5.84 g ± 0.09 SE) at the end of the study period. Mean acorn mass of mother trees was positively correlated with the emergence (r=0.83, P=0.0000) and survival (r=0.81, P=0.0000). In view of these results, it is advisable to locate mother trees with high germination potential, select large acorns, sow early (autumn), and control weed competition over time. Sowing success will be less in drier sites or years.

Keywords: Quercus ilex, Mediterranean, emergence, dehesa, SE Spain

Prioritizing areas for conservation and restoration of nature in Denmark

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ABSTRACT

The way humans choose to manage or not manage the land surface is important in many ways. Different land system types can act as carbon sinks or carbon sources, land use change can lead to both destruction and rebuilding of habitat, land is needed to feed a growing world population, and having access to nature improves mental health. This project aims to explore the synergies between different goals for land use at different scales, primarily protection of biodiversity and mitigation of climate change. The focus will be on Denmark but placed in a European and global context. This will be done through a spatial prioritization performed with both conservation and restoration in mind, aiming to determine which current natural areas are most important to protect and which agricultural areas are most important to set aside for nature.

Keywords: land use change, prioritization, conservation, restoration, biodiversity, climate change

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Restoring and promoting a long term sustainable management of wooded meadows in Estonia and Latvia

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ABSTRACT

EU priority habitat 6530* Fennoscandian wooded meadows (hereinafter wooded meadows) is a highly endangered habitat that is in an unfavourable-bad conservation status (U2) throughout its range, in both, Boreal Biogeographical region and in Continental Biogeographical region (Article 17 report, 20191).

The main threat to the wooded meadows is the same that all valuable semi-natural grassland habitats are facing nowadays - abandonment or inappropriate management, but this threat manifests especially severely in wooded meadows due to the fact that they are labor-and cost-intensive to restore and maintain. Wooded meadows are a unique example of semi-natural landscapes that hold an enormous socio-economic value, in terms of ecosystem services and ecological functions, but they need investments, to return them to the economic cycle of modern farming.

This year we have started EU LIFE programme project “WOODMEADOWLIFE” under which we will improve the conservation status of wooded meadows in Boreal Biogeographic region by restoring Estonian and Latvian wooded meadows (700 ha in two countries), develop agreements, guidelines and smart solutions for their future management and highlight their ecosystem services, ecological functions and unique heritage value in both countries. By doing that, it will significantly contribute to the overall conservation status of 6530* in the EU, as both countries host 60% of all wooded meadows in the Boreal Biogeographic region.

As degraded wooded meadows often include conservation dilemmas between forest conservation and meadow restoration, the restoration plans have to be carefully designed and fully communicated to the owners and managers ensuring co-development of the restoration plans.

The poster presentation provides an overview of the current condition of the wooded meadows in the area, planned measures to increase the habitat-specific structures and speed up the restoration on grasslands cleared from overgrowth.

Keywords: Fennoscandian wooded meadows 6530*, cultural heritage, heterogeneous landscape, conservation challenges.

Afforestation of reclaimed oil shale quarry – production and phytoremediation potential of hybrid aspen plantations

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Abstract: The main aim of degraded land restoration is to shorten the transitional time from overburden to self-functioning forest ecosystem. Afforestation of former oil shale mining areas is considered to be the best opportunity to restore the ecosystem. Since the 1960s, more than 10 000 ha of exhausted opencast mining areas have been afforested in north-eastern Estonia. Therefore, the choice of tree species for the afforestation of post-mining areas is an important factor that determines the duration of soil pedogenesis and successful forest ecosystem restoration. *Populus* spp. trees are optimal plants for the absorption, accumulation, storage and degradation of environmental pollutants, such as heavy metals. Fast-growing tree species, especially hybrid aspen (*Populus tremula L.* × *P. tremuloides* Michx.) has proven to be a good choice as the first rotation tree species in post-mined oil shale quarries in hemiboreal Estonia to accumulate considerable amounts of heavy metals and restore the functioning of the ecosystem. The previous studies showed that 15 years since plantation establishment, hybrid aspen had higher production potential than other tree species and supported the development of the topsoil cover. However particular attention should be paid to the distribution of heavy metals in plant tissues, because high concentrations of heavy metals can cause significant alterations in tree physiological and forest ecosystem functioning. The findings will help to understand the changes in the system tree-soil growth environment and prognosticate possibilities of using hybrid aspen for afforestation of former oil shale mining areas. Moreover, hybrid aspen plantations have caused an increase in soil acidity during the 15 years after planting which should support the mobility and acquisition of heavy metals by trees during the second half of the rotation cycle (25–30 years) where the leaf area and growth have peaked.

Keywords: afforestation, hybrid aspen, oil shale quarry, phytoremediation, production

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Afforestation of organic soils - effect of wood ash on the biomass formation and leaching of heavy metals

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Abstract: Interest in bioenergy, including the use of forest biomass as a fuel, is increasing in response to concerns over climate change, growing oil prices and energy security. The end product of bioenergy is wood ash. Wood ash has been used as application in forest ecosystem to return nutrients and to counteract soil acidification; as fertilizer or fertilizer supplement in agro-systems. Because of rich chemical composition wood ash is an important source of plant nutrients for restoring the fertility of nutrient-poor soils. Better results have been achieved by using biofuel ashes to stimulate tree growth in organic soils because wood ash contains all elements necessary for tree growth except for nitrogen. Using biofuel ashes (wood ash, etc.) for the afforestation of organics soils helps to balance the content of nutrients in growth substrate, which improves the survival of planted seedlings and significantly increases bioproduction. Using biofuel ashes in the afforestation of organic soils (cutaway peatlands etc) helps to balance the content of nutrients in peat substrate (shortage of phosphorus and potassium is considered to be growth limiting in organic soils). After fertilizing with wood ash the pH of the top layer of peat may rise by several units. The higher pH of peat improve aeration conditions, as well as the microbial activity of top peat layer and development of plant cover. In the upper layers of peat of the ash-treated plots the contents of phosphorus and potassium were significantly higher compared to unfertilized control plots. In addition to important fertilizer nutrients, wood ash contain considerable amounts of heavy metals (especially Cd, Ni etc) that are potentially toxic to humans and forest flora and fauna. Important is to monitor possible emissions of heavy metals.

Keywords: biomass, heavy metals, seedlings, wood ash

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Delayed storm and salvage logging effects on understory vegetation recovery and development

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ABSTRACT

The herbaceous understory is a key component of forest biodiversity. Moreover, it holds capability to alter the dynamics and composition of the overstory. Severe wind disturbance changes the conditions in a forest ecosystem radically, causing alteration of understory characteristics as well. In this paper we analyze impacts of different storm damage levels and post-storm management method on understory vegetation richness, diversity and composition in mixed spruce–hardwood forest stands located in hemiboreal Estonia. We examined understory vegetation in moderately damaged (n=4), heavily damaged (n=4) and post-storm salvage-logged stands (n=4) 19-20 years after storm. Mature mixed spruce–hardwood forests were included as a reference group (n=4). Study plots were also assessed regarding canopy openness, richness of microhabitats and coverage of woody species. A total of 98 herbaceous and 2 dwarf shrub taxa were found on 208 vegetation quadrats (1 m^2 square each). Total coverage of the herb layer and species richness were greatest at salvage-logged plots, compared to other treatments. However, we found no significant effect of treatment on diversity (Shannon's H') nor evenness (Pielou's index) of herbaceous species. Our results indicate that approximately two decades after wind disturbance, the understory communities differ from each other as a response to different storm damage levels and post-storm management method. All treatments differed from control plots regarding species composition as well, while salvage-logged stands demonstrated greatest contrast. Salvage-logged plots had greatest light levels, but lowest estimates for microsite richness and woody species coverage. Moderately damaged plots demonstrated greatest within-group variation regarding light conditions and species composition. Our findings suggest that salvage logging after severe wind disturbance might induce delayed succession toward a closed canopy due to intense understory competition and lack of opportunity-providing microhabitats for tree regeneration.

Keywords: windthrow, herbaceous layer, forest dynamics, salvage logging, vascular plants

Insect pests of newly planted urban trees in the city of Nitra (Slovakia)

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ABSTRACT

Planting trees in urban areas is a way to mitigate the impacts of climate change in these vulnerable environments. To have healthy urban trees species selection criteria, proper management and maintenance, pruning according to arboricultural standards is essential. Local authorities in Slovakia plant a large number of trees, but the care after planting is not satisfactory. Stressed trees are attacked by insect pests which lower the survival rate of trees. The main aim of this contribution is to present the findings of a 5 year old survey (2016-2021), where we investigated insect pests on 600 urban tree individuals planted in the city of Nitra. We found that the most resistant tree species towards insect damage was *Prunus serrulata* ´Kanzan´. The highest mortality was among *Sorbus aria* ´Lutescens´specimens, caused by *Scolytus mali*. High number of insect pests was on species like *Tillia* sp. and *Quercus* sp., but they did not cause significant mortality. Alarming was the presence and abundance of *Metcalfa pruinosa* and the first record of *Corythuca arcuata* in the city park of Nitra 2020.

Keywords: invasive species, tree care, urban forestry, insect pest damage

Acknowledgement: This contribution was supported by the COST Action CA20132 - Urban Tree Guard - Safeguarding European urban trees and forests through improved biosecurity (UB3Guard) and KEGA 003SPU-4/2020 ZEL:IN:KA - Integration of Green Infrastructure into Landscape Architecture.

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Understanding the barriers for forest restoration in the Brazilian Amazon, Pará: a comparative stakeholder survey

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ABSTRACT

Legal provisions intend to promote forest restoration using native species in Brazil, including the Forest Code and the National Plan for Native Vegetation Recovery (PLANAVEG). Forest restoration and agro-ecological production that provides economically valuable non-timber forest products (NTFPs) is rare in deforested areas in the Amazon basin, but can serve as a sustainable basis for family farmers' living, especially when it combines the implementation of good practices with product innovation, to provide significant levels of income. In order to investigate the opportunities and barriers for developing such systems, we conducted a stakeholder survey with 27 household and 26 expert respondents in north-eastern Pará, Brazil. Experts from public agencies, NGOs and the private sector pointed to the lack of 'knowledge or awareness' as the main barrier for farmers to get involved in agro-ecological activities, followed by lack of 'financial incentives', 'technical assistance' and 'special credit formats'. 'Cultural barriers', lack of 'adequate infrastructure' and 'difficult to access markets' were also relevant aspects. Small, medium and large household agricultural producers were asked what they understand by the terms 'forest restoration' and 'agroforestry'. Four and fifteen out of 27 respondents, respectively, gave unsatisfactory answers or stated 'I do not know', thus supporting the experts' narratives. However, six of the fifteen farmers were to some extent practicing agroforestry, revealing a mismatch between their understanding of concepts and their practices in the rural environment. In terms of management that supports their activities, 'soft forest clearings' was the most commonly used practice, especially for native açaí production (*Euterpe oleracea* Mart.), which is the most important commercial agroforestry crop among the surveyed households. Contrary to our expectations, households expressed a decrease in the use of 'controlled burnings', indicating a change towards more sustainable practices in the region.

Keywords: Agroforestry, forest restoration, stakeholders, barriers, opportunities.

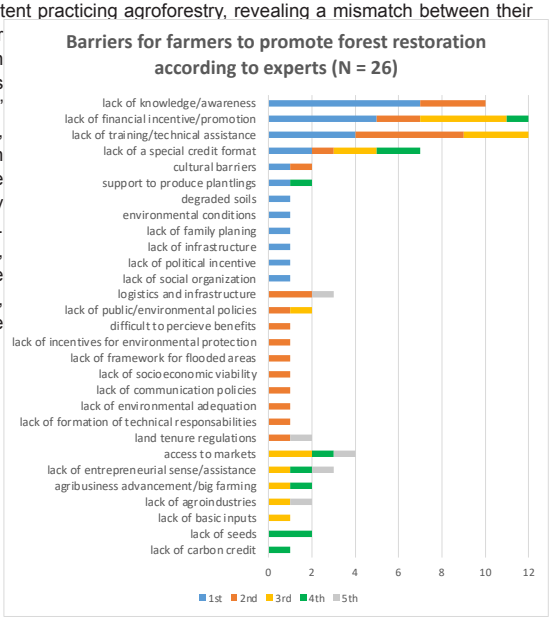

Fig. 1: Results for the open question "what are the main barriers for farmers to promote forest restoration?" as answered by 26 expert respondents. Indicated ranking corresponds to the order in which each factor was stated. The x-axis shows the number of respondents indicating that a particular issue is a barrier.

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Prioritizing restoration areas thanks to green-blue infrastructure

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ABSTRACT

In recent decades, a new land management model has emerged, the Green-Blue Infrastructure (GBI), which encompasses, in addition to landscape connectivity, its multifunctionality (supply of a wide range of Ecosystems (SE)), with the aim of conserving biodiversity and facing current challenges (landscape fragmentation or climate change). GBI has begun to be identified at different scales in Europe. This is the case of Bizkaia (Basque Country), where a GBI proposal has been made, identifying both the multifunctional areas that provide multiple SE and the ecological corridors based on the movement of three animal species and SE supply. The objective of this study was to identify the bottlenecks in these proposed ecological corridors and to select priority areas where to establish future restoration and improvement actions. To identify the bottlenecks, the *Pintchpoint mapper* tool of the *Linkage mapper* program and the *Circuitscape* program in ArcMap 10.8 were used to develop a current flow map and identify the sectors where connectivity is particularly vulnerable. To obtain the current flow value from which a bottleneck is considered, the values were classified into three ranges using the Jens natural cutoff method, considering bottlenecks those included in range 3 (>0.33), that were ≥0.03 ha in size. Subsequently, those bottlenecks that were found in the corridors used by the three species studied, whose importance and quality was high or in those that had a high importance, but low quality, were selected as priority areas to restore. The results indicated that 15 bottlenecks were identified in the corridors in which there was an overlap for the three umbrella species, with an average size of 0.39 ha and 515 in the corridors based on the provision of SE with an average size of 1.9 ha. Finally, a series of actions to be carried out in these areas is proposed.

Keywords: Bottlenecks, Connectivity, Ecological corridors, Ecosystem Services, Multifuncionality.

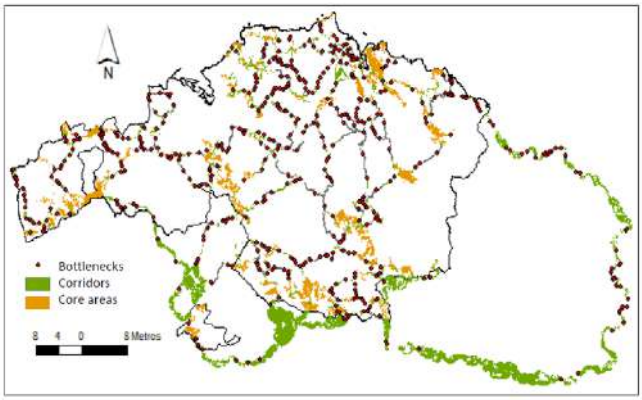

Fig. 1 Bottlenecks and Green Infrastructure (ecological corridors and core areas) in Biscay (Euskadi).

Giving LIFE to grasslands – restoring biodiversity and ecosystem services

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ABSTRACT

Semi-natural grasslands and their diverse biota are currently most threatened by changes in land-use like afforestation, abandonment of historical low-intensity management practices or conversion into arable land. Extensive loss and fragmentation of semi-natural grasslands consequently affects the ecosystem functioning and sustainable provision of ecosystem services.

Our study focused on calcareous semi-natural grasslands in Estonia that have gone through considerable changes in their habitat spatial structure and coverage during the past century. These grasslands have lost an extensive area of their historical spread due to afforestation or shrub encroachment, having profound effect on the local biodiversity and on the supply of ecosystem services. To halt further degradation large-scale LIFE programme restoration efforts were set in motion. Before the restoration activities, we selected 35 study sites and within each study site we established three subsites according to different stages of alvar grassland degradation – relatively open grassland, overgrown grassland (dense juniper shrubs), and afforested grassland (Pinus sylvestris plantations). Additionally, we selected control subsites that were not going to be restored for all the study sites. In our study we aimed to determine whether there is any difference in the recovery between the relatively open, overgrown and afforested grasslands after restoration and how has that affected the overall biodiversity and supply of ecosystem services.

Our results suggest that already few years after restoration, restored grasslands are characterized by quickly increasing biodiversity and improved capacity to provide vital ecosystem services. Even the highly degraded afforested sites and dense (>75% cover) shrublands were recovering nicely with mostly characteristic alvar grassland specialist plant species emerging from seed banks or from surrounding relatively intact habitats. Ecosystem functioning inherent to open grasslands recovered quite quickly and after couple of years the provision of ecosystem services evened out between the remaining good quality alvar grasslands and all the restored areas.

Keywords: grassland restoration, ecosystem services, biodiversity, semi-natural grasslands

Adaptive maintenance of the Nemunas river waterway for effective conservation of Little and Common terns

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ABSTRACT

Common and Little terns are often restricted by the availability of suitable sites for nesting. In Lithuania, Common tern colonies establish on exposed islands of different waterbodies. Consequently, conservation efforts are usually focussed on proper management of such islands. While Little tern nests mainly on islands of the largest river Nemunas and its sandy banks with up to 80% of its national population breeding there. Therefore, Nemunas river is of crucial importance for conservation of the Common and, in particular, Little terns, with 4 SPAs designated there. Among threats related to the conservation status of both terns breeding on rivers, waterway maintenance was identified as one of the most significant in Lithuania and elsewhere in Europe.

According to the long-term monitoring data the conservation status of the breeding Little and Common terns was assessed as unfavorable in all 4 Nemunas river SPAs in 2009-2019. The lack of the nesting sites was noticed as the main reason of such status. The excavation of the shallow river zones during maintenance of the waterway together with high water level during terns breeding seasons have determined this scarcity.

17 new sandy/gravel islands and beaches were poured for terns breeding on the Nemunas river in 2019-2021 while implementing the EU LIFE Program project "Adjustment of key stakeholders' capacity for improvement of Common and Little terns conservation status in Lithuania". The formation of new islands was combined with regular maintenance of water transport corridor, when natural sandy islands in the most cases were adopted for terns breeding as well.

Recent monitoring data showed significantly increased number of the breeding Common and Little terns due to occupation of newly formed islands. Although, extremely high-water level on Nemunas river was important limiting factors in some last years, poured higher islands have compensated scarcity of the terns' nesting sites.

Keywords: breeding terns, conservation, waterway maintenance, island formation.

Marker-trait associations in Alnus species – from genotyping to riparian restoration

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

To plant or not to plant? Drivers of native woodland creation in the United Kingdom

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Abstract: The United Kingdom (UK) has ambitious plans to expand its woodlands and restore its ecosystems. However, recent surveys show that generally landholders do not plan to create new woodlands in the next five years. So, can woodland creation programs be designed to increase participation? In this study, we identify what types of woodland restoration programs are more likely to be adopted and who is likely to adopt them. We survey landholders across the UK, using diffusion of innovation theory and the comprehensive action determination model to explore differences across landholders and their perceptions of restoration programs. Ultimately, we want to understand how characteristics of landholders, their context and the woodland creation interventions themselves, influence land managers' decisions to create native woodland or not. The theory and our preliminary results show these three aspects are key to understanding what drives the uptake, spread and abandonment of woodland ecosystem restoration interventions. Our future results should provide further and more robust insights into what drives landholders' decisions to create native woodland in the UK. This will expand our knowledge of how landholders' behaviours change towards more ecologically restorative land management.

Keywords: Woodland creation, behaviour change, diffusion, innovation, ecological restoration.

Restoration under climate change: seeding versus planting of two oaks

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ABSTRACT

For large-seeded species such as oaks, selecting among seeding and planting as revegetation method can define survival and performance throughout the plant's life. While planting may help establishment by using larger seedlings, direct seeding allows the development of a deep tap root, which can help access soil resources and mitigate water stress. The balance between seeding and planting may thus vary under conditions of climate change and depend on species traits related to water acquisition. In 2020, we established an experiment in an agricultural field near Granada (Spain) to assess the effect of revegetation method under current and future climate (using open-top chambers OTCs, which increased mean air temperature by 2ºC) for an evergreen and a marcescent oak (*Q. ilex* and *Q. faginea*, respectively). We sowed acorns in the field in late 2020 and at the same time cultivated seedlings from the same acorn lots in a nursery, which were transplanted in early 2022. The study encompasses 1084 individuals, which are being monitored for survival, growth, and physiology. We will present results from the first summer of common growth. The results of this experiment will help decision-making in restoration regarding revegetation method, improving the probability of success both under current climatic conditions and under future ones with increased global temperature.

Keywords: revegetation, Open-top chamber, planting method, sowing, *Quercus*.

Water infiltration in restored birch woodlands ecosystems in Iceland

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ABSTRACT

Mountain birch (*Betula pubescens*) woodlands were the key natural ecosystems of Iceland prior to the settlement about 1200 years ago. Massive land degradation has taken place over the past Millennium, including destruction of most of the birch woodlands, down to <1% cover, forming extensive barren lands in some areas. The woodlands provide important services such as being key system for preserving biodiversity, maintaining high carbon and fertility levels, and favorable hydrological properties. The woodlands allow for water infiltration in winter contrary to the degraded ecosystems of today – which are subjected to flooding and minimal storage of winter precipitation.

Iceland has set goals to restore the birch woodlands. EcoBirch - Restoration of birch woodlands in the 21st century (www.birkivist.is) is a multi-disciplinary research project carried out by six institutions and universities. The project has multiple aims, including characterization of ecosystem changes that accompany the restoration of the birch ecosystems.

We set out an experiment to test differences in water infiltration rates between mature birch ecosystems, young birch ecosystems, and adjacent treeless land. The double ring infiltration method is difficult to carry out under Icelandic conditions due to frost effects and other constraints. We are therefore comparing single ring and double ring infiltration methods in birch woodlands and other systems. First results indicate some but not a large difference between the methods. Concurrently we are measuring infiltration rates in birch woodlands of various age. First results indicate much slower infiltration rates in treeless areas compared to the birch woodlands with no infiltration on frozen barren ground.

Keywords: *Betula pubescens*, soil, hydrology, infiltration

Impact of landscape-scale invasion level on sand grassland restoration

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Abstract: Invasive alien species are among the main threats to biodiversity, and nature conservation seeks the best methods to eliminate them and restore natural habitats. We collected long-term datasets from four different experiments to restore sand grasslands in degraded areas in the Kiskunság Sand Ridge, Hungary. We tested three methods: seeding, mowing and carbon amendment. To assess the level of invasion in the landscapes surrounding the experimental sites, we established 100-meter-long transects from the center of the experiments toward the eight cardinal directions. We recorded the number of individuals of each invasive alien species in adjacent plots of 1 m x 1 m along each transect. We used the difference between the relative cover of invasive species of control and treatment plots to indicate restoration success. We applied linear mixed-effects models (LME) to investigate the impact of treatment, time and invasion level on restoration success. Treatment included three levels according to the studied restoration interventions. Time was used as continuous variable ranging from 1 to 25 years as maximum. Invasion level was calculated as the number of individuals within the 100-m buffer around each site. Site were used as random factor. We did not find a significant impact for any of the studied variables. These results contradict to our earlier findings where treatment and invasion level within 500 m both had an impact on restoration success for sand grasslands.

Keywords: invasive species, invasion level, long-term monitoring, old-field restoration, restoration success

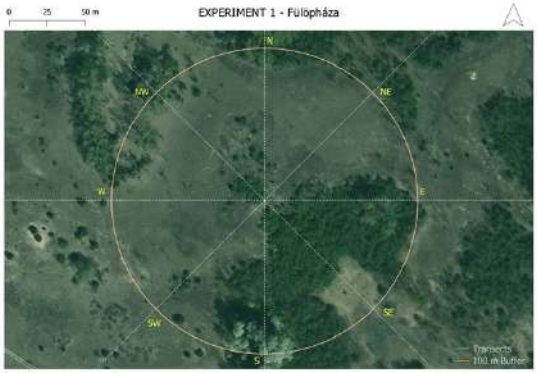

Fig. 1 Example map of the monitoring of invasive species with the mentioned transect method

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

The first-year results of natural landscaping initiative in Moscow, Russia

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ABSTRACT

Our work is covering one plot of a nature landscaping initiative in Moscow, Russia. Moscow is a big city with more than 12 million citizens. It is rapidly losing its biodiversity and nature areas due to new construction and maintenance approaches. The initiative of "Natural mini-gardens" started in 2021 with the main idea to restore biodiversity in the city using an alternative approach to landscaping. One plot 20 sq.m of bare soil in the courtyard of an apartment complex in Akademichesky district was chosen. We investigated the initial ecological circumstances of the plot including soil and snow sampling. We used local plant species from plant communities of the *Querco-Fagetea* vegetation class, which is common for Moscow region's forests. We used original soils with little preparation and planted 335 plants of 18 plant species from several Russian plant nurseries and the Moscow State University Botanical Garden. Involving citizens and communication with municipalities were additional challenges for the initiative. Some parts of mini-garden were lost during 2021 not only because of tough environmental conditions but also due to pressure of recreation and misunderstanding with municipality. In this work we present the results from the first year of the initiative, analyse the challenges that we faced and learned lessons for further implementation in other districts and cities.

Fig.1 The plot in summer 2020 and in July 2022

Keywords: urban biodiversity, local initiative, natural landscaping.

Ecological restoration in areas under desertification: experiences from the LIFE Desert Adapt project

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ABSTRACT

The EU's biodiversity strategy for 2030 clearly states the need to reverse the degradation of ecosystems, including ecological restoration and the increase of biodiversity in agricultural areas. However, the implementation and management of such measures still face technical, social and economic difficulties. The Mediterranean biome is threatened by high desertification risk boosted by negative climate change effects and many ecosystems are severely degraded. The LIFE Desert-Adapt project "Preparing desertification areas for increased climate change" aims to promote ecological restoration and reverse the degradation of natural and agricultural ecosystems at risk of desertification in Italy, Spain and Portugal by applying a Desertification Adaptation Model (DAM). This model comprehends a functional diversification of land use, including the increase of abundance and diversity of shrubs and trees as well as adaptation measures to enhance their chances to survive in harsh conditions, finally promoting both the restoration of degraded habitats coupled with multifunctional agricultural landscapes. Here we will present the main results obtained so far and the next steps, including a discussion of the challenges and opportunities from a technical, social, economical and political point of view.

Keywords: active restoration, agroecosystems, climate change, desertification, multifunctional systems

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Use of species-habitat relationships to assist for effective restoration actions

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ABSTRACT

We implemented a fish and environmental variables survey to evaluate fish diversity, occurrence and abundance and, estimate fish occupancy with habitat associations.

We collected data at three different spatial scales: site, reach and valley segment. Fish samples were collected using a backpack SUM electro fisher that was applied from downstream to upstream at 21 sampling sites. The sampling sites were distributed along the Gilort, Galbenu, Blahnița and Ciocadia Rivers. Each sampling site was 150-400 m long with different habitat types and anthropogenic features. A total of 3646 fish were captured during the low flow season of 2018 for 18 species.

We developed a site by species occurrence matrix and calculated the Shannon diversity index for each site. Relative abundance was computed to determine the dominant species with a value of more than 10% and rare fish with a value lower than 1%.

For the collection of habitat data, we multiplied the channel width by 10 to determine the length of the reach. At the reach level, habitat characteristics were assessed using geographic information systems (sinuosity, water slope, per cent of channel unit habitats classes, stream energy, dam distance, riparian conditions, river hystoric occupancy). Point and cross-section measurements of depth, velocity, water temperature, conductivity and dissolved oxygen, as well as large woody debris index and pebble count, were performed to develop site occupancy models.

The goal was to examine species' habitat needs and improve monitoring activities. Occupancy models can be used to promote the suitability of prospective restoration actions along the Gilort River.

Analyses were implemented in program R (R Core Team, 2017) and ArcGIS 10.2 (ESRI) as part of a LIFE Nature project ("Fish for Life" LIFE16NAT/RO/000778) aiming to ensure a favourable conservation status for rheophilic fish species of European Union importance and restore their habitat in Gilort River.

Keywords: river restoration, ocupancy model, evaluation and monitoring, biodiversity.

The Washington Department of Fish and Wildlife (WDFW) is conducting a project in the Chehalis River of southwest Washington to determine the effects of salmon- and steelhead- focused restoration efforts on other native freshwater fish. The goals of this study are to, 1) define a baseline from which WDFW can monitor changes in native fish occupancy following restoration actions, and 2) describe the relationship between native freshwater fish occupancy and habitat and landscape metrics. WDFW aims to develop a multi-site occupancy model to describe how the fish community is influenced by habitat or landscape metrics. This information will inform the design and location of future restoration projects.

We proposed to conduct analyses for four species of conservation interest:

Evaluating *Quercus ilex* afforestation success on former agricultural land under increasing aridity.

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ABSTRACT

In the 1990s, afforestation of former agricultural land with *Quercus ile*x was largely applied in Spain under the Common Agricultural Policy in order to recover woodlands especially where climatic conditions were limiting for holm oak natural regeneration. In this study, we investigated if holm oak afforestation success is limited by environmental factors, especially aridity, as it is the case for natural regeneration.

Around 25 years after plantation was performed, we evaluated afforestation success of 4620 holm oak trees from 154 holm oak plantations located in the eastern Spanish provinces of Teruel, Castellón and Valencia along a spatial aridity gradient (MAP/PET ratio ranges from 0.32 to 0.68). Afforestation success was determined in terms of tree survival, height and reproduction ability. Afforestation success was analyzed as a function of a set of variables related to climatic (aridity, drought magnitude), soil (fertility, texture, infiltration capacity, rock cover), topographic (slope) and planting (tree density) conditions.

Overall, afforestation success was high and no aridity threshold prevented tree survival, growth or reproduction. More than 70% of the trees planted survived 25 years after planting. Almost one third of them exceeded 2 meters and over half were able to reproduce. Afforestation success was positively influenced by soil fertility and infiltration capacity, but negatively affected by aridity, drought magnitude, slope and planting density. Random effects, such as tree nursery and plantation owner, also strongly influenced overall afforestation success.

Beyond identifying limiting factors for *Q. ilex* afforestation success, our results allow a better understanding of ecological filters that constrain *Q. ilex* natural regeneration in harsh climatic conditions.

Keywords: holm oak, regeneration, afforestation, limiting factors, common agricultural policy (CAP)

A low-cost device to measure soil water content and conductivity in field.

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ABSTRACT

Soil water availability is a critical factor for restoration success in drylands. The soil volumetric water content (θ), which is related to the soil dielectric constant (ε_a), can be measured by the time domain reflectometry (TDR) technique, an accurate and nondestructive method which also provides measures of the soil electrical conductivity (σ). However, the high cost of the TDR devices may limit their use. This study evaluates two different small-volume and low-cost FDR-TDR devices, 1.5 (VNA1.5) and 3.0 (VNA3.0) GHz Nano-VNA (Vector Network Analyzer), to measure θ. TDR and FDR are related to each other by direct inverse Fourier transformations. For this evaluation, the TDR waveforms and θ measured with the VNAs with probes immersed in air, distilled water, and a soil column with different θ were compared with measurements made with a TDR100 (Campbell Sci.) cable tester. The ability of VNAs to measure σ was evaluated by immersing a 10-cm-long three-rod probe in different NaCl-water solutions. Finally, θ measurements made in a field experiment with the VNAs were compared with those obtained with the TDR100. A very good fit was observed between the TDR waveforms recorded with the VNAs and TDR100 devices. Although VNA3.0 doubles the frequency range of VNA1.5, both allowed good estimates of ε_a ($y = 1.001x - 0.2125$; $R^2 = 0.999$). Both VNAs were capable of measuring θ with similar accuracy as the TDR100. A good relationship ($y = 0.999x + 0.0023$; $R2 = 0.999$) was observed between σ measured with a conductimeter and those obtained by the VNAs. These results demonstrate that these low-cost instruments are a good alternative for accurate measurements of θ and σ. The use of VNA instead the available TDRs for scientist use allows around a 100-fold reduction in the cost of θ measurement equipment used by practitioners and restoration ecologists.

Keywords: Soil volumetric water content, TDR, Soil conductivity, Drylands.

Application of natural processes in restoration of mining sites in the Czech Republic

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ABSTRACT

Extraction of minerals often leads to significant landscape disturbances, habitat destruction and changes in biological, hydrological, and other environmental conditions in affected areas. However, many post-mining sites have a considerable potential to become habitats suitable for endangered species of plants and animals. Ecological restoration using natural succession is a method of creating non-productive and ecologically valuable habitats. Whether natural succession will be used to restore mining areas is usually determined in reclamation plans. The factors influencing presence and ratio of successional areas specified in reclamation plans made for post-mining sites located throughout the Czech Republic were studied. Relevant documents were collected from local authorities and open sources and successional areas ratios were calculated. Furthermore, we obtained information on the effects of type of mineral, site area, method of mining, mining company, proximity to protected areas and settlements, and local nature protection status. Subsequently, statistical evaluation of influence of these factors on presence and ratio of successional areas was carried out. For most regions of the Czech Republic site area, type of extracted mineral and proximity of settlements were the most significant factors driving natural restoration approach. In smaller mines, natural succession covered the largest part of the mining area. Natural succession was widely used in quarries, where materials such as limestone and greywacke were mined. In the Moravian-Silesian Region, where coal mining industry is of great importance, subsurface mining method was a significant factor since natural succession was less applied on spoil heaps (only 5 percent of the studied heaps area). The study of factors influencing inclusion of natural succession in reclamation plans allows to better understand possible obstacles to a wider use of post-mining sites for nature conservation.

Keywords: restoration, mineral extraction, natural succession

SER EUROPE 13th SERE CONFERENCE 5th – 9th SEP 2022 ALICANTE, SPAIN

Identifying reference ecosystems for restoration of Icelandic birch woodlands

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ABSTRACT

In ecological restoration, a clear vision of the target ecosystem is critical, both for determining the most appropriate interventions and setting benchmarks for monitoring and evaluating the outcome. In Iceland's long history of reclamation and restoration projects, the emphasis has primarily been on restoration of ecosystem function and ecosystem services such as halting soil erosion rather than the characteristics of the ensuing ecosystem. Identifying a reference ecosystem in the early stages of any restoration project will help to establish clear and measurable goals and objectives. This should specify attributes of an ecosystem in good condition and of high integrity, based on information about past, present and anticipated future conditions at comparable sites.

BirkiVist is a new research project on a large-scale birch ecosystem restoration in Iceland integrating environmental, social, economic, and cultural aspects to ensure successful restoration of birch woodlands on a country scale. To identify the reference ecosystems, we adhere to the SER standards and guidelines.

Our approach comprises of existing data, new data, and expert knowledge. A workshop with 20 experts was held in the spring of 2022 with the purpose of building a database of expert opinions on the characteristics and development of reference ecosystems. This summer, data on old birch woodlands will be compiled using both existing data and data collected in BirkiVist. We will then examine these data and propose reference ecosystems for birch woodland restoration in Iceland, followed by evaluation by review teams.

This study is not only important for birch restoration in Iceland, but it also serves as a valuable resource for other restoration projects in the country. We believe that identifying and using reference ecosystems while adhering to the SER standards will improve professional work practices for future restoration of key ecosystems, resulting in more successful restoration.

Keywords: birch, ecological restoration, reference ecosystem, Iceland, SER

Effects of afforestation of Mediterranean agricultural land and forestry management on vegetation establishment

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ABSTRACT

Afforestation of abandoned agricultural lands in the 90s have partially counteracted deforestation caused by human activity in Europe. However, lack of forest management has led to homogeneous, low diversity stands that are vulnerable to environmental risks such as fire and pests. We evaluated the effect of 26-27 years-old plantations with *Pinus halepensis* Mill. and *Quercus ilex* L. (holm oak) in Central Spain on spontaneous recruitment of tree species and the response of sown holm oak acorns and their emerged seedlings to forestry management. An experiment with (1) non-afforested control plots, (2) afforested control plots without management, (3) afforested plots with systematic thinning and pruning, and (4) afforested plots with selective thinning and pruning was established. Spontaneous recruitment and emergence, survival, and growth of the emerged seedlings after one year were measured. Compared to non-afforested plots, afforestation increased the spontaneous recruitment of tree species (272 counted recruitments – 33.6 individuals ha^{-1} –, all in afforested plots: *P. halepensis, Q. ilex, Olea europaea, Prunus dulcis, Q. coccifera*, and *Rhamnus alaternus,* in decreasing order of abundance). The size of these seedlings was overall small (mean height = 10.5 cm; mean crown projected area = 94.4 cm^2), hinting that they recruited recently and/or cannot develop into adult individuals. The emergence and growth of holm oak seedlings did not vary among plots. Survival and time of persistence of the emerged seedlings was higher in afforested plots compared to non-afforested plots (59.3 vs. 0% and 218 vs. 69 days, respectively). Thinned plots showed a greater survival and time of persistence than those with no silvicultural treatments (41.9 vs. 24.2% and 262 vs. 168 days, respectively). We conclude that afforestation of Mediterranean agricultural land facilitates long-term tree establishment and short-term oak seedling survival, especially in thinned stands.

Keywords: recruitment, Quercus ilex, thinning, sowing

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