POSTERS

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II. POSTER DESCRIPTIONS

The first author is the presenting author unless indicated otherwise.

Thematic Working Group Posters (T)

T1a Social-Cultural Dynamics and Biodiversity: Developing Indicators for Cultural Ecosystem Services and Disservices in German Cultural Landscapes

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In Europe, according to IPBES, land-use change, as one of the main direct drivers of biodiversity loss, poses significant risks to human well-being and quality of life. Research also shows that cultural ecosystem services (CES) and cultural landscape design are inextricably linked, and that positive and negative ecosystem services, or ecosystem disservices (EDS), can harm society and human well-being in a cul-tural landscape. At the same time, they are difficult to quantify and it is rather chal-lenging to integrate them into comprehensive ES studies.

The DFG-funded project SoCuLa (Socio-cultural Dynamics of German Cultural Land-scapes – A Future-oriented Perspective) is part of the Biodiversity-Exploratories research programme and aims to better understand the social-ecological system in three German study regions. One research objective is to identify and develop indi-cators for CES and CEDS. This will contribute to the research on ES multifunctionali-ty in the Biodiversity Exploratories. These findings, combined with societal trend analyses, can be used to envision future cultural landscape scenarios, e.g. the im-pact of globalisation on the demand for CES 'regional identity'. Ultimately, this will allow us to make robust statements about the role of indirect societal drivers in a transformative world.

In my poster I will present the results of our literature review and exploration of robust CE(D)S indicators, as well as the expected methodologies.

The innovative approach of the SoCuLa project aims to bridge the gap between social and ecological research, ultimately contributing to more effective biodiversity conservation strategies and sustainable land use practices in the future.

Keywords: Cultural Landscape, Indirect Societal Drivers, Cultural Ecological Services and Dis-services, Sustainable Land Use, Social-Ecological Research

T1d-1 Putting the One Health concept into practice through a transdisciplinary research project

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Health can no longer be viewed solely through the prism of the human being, but must be considered holistically, linking humans, animals, plants and the environment in recognition of the interdependence of their health states. This "rethinking" has led to the concept of "One Health" or "Eco Health". This paradigm shift is relatively easy to understand. However, its implementation and acceptance is in many ways still at an early stage. We will present the Territory Health project, which aims to operationalise the concept of One Health at the scale of an agricultural landscape by analysing and formalising the links and interdependencies between these three facets of health: the environment, non-humans and humans. Specifically, the project involves researchers, local residents, local decision-makers and NGOs in an inclusive, participatory and experimental project by explicitly analysing the relationships between pesticide use, in situ exposure to a pesticide cocktail and the impact on the health of non-target organisms (human and non-human). The project aims to put the One Health concept into practice by establishing a "partner cohort" in an agricultural landscape that is itself a long-term socio-ecological research infrastructure (the Zone Atelier Plaine & Val de Sèvre in Western France). The project also aimed at exploring the Nature-Based Solutions capable of reducing exposure to and/or the effects of pesticides as well as the role of garden birds as sentinels of

the state of the ecosystem health for people in the villages. We will present the first years of this transdisciplinary research, focusing on the interventions that could increase the co-production of knowledge and the ownership of One Health by all local residents through their involvement in the project.

Keywords: Biosiversity, Organic farming, Pesticide cocktail, Socio-Ecosystem, Research Action

T3-1 Natural and Anthropogenic factors driving ecosystem services supply and distribution in Mediterranean agroecosystems

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Most ecosystem services (ES) are co-produced by combining natural and anthropogenic capital, the latter including human (knowledge and skills), social (associations and institutions), manufactured (tools and infrastructures)

and financial capital (investments and credits). Understanding the relative importance of natural and anthropogenic capitals in the supply of ES is one of the most important challenges in ES research. This is especially critical for the sustainable management of Mediterranean agroecosystems, which are facing cumulative risks due to climate change and increasing land use intensity. The project NADESUD will investigate how increasing land management intensification and the substitution of natural by anthropogenic capital affect (i) the sustainable supply of multiple ES, (ii) the equitable distribution of ES in terms of use and demand; and (iii) how this changes across different stakeholders and multiple spatial scales (from plot to region).

The study area of NADESUD is distributed across four low mountain regions: two in the pre-Pyrenees (Huesca and Navarra), and two in the Iberian range (Guadalajara and Zaragoza). In each case study, we collect biodiversity and ES data across two land use intensity gradients, a forest one (ranging from protected areas to intensive forestry activities) and an agricultural one (from organic rainfed agriculture to intensive irrigated cereal crops agriculture). In addition, we conduct social surveys with land owners, land managers and visitors in each of the sites.

We will show preliminary results regarding the co-production of the ES “recreation” obtained from social surveys to forest visitors in each study site. We expect to find this cultural service mostly coproduced by physical and social capitals instead of by financial and physical capitals, but differences may arise depending of the level of land use intensity.

Keywords: land use intensity, coproduction, visitors, forests, anthropogenic capital

T3-2 Land Equivalent Ratio as a productivity indicator for diversified agricultural systems

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Land use, and agricultural land use in particular, is one of the biggest drivers of biodiversity loss and ecosystems degradation. While agricultural land is needed to produce food, feed and fibre, its biodiversity impacts must decrease to reduce biodiversity loss trends. The Global Biodiversity Framework includes in its target 10 the aim to sustainably manage agricultural areas through the use of biodiversity and biodiversity-friendly practices, contributing to the productivity of agricultural systems for food security.

Biodiversity-friendly practices such as growing different crops in the same field, agroforestry or the integration of crops and livestock have in common the fact that different products are obtained from the same field. This helps to increase the biodiversity in agricultural land as well as the farmer’s income resilience. However, diversified systems in agriculture are often seen as less productive than simplified systems, leading to the idea that by diversifying we increase the demand for agricultural land. When comparing diversified and simplified systems though, often only the productivity of the main crop is considered, overlooking the diversity of products obtained in diversified systems.

Land Equivalent Ratio (LER) is a land use efficiency indicator developed to measure the productivity of intercropping systems. However, this indicator has the potential to be used in a variety of agricultural systems including different forms of agroforestry and integrated-livestock systems in which byproducts of agricultural systems are used to feed the livestock. LER measures the relative land needed in simplified systems to produce the same output as diversified systems. In that sense, it is helpful to evaluate the land demand of simplified versus

diversified systems. Consequently, LER is a very useful tool to asses the contribution of biodiversity-friendly practices to productivity by reducing agricultural land demand.

Keywords: Land use efficiency, diversified agriculture, multifunctional agriculture, mixed crop-livestock systems, agroforestry

T5-3 ASSESSMENT OF GREEN-BLUE INFRASTRUCTURE AT THE MUNICIPAL LEVEL IN THE BASQUE COUNTRY

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In recent years, a new land management model has emerged, called Blue-Green Infrastructure (BGI), to be implemented at different scales. In the Basque Country (Spain), it has been identified in the Territorial Planning Guidelines and is based on the Natura 2000 Network. However, it is necessary to develop it at other scales, being the municipality the backbone of its development. Thus, the objective of this study has been to evaluate the Blue-Green Infrastructure at three levels (urban tree, urban/peri-urban and non-urban) using indicators at the municipal scale. These indicators have been selected taking into account the information available for the Basque Country. As an example of application, the data obtained in the evaluation carried out for the municipalities of Bilbao and Vitoria-Gasteiz are shown. In the case of urban trees, this infrastructure has been evaluated using three criteria (quantity, quality and multifunctionality) based on data on the number of trees per 100 inhabitants, the type of species and the provision of ecosystem services and disservices they provide. In the case of other infrastructures, they have been evaluated using five criteria (quantity, quality, accessibility, connectivity and multifunctionality) based on the following data: the surfaces they occupy and the size of the elements, the surface area occupied by multifunctional areas within them, the distance of these elements from urban areas, the resistance they possess for the movement of key fauna species, as well as, the number of elements, and the provision of ecosystem services they provide for society. The results indicated that it is necessary to implement different Nature-Based Solutions to improve and increase the Blue-Green Infrastructure in both municipalities, especially in Bilbao, where the Blue-Green Infrastructure is scarcer and in worse conditions than in Vitoria-Gasteiz.

Keywords: accessibility, connectivity, ecosystem services, indicators, urban/peri-urban

T7-2 Monetary valuation of ecosystem services helps justify and facilitate transformative change towards sustainable nature management: examples from LIFE habitat restoration projects in Lithuania

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Presentation is based on the results and activities of the three LIFE projects (LIFE TERNS, LIFE LWFG CLIMATE, LIFE21-NAT-LT-LIFEfarms for birds), dedicated to establishment, restoration and management of breeding or staging/wintering grounds of the bird species of EU importance, implemented in Lithuania and partner countries.

The assessment of the impact of implemented or ongoing resourceful and innovative management practices on the selected ecosystem services reflects the projects as the commendable examples of win-win results, with business, local farmers or international community's interests on one side and the well-being of habitats and biodiversity on the other. The case studies demonstrate that even a rough monetary valuation of expected changes in the assets or quality of selected set of the ecosystem services could help to justify and facilitate a transformative change towards sustainable nature management or natural resource use.

Keywords: ecosystem services, monetary valuation, habitat restoration, transformative change, LIFE.

T8a-2 KlimaOasen – A participatory process to develop nature-based solutions at the University of Stuttgart

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As institutions that promote learning and innovation with a responsibility towards society, universities can play an important role in advancing nature-based solutions (NBS), leading by example. In this context, university campuses become important locations to implement NBS, but to succeed in that task one needs to understand and navigate the complex governance structures of a university. Nevertheless, guidelines and scientific literature pertaining to NBS development for university campuses are still limited. In this contribution, we present insights from the project KlimaOasen (Climate Oases), funded by Stuttgart's Klima-Innovationsfonds and The Nature Conservancy Europe and carried out jointly by the Institute of Landscape Planning and Ecology and the Green Office of the University of Stuttgart, Germany. The project's ultimate goal was to promote NBS on campus, focusing on the evaluation of organizational structures and potential implementation enablers or barriers, and to connect this with the current discourse on campus climate adaptation. To achieve that, we designed and conducted a participatory process bringing different actors together, who (would like to) play a role in initiating, implementing, and maintaining NBS at the University of Stuttgart. The process took place mainly through a series of three participatory workshops, involving thirty participants in total. Each workshop had specific objectives, including (i) getting to know different initiatives and actors, (ii) gathering initial ideas for NBS development, discussing and assessing exemplary potential NBS, as well as (iii) identifying critical aspects and actors for the planning, implementation and stewardship of NBS. We pursued synergies with teaching activities, whereby students developed concrete NBS proposals for different sites on campus, which were the basis for in-depth discussion with workshop attendees. The project sparked and facilitated the development of a NBS-roundtable at the University of Stuttgart. Based on the results of the workshops, we synthesized concise recommendations for NBS development on campus.

Keywords: Nature-Based Solutions, Sustainable Campus, Green Campus, Participation, Climate Adaptation

T8a-3 Plural values of soil-mediated nature's contributions to people in sustainable soil management

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Sustainable soil management offers the potential to reverse trends of the adverse impacts of conventional soil management on ecosystems and human wellbeing. Conventional soil management has provided high output in terms of food and feed production, but this has come at the cost of several of soil-mediated contributions to people (SmCPs) such as climate regulation, soil formation and protection, physical and psychological experiences as well as learning and inspiration. Disciplinary approaches to understand such impacts have often been focused solely on, for example, economic considerations and fail to consider the plurality of values at risk of continued unsustainable management of soils.

To better understand the impacts of transitioning to sustainable soil management on human wellbeing, we investigated both the economic and socio-cultural values that societies hold for changes in the provision of SmCPs. A household survey was conducted in Denmark, Ireland and Spain to elicit these values using a socio-cultural ranking of SmCPs, a landscape preferences tool, a discrete choice experiment and further items regarding different worldviews, life frames, quality of life and pro-environmental behaviour.

The socio-cultural valuation of SmCPs indicated nuanced differences between the different countries, and the discrete choice experiment highlighted similarities between the regions in terms of the willingness to pay for soil erosion reduction, increases in woody vegetation and landscape heterogeneity between the three countries. Furthermore, the landscape preferences tool demonstrated subtle differences between the countries in terms of preferences for biodiversity elements, renewable energy, agroforestry and agriculture. These results reflected similarities between the countries also in found in the responses concerning worldviews, life frames, quality of life indicators and pro-environmental behaviour.

Keywords: Sustainable Soil Management - Socio-Economic Valuation - Nature's Contributions to People (NCPs)

T8a-4 ESS-certificates save the world – at least orchard meadow

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Traditional cultural landscapes play an important role in the provision of ecosystem services. However, they often lack an economic basis due to the considerable amount of time and effort required for maintenance and preservation. This is demonstrated by the example of orchards meadows - a characteristic cultural landscape in Europe. Orchards and the associated ecosystem services can only be maintained if they are managed and cultivated.

The Hochstamm Deutschland association is developing a certificate system in the "Orchard meadow 2030" project. The objective is to ensure the safeguarding of ecosystem services and orchard meadows. Managers of orchards who comply with cultivation requirements and provide evidence of this through a control and certification process enable Hochstamm Deutschland to sell "orchard certificates" as a voluntary agricultural nature conservation measure. This allows ecosystem services to be commodified and external effects to be internalized which cannot be generated through product sales. By developing these certificates, additional income can be generated for the preservation of orchards, as new target groups are addressed. Customers are, for example, companies which want to voluntarily compensate for their resource use. The certificates are compatible with the EU's mandatory reporting system and are provided with a suitable communication package.

T8b-2 Provisioning and Cultural Ecosystem Services based on wild plants in the Pieniny Mountains

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In the past, wild plants were fundamental in human diets and provided essential provisioning and cultural ecosystem services. However, with the rise of industrialized food systems, their use declined. Recently, collecting wild plants has regained popularity, particularly among well-educated individuals who value local food origins and a balanced lifestyle. Wild plants are now commonly used in regional dishes, highlighting their cultural significance.

Data on the utilization of wild plants was collected as part of a broader survey involving residents and tourists in the Pieniny Mountains. Among the interviewed residents, 89% reported collecting wild plants. The highest percentage of use was for natural medicine (69%), followed by direct consumption (66%) and food preparation (53%). The widest range of plants (20 were named) was used for natural medicine, including herbs for infusions (St. John's wort, nettle, and mint), fruits for liquors (blackthorn and hawthorn), and dandelion flowers for syrup. Respondents named nine wild plants for direct consumption and eleven for food preparation. The most popular wild plants for direct consumption included wild fruits (e.g., wild strawberry, blueberry, raspberry, and blackberry), followed by sorrel. For food preparation, fruits (especially blueberry) and sorrel were most important. Informants indicated that "taste" was a primary motivator for direct consumption, a finding supported by other studies on cultural ecosystem services. Additionally, the use of wild plants for natural medicine relates to health, also highlighting non-material benefits.

Promoting locally made products from wild plants can contribute to the sustainable livelihoods of residents and attract ecotourists seeking authentic experiences. To realize this potential, a strategic marketing campaign focused on existing local products is necessary.

Keywords: health benefits, collecting wild plants, food, natural medicine, sustainable livelihood

T9a-1 Co-production of knowledge beyond One Health in a local case study: the socio-ecological system of the Bay of Plentzia

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Over the last century, health approaches like One Health have recognized that human, animal, and ecosystem health are closely interconnected within a socio-ecological system (SES). The Bay of Plentzia, located at the mouth of the Butroe River on the northern coast of the Iberian Peninsula, represents a location where the natural environment and ecosystems strongly interact with human activities. The objective of this research is thus to understand how health is configured in this local SES from the comprehensive definition provided in 2022 by the One Health High-Level Expert Panel.

Methodologies of knowledge co-production, like Fuzzy Cognitive Maps (FCM), allow the emergence of different types of knowledge based on the expertise and perceptions of local agents. We contacted experts living or working in the Bay of Plentzia and surroundings, with backgrounds in human-, animal-, and ecosystem health. We conducted 17 interviews where individual FCM were elaborated, collecting participant's knowledge about the health status of the Bay of Plentzia.

After homogenisation, we aggregated this knowledge into a co-created network of 367 components and 907 connections. In this network, the determinants that shape the health of SES are determined by how strongly the components are interconnected among each other. Overall, a very high interconnectedness between components that represent human, animal and ecosystem health is revealed.

Deciphering this interwoven network of connections shows that most influential components are "water quality", "education to promote health literacy" and "biodiversity". Preliminary results indicate the importance of both general terrestrial, freshwater and marine biodiversity in the SES. Microbiological biodiversity is also revealed as a central component, especially influencing human health.

Although the network is strongly determined by the participants' personal perceptions, FCM is seen as a useful methodology for collecting knowledge from multiple and diverse stakeholders.

It also provides a visual representation of an integrated understanding that helps to reveal its complexity.

Keywords: Fuzzy cognitive maps, One Health, Socio-ecological System, local knowledge, Bay of Biscay

T9a-2 Indicators for assessing the medicinal and aromatic potential of plant taxa: the endemic flora of Peloponnese, Greece

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Despite the growing interest in new natural products and compounds, many plant taxa with restricted distribution are often disregarded as potential resources. In order to expand the scope of research for sustainable development globally and improve relevant conservation efforts, it is essential to create tools for assessing the potential of such taxa as ecosystem services providers. Within the frame of the LIFE IP 4 NATURA Project, this research developed a set of indicators to pinpoint taxa that show promise for future pharmaceutical or culinary applications among underexplored plant species. These indicators rely on existing literature concerning plant taxa with restricted distribution and their closely related species, whether in terms of taxonomy, phylogeny, distribution, or documented use in traditional herbal medicine. The study focuses on the endemic flora of Peloponnese, a region in Greece known for its rich diversity of total species and endemic species, particularly those valued for their medicinal and aromatic properties. Despite only a small portion (12.5%) of the endemic taxa being previously associated with medicinal and aromatic uses, the indices reveal that a significant proportion of the flora possesses potential in this regard, while most of the taxa could be classified based on their suitability for further investigation. The findings recommend particular attention towards specific taxa with substantial medicinal and aromatic potential, as well as for taxa that warrant prioritization in future research. This study is the inaugural effort, to the best of our knowledge, in establishing a systematic, literature-based approach for assessing potentially noteworthy medicinal and/or aromatic plant taxa.

Keywords: aromatic plants, conservation, Greece, MAP, medicinal plants

T9a-3 Subjective greenspace exposure does not directly influence self-reported health & wellbeing

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Urban living conditions pose a threat to human health and wellbeing, confronting people of all ages with harmful influences like air pollution or noise. Understanding the link between subjectively perceived greenspace quality and health is critical for public health interventions. This study analyzes the influence of greenspace on four human wellbeing outcomes. Data was obtained from the longitudinal LIFE Adult study from Leipzig, Germany (N=4178 after exclusions). We analyzed self-reported psychological (depression, anxiety) and physical (diabetes, asthma) health via longitudinal cumulative link mixed models in R. We set up separate models per outcome to test for effects of greenspace quality and hours spent in greenspace. All variables were normalized to provide comparability between models. Age, sex and socioeconomic status were included as factors of no interest. Our model detected a TIME effect on anxiety scores (Estimate: 0.22, SE = 0.04, $p < .0001$), indicating that severity rose between baseline and follow-up. Depression scores were diminished between baseline and follow-up (Estimate: -0.11, SE = .04, $p < .01$). The model showed effects of INTERCEPT (Estimate: 0.14, SE = .03, $p < .0001$) and TIME (Estimate: -2.28, SE = .04, $p < .0001$) on asthma scores indicating significant morbidity at baseline that decreased with time. Diabetes rates did not converge sufficiently well with our CLMM — this might be due to missing precision of self-report measures. The negative slope of asthma needs to be re-evaluated including environmental data like air quality or noise, as the follow-up partially coincided with reduced traffic during partial lockdowns in 2020. The negative slope of depression scores might be attributed to the relatively high age of our sample (BL: 57.59; FU: 63.57). In summary, our models did not show influences of self-reported greenspace exposure on psychological and physical health and warrant further investigation using structured health assessments.

Keywords: Greenspace exposure, Greenspace quality, Mental Health, Chronic Disease, self-report

T9a-4 How to Assess the Impact of Forest Degradation on Biodiversity Loss at the Landscape Scale? – A Review on Landscape Metrics

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The Horizon Europe project ZOE (www.zoe-project.eu) assesses the linkages between landcover and land use changes, biodiversity loss and associated impacts on zoonotic disease emergence. As part of the project, biodiversity in forest ecosystems will be assessed at different levels including the landscape level. Landscape metrics have been used previously to analyse ecosystem diversity and landscape structures and to provide valuable information on ecosystem conditions. The present research will show results from a system review on landscape metrics used to assess landscape diversity and biodiversity loss at different forest degradation levels. The review will present the applications of landscape metrics in forest and land-use change research in the context of biodiversity assessments and highlight potential spatial differences in use. It will identify the most suitable metrics to be used as indicators for species diversity as well as for the direct loss of habitats and ecosystems. The systematic review is an important step in creating a foundation that can provide insights into ecosystem and landscape diversity and thus contribute to improving our understanding of the biodiversity-disease relationship.

Keywords: Biodiversity conservation, zoonotic diseases, forest ecosystem fragmentation and degradation, landscape metrics, systematic review

T9b-1 Social-ecological resilience through the lens of community health - access to nature in Plovdiv city and its recreational functional urban area

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Theoretical background: Social-ecological resilience and long-term sustainability of cities are strongly related to balanced land use, easy access to favourable environments, availability of well appreciated natural resources and values actively visited by health conscious citizens that in return appropriately safeguard them.

Case study context: One of the oldest cities in the world and the oldest continuously inhabited city in Europe - Plovdiv with its variety of urban green and blue infrastructure and challenging parallel compacting in the core city and sprawl in the metropolitan area is in the focus of this report.

Applied methods: The study approach includes mapping of multimodal mobility isochrones of accessibility to urban, peri-urban, and rural natural and semi-natural landscapes from the demand side in the framework of assumed weekend travel time threshold defining a recreational functional urban area (RFUA). From the supply side, a multicriteria evaluation of possible health benefits from cultural ecosystem services is based on mapping and assessment of the attractiveness of key natural features as part of landscape typology accessible in the city of Plovdiv and its RFUA.

Outlined results: Red lines between the demand and supply sides of cultural ecosystem services are drawn as critical access or pressure spots.

Discussion and implications: The estimated hypothetical patterns are juxtaposed with available indicators like density of manmade tourism and recreation infrastructure, rate of bed-nights usage and other secondary sources of information for presence of natural tourism offers and self-organized recreational visits in nature. Furthermore, recommendations are provided towards more space for nature-based therapies, more sparing contact with nature and more health beneficial regional and city environment for the citizens of Plovdiv.

Keywords: health benefits, cultural ecosystem services, recreational functional urban area, Plovdi

T13b-1 Ecosystem services provided by peatlands in hemiboreal landscape

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Peatlands are important component of hemiboreal landscape due to their ecological functions and benefits. In Latvia, ~400 kha are covered with forests with drained organic soils and ~ 340 kha are covered with forests with naturally wet organic soils (~12% and ~10% of the total forest area, respectively). Considerable area of organic soils is used for agricultural production (92 kha managed as cropland, 76 kha managed as grassland). Approximately 50 kha are affected by peat extraction – ~30% active peat extraction areas, ~34% areas with implemented or ongoing recultivation measures, mostly natural afforestation, and ~36% abandoned cutaway peatlands where recultivation should be carried out. Scientifically sound information about the wide range of ecosystem services (ESs) provided by peatlands is needed to facilitate the ongoing intense discussions about the management of organic soils.

In Latvia, ESs assessment has been performed for peat extraction sites (five specific study sites including recultivated ones) and peatland forests (within the scope of nation-wide forest ES assessment). For both assessments, CICES classification (V5.1) and Matrix model was used to identify the ESs of interest and to assign them relative values. For peat extraction sites 30 indicators (11 indicators of provisioning services, 16 indicators of regulating services and three indicators of cultural services) were mapped, while for forests – 13 indicators (six indicators of provisioning services, five indicators of regulating services and two indicators of cultural services). The results obtained so far indicate the usefulness of the approach for a comprehensive and comparative evaluation of the ESs across different types of peatlands including evaluation of different management approaches and land use change. Current activities include wetland ESs evaluation across different climatic zones in Europe within the frames of ALFAwetlands – Wetland restoration for the future.

Acknowledgement: This study was funded by Horizon Europe project ALFAwetlands (Grant Agreement Number 101056844).

Keywords: peatland forestry, hemiboreal zone, drained organic soil, naturally wet organic soil

T13b-2 Exploring Transformative Climate Change Adaptation through Nature-Based Solutions Potential Disaster Risk Reduction in Coastal Areas

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Nature-Based Solutions (NBSs) are increasingly embedded in policies for climate change adaptation (CCA) and disaster risk reduction (DRR). The European Green deal promotes the integration of NBS by providing a new narrative involving biodiversity, Ecosystem Services (ES), and their potential for transformative pathways. The selection of suitable NBS should be based on their ability to reduce the magnitude, duration, or frequency of climate hazards considering their effectiveness under present and future conditions. However, empirical evidence on NBS performance is lacking – especially for coastal and transitional environments where there is limited site-specific evidence, and there are no internationally recognized NBS standards. REST-COAST aims to address these issues by demonstrating that upscaled coastal restoration can provide a solution to CCA and DRR. This work (funded under the Horizon2020 grant agreement No. 101037097) supports reaching this objective by conducting a systematic review to expand the evidence-base for NBS implementation through identifying performance indicators. Noting that NBS performance is most frequently evaluated based on environmental and physical indicators, e.g., vegetation cover, carbon sequestration, morphological changes, sediment, and nutrient dynamics. The challenges related to the design and development of risk scenarios that explicitly include NBS simulations as transformative pathways can be addressed by incorporating the NBS performance indicators and using new data technologies. To do so, a conceptual risk framework for the Venice lagoon is being developed that will integrate the NBS performance indicators with climate and NBS intervention scenarios to evaluate risk reduction through ES provisioning. This framework will provide the basis for the development and implementation of a Bayesian Network for risk modelling, as well as the co-creation of adaptation pathways for the Venice Lagoon. Through exploring these research inquiries, this work aims to support the establishment of better guidelines for coastal and transitional adaptation management.

Keywords: Nature-Based Solutions, Ecosystem Services, Climate Change Adaptation, Effectiveness

T13b-3 Ecosystem Services in urban regeneration projects by NBS key

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The objective of this project is to assess and quantify the ecosystem services (ES) provided by urban regeneration interventions through the application of Nature-Based Solutions (NBS) framework. This research will contribute to important issues such as sustainability, economic support, biodiversity protection and informed policy-making. The project started with an extensive review of contemporary literature to identify the optimal indicators for ES quantification in urban area like squares. However, the literature review revealed a very heterogeneous perspective on both the type and methodology of these indicators, thus making a selection based merely on literature unworkable.

Subsequently, we adopted a structured procedure designed for the monitoring of NBS. This procedure permit to visually representing the project context and the related Theory of change. This methodology maps and traces the observed and presumed causal relationships supposed to influence one or more project objectives, providing a solid basis for accurate planning, management, and monitoring of NBS effectiveness. By documenting the direct threats affecting the objectives and the factors that influence those direct threats, practitioners can identify key intervention points and how to quantify their variations over time.

The project is currently applying this methodology to the analysis of the NBS projects of Piazza della Scienza and the renovation of Piazzale Loreto (Milan) where to monitor some target such as: the concentration of CO2 and PM10, the abundance of invasive species, the thermal comfort, the percentage of impermeable surfaces and the economic budget required for maintenance. To enhance comparability with other case studies and achieve the uptake of current knowledge, the indicators will be based on the EU evaluation framework.

Eventually we aim to conduct a multiscale and transdisciplinary qualitative-quantitative analysis, enabling a comprehensive evaluation of ecosystem services in their entirety-encompassing ecological, social, and economic dimensions—within diverse territorial and cultural contexts.

Keywords: Ecosystem Services Evaluation, NBS, Urban Squares, Urban Regeneration

T13b-4 Designing Systems of Systems: Connecting Resources and Mapping Assets for Ecological Citizen(s)

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The transition to sustainable modes requires navigating existing services and resources. In this paper we specifically argue for the role of design to rethink 'system within systems' but that this requires a fundamental understanding of ecosystem services. Our approach builds on The Green Skills gap, defined as 'the knowledge, abilities, values and attitudes needed to live, develop and support a society which reduces the impact of human activity on the environment'. We reframe this 'gap' through the concept of 'Ecological Citizenship'; by connecting opportunities with communities, enabling localised propositions, empowering citizens to benefit their contextual circumstances.

Design (as a practice/tool) is becoming more democratised, accessible and systemic. Specifically, the designer's role of 'connector and convener' is one of four drivers, in The Design Council's Beyond Net Zero to help the gap in understanding between theory and implementation, in addition to the skills gap.

In this paper we present an analysis of award winning UK and Nepali examples which sensitively comprehend what mapped resources and environments can be nurtured/protected. It looks for Systems of Systems: Connecting Resources and Assets for Ecological Citizen(s) through non-formal communities, charitable organisations, and sustainable businesses which embody the Quintuple Bottom Line, (Profit, People, Planet, Purpose and Place). It positions collaborative insights, and navigates 'system to system' crossovers, green assets with sensitive non-extractive design insights. We believe that identifying and aligning reciprocal systems can be regenerative, mutually beneficial. This contemporary 'design-led review' unpacks 'strategic overlaps' of these examples which embed a fundamental understanding of ecosystem services.

The objective of our analysis is to identify and ascertain pertinent metrics (within civic and business) which sensitively comprehend what mapped resources and environments can be nurtured and protected. We thus propose that design is a key tool to leverage transformative change that can support and sustain ecosystem services.

Keywords: #systems #design #ecologicalcitizens #greenskills #transitiondesign

Biome Working Group Posters (B)

B1-2 Are the Greek beaches accessible to all? Monetary valuation and mapping of recreational ecosystem services for wheelchair users

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Individuals with ambulatory difficulties are frequently excluded or prevented from participating in various aspects of life, including recreation activities in coastal areas. The most common obstacles encountered by individuals with ambulatory difficulties are the lack of infrastructure and its inadequate maintenance. This research examines the needs and habits of wheelchair users to assess and map the ecosystem service of beach recreation for this stakeholder group. Specifically, the value of Greek beach recreation for wheelchair users is estimated at €236.8 million/yr. However, a value of € 57 million/yr is lost due to the inability of these individuals to access the beach. The mapping of this value according to a hierarchical model revealed a significant increase in the value per beach as more access infrastructure became available. Currently, there are 322 access ramps in Greece for a shoreline of approximately 13,000 km, but only 11% of these offer all necessary accessibility infrastructures (e.g., disabled parking). A comparative analysis of the costs of installing the requisite infrastructure for beach accessibility and the benefits yielded a conclusion that the value forgone might be sufficient to cover the installation of approximately 234 ramps and peripheral infrastructure. Given the substantial social and economic advantages, there is a compelling rationale for immediate action to enhance accessibility, guarantee equitable access to coastal ecosystems, and facilitate inclusive tourism growth.

Keywords: accessibility, Greece, disability, ecosystem service, beach

B8 An Ecosystem Services Assessment towards the adoption of a Climate Change Adaptation Plan in the Province of Trento (Italy)

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The ongoing climate change requires the implementation of urgent adaptation measures in alpine areas in order to mitigate the detrimental effects on natural capital and associated Ecosystem Services (ES). Alpine regions, like Trento province in North Italy, are facing significant challenges, including shifts in temperature, altered precipitation patterns and increased frequency of extreme weather events. The objective of this study is to evaluate the most relevant ES in order to support the Climate Change Adaptation Plan (CCAP) for the Trento province, using the river Noce basin as a pilot area. The research began by identifying the most relevant ES provided in the area, including water provision, livestock, carbon sequestration, biodiversity support and cultural services. Effective indicators for each ES were then selected based on available data and suitable methodologies, ensuring that the assessment was comprehensive and context-specific.

The results highlight a heterogeneous distribution of ES within the basin, driven by varying environmental characteristics and landscape patterns. This spatial variability underscores the necessity for adaptive management practices that can address local needs and conditions. The study emphasizes the necessity of incorporating ES assessment in adaptation planning to ensure that alpine areas can effectively navigate the challenges posed by climate change while safeguarding their natural and socio-economic assets. The integration of ES assessment into CCAPs is of paramount importance for the sustainable management of alpine regions, as it provides a framework for the recognition and valuation of the multifaceted benefits that ecosystems offer.

Keywords: Climate change, Adaptation measures, Alpine areas, Natural capital

B10a Integrated assessment of health and wellbeing benefits for the 3-30-300 urban greening rule for multiple ecosystem service outcomes.

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Cities face multiple pressures which impact health and wellbeing. Urban green and blue space (or green infrastructure) and the nature-based solutions (NBS) which build on them offer a multi-functional approach to helping alleviate these challenges. However, existing quantification approaches tend to use simplistic look-up or value-transfer approaches, or use more complex models to assess single functions. They also tend to focus on the biophysical quantification of ecosystem services provided, and rarely move to the next stages of assessing health and wellbeing benefits. Here we present an integrated analysis of the ecosystem service benefits for three key challenges where we can model the health and wellbeing benefits of NBS to reduce: air pollution, hot-day temperatures and noise levels, in terms of health outcomes and the economic value of those benefits. In the same analysis we also present outcomes for additional services of surface water flow mitigation and greenspace access, where wellbeing outcomes are harder to quantify. We test these approaches in three European cities (Paris-France, Aarhus-Denmark, and Velika Gorica-Croatia), and evaluate ex ante the performance of likely changes in green space that would need to be implemented to meet the 3-30-300 guidelines on urban greening. 3-30-300 is a new rule that is rapidly gaining attention from city authorities, NGOs and policy makers in the context of target setting for urban greening. We show that the outcomes can be quite different in each city, depending on local context.

Keywords: health, economic assessment, cooling, air pollution, noise, urban greening, 3-30-

B10b-1 A systematic integration and monitoring of ecosystem services generation on buildings

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Regenerative design is being increasingly explored in urban environments to counteract and adapt to the changing climate and the degradation of ecosystems. A critical success factor for the implementation of regenerative design is the systematic evaluation of urban and building systems in relation to ecological performance and benefits. The presented work streamlines how ecosystem services (ESs) can be successfully integrated and monitored in buildings.

In biological ecosystems, the availability of high-quality energy, called exergy, and structural order can be used as indicators of the efficiency of on-going ecological processes. Therefore, structural order and ESs generation are proposed as quantifiable indicators for exergy efficiency and accumulation in building systems to evaluate the extent of ecological functionality and regeneration. Based on this insight, this research presents nine design strategies that are derived from ecosystems and describe how buildings could become habitats that host living, non-living, and hybrid systems through nature-based, hybrid, or mechanical design solutions with optimized thermodynamic efficiency that can generate ESs. To facilitate building professionals to practically integrate and assess regenerative design strategies in buildings, this work also presents how the ESs framework can be linked to buildings through building metabolism flows and building systems.

Furthermore, to create a better global understanding of the benefits of regenerative design strategies, existing data on ESs measurements on buildings need to be collected. Scientific information has to be streamlined into practical guidelines for regenerative decision-making by systematically organizing data. Interactive digital tools can become useful scientific data-driven consultants for ESs generating building design that pinpoint knowledge gaps related to their ecological performance in specific climates and therefore also serve scientists as a platform and stepping stone to define urgent practice-oriented research on empirical data collection. At the same time, such tools can accelerate regenerative policy-making by proposing potential key performance indicators for ESs generating building design.

Keywords: buildings, ecological functionality, exergy, building metabolism, interactive digital tool

B10b-2 NBS4Water - Nature-based solutions for urban water security: A case study in Asmara, Eritrea.

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Like many cities worldwide, the city of Asmara, Eritrea, faces severe water security challenges that technical solutions alone cannot address. Nature-based Solutions (NBS) have been identified as a promising and multifunctional approach to address multiple societal challenges, including urban water security. NBS4Water is an interdisciplinary research and innovation project, aiming to develop and apply a strategic planning approach for harnessing nature-based solutions (NBS) for water security in the Asmara metropolitan region. It comprises three objectives: i) to assess water security challenges and opportunities, ii) to co-develop spatial scenarios of NBS for water security, and iii) to evaluate potential impacts of NBS scenarios regarding the alleviation of water challenges and generation of co-benefits.

NBS4Water's work plan systematically combines quantitative and qualitative methods and interdisciplinary expertise from spatial modelling, remote sensing, and environmental planning. It consists of four, logically linked work packages. Firstly, water security challenges and NBS opportunities in Asmara will be assessed through geospatial analyses and landscape metrics. Hence, plausible storylines with NBS will be co-developed with stakeholders and translated into spatial scenarios through simulations. Thirdly, scenario impacts on ecosystem services will be evaluated, including trade-off analysis, to inform the refinement and decision-making of NBS strategies in Asmara. Importantly, novel approaches such as online map surveys will be tested to engage the youth. NBS4Water promises the co-production of credible and salient knowledge to support NBS planning in Asmara, contributing to raising awareness, and transferability to other cities.

Keywords: urban resilience, ecosystem services, transformative change, sustainability transition, knowledge co-production

B10c-1 Assessing the effectiveness of nature-based solutions in cities

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Urban areas worldwide face numerous societal challenges, and nature-based solutions (NbS) have been suggested to provide integrated and multifunctional solutions to enhance resilience and sustainability in cities. Despite growing practical interest, the widespread adoption of NbS in cities is hindered by a lack of understanding of what constitutes successful and effective NbS. There is a critical need for building an evidence base on NbS effectiveness, to translate scientific evidence into practical management strategies and policy instruments. To address this, we integrated evidence from scientific literature and input from expert workshops to gain a better understanding of the effectiveness of urban NbS. We first synthesized 547 urban NbS cases worldwide and systematically assessed NbS effectiveness. This was based on studying urban challenges, NbS interventions, and their outcomes related to biodiversity and human well-being. We then investigated how NbS contribute to urban biodiversity, analyzing diverse dimensions of biodiversity measurements and outcomes across a wide range of NbS in urban contexts. Finally, we performed elicitation workshops to set a pathway toward a comprehensive evaluation of NbS effectiveness that integrates multiple indicators for and dimensions of biodiversity and well-being. Our research contributes conceptually to the discussion on how to assess urban NbS effectiveness. It also provides an evidence base for the effectiveness of NbS across the globe. We welcome further discussion on how to assess effectiveness, which indicators and dimensions to consider, and how to inform decision makers and urban planners.

Keywords: Cities, Biodiversity, Ecosystem services, Effectiveness, Well-being, Integrative evaluation

B10c-2 A method developed to mapping recreational fishing ecosystem services supply in lakes located in northern latitudes.

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Freshwater ecosystem services (ES) supply many regulating, provisioning and cultural ES. In urban areas located in northern latitudes, lakes are important for recreation. Fishing on iced lakes is a common winter recreation activity; it is crucial to identify the areas where this activity is conducted. Here, we developed a method for mapping and assessing winter recreational fishing. An urban artificial lake (17,527.11 m2) was selected to develop this method in Vilnius (Lithuania). A drone mission was established using a DJI Mavic 3 M with an RGB and multispectral camera. The area surveyed was 38,867.7 m2 at a resolution of 2.15 cm. The flight time was 18 min and 31 s. 646 photos were taken at an altitude of 60 m. Subsequently, an orthomosaic was created using ArcGIS Pro, and the images were corrected and georeferenced. Once the images were georeferenced, the fishing holes left in the ice were vectorized. Overall, 3268 fishing ice holes were mapped, and two methods were applied to map winter recreational fishing in the studied lake: the Kernel Density and Point Density. Overall, Kernel Density was the most accurate method and produced a better map than Point Density. The method is simple, although some time is needed to identify the fish holes and keep them distinct from steps, garbage or branches found on the ice. The method developed presents several advantages, such as the fact that it is non-invasive and risks (e.g., ice crack) can be avoided if the holes are mapped in situ. Nevertheless, some caveats identified are essential to highlight, such as the time needed to process the data and the difficulties to apply to lakes with a large dimension.

Keywords: recreational fishing, lakes, ecosystem services, winter, mapping, method

B10c-3 Spatial accessibility as main driver for cultural ecosystem service demand in Finnish urban areas. A case study with recommendations for urban planning.

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Urban ecosystems play a critical role as providers of cultural ecosystem services (CES) in urban areas. With rapid urbanization, urban populations are growing, leading to increased demand for CES. Important service provision areas include not only green and blue urban spaces, but also human-made outdoor infrastructure. In contrast to the provisioning ecosystem services, CES are often provided near or within the cities, as nearby locations are generally preferred by city dwellers.

In our study, we argue that spatial accessibility to service providing areas is crucial for shaping the demand for CES in Finnish cities. We use public participation survey data, collected in the cities of Kuopio, Jyväskylä and Espoo, with information on places important to residents in terms of recreational use and natural values. Our main objective is to gain a deeper insight into the significance of spatial accessibility in relation to preferred ecosystem service provision sites, and their subjective quality of beauty, as reported in the survey. In our study we use multiple GIS-based tools and statistical analysis. The background variables, corresponding to service providing areas, include green (urban forests, recreational parks, protected green areas), blue (lake, river, sea) spaces as well as the outdoor infrastructure (recreational trails, recreational parks, etc.).

The results of this study present an overview of the demand for CES in relation to the spatial accessibility of service providing areas and their aesthetic value in Finnish cities. These findings are intended to help Finnish city planners, for example, when designing new residential areas, and taking into account CES providing areas for the future residents, within suitable proximity. They can also be used to improve the aesthetics of CES providing areas in existing neighborhoods.

Keywords: cultural ecosystem services, spatial accessibility, urban green spaces, urban blue spaces, urban infrastructure.

B10c-4 Favorite Services, Preferred Species, and Avoided Places: Analysing Visitors' Preferences and Use of a Natural Park in Bucharest, Romania

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Planning the urban wilderness begins at the intersection of two major elements: ecology (ecosystem services supply) and social (ES demand). Therefore, the main challenges in studying and planning urban wilderness involve to resolving the trade-offs between the conservation of nature and the needs of urban communities.

Our research builds upon the socio-ecological framework and starts with the question of how management measures can reconcile the needs of nature with the necessities of people in an urban protected area. Our case study is Văcărești Natural Park— Bucharest, IUCN Category V.

We collected information on how visitors (n=1096) perceive the: ES provided by the park, main risks and challenges for nature and infrastructure. A PPGIS platform helped collecting data about the interaction between the visitors and the place. By reviewing the literature and applying statistical and cartographic (GIS) analysis, we obtained a comprehensive picture of how visitors perceive the ES provided, what are the factors that can affect the park's contribution and how the park's spaces are used.

The results indicate that the most important ecosystem services from the visitors' perspective are cultural and regulatory services (nature observation 81.5%, biodiversity conservation 81.2%, recreation 82.3%, air purification 81%).

Next, we overlaid the preferred locations from the perspective of ES onto the avoided locations and obtained maps indicating where interventions are necessary to address the issues identified by respondents.

The synergy between nature and people in the urban natural park requires that the visiting infrastructure should be as separate as possible from the park's natural areas. We concluded our study with a series of management measures.

Keywords: wilderness, ecosystem services, management, public participatory GIS

B10c-5 Nature-based Solutions: Modeling to Support Practical Challenges

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Nature-based solutions (NbS) can support sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to promote climate adaptation and resilience. For the private sector and for public agencies, NbS can take an holistic approach to addressing several of corporate and regulatory goals, highlighting where risks can be reduced and where co-benefits are possible. Despite current interest and decades of academic research on NbS, there are still many questions regarding their efficacy, efficiency, short and long-term costs, methods to estimate benefits, specific spatial extent, hazards best addressed (storm surge, extreme heat and other hazards), continuous benefits (building energy efficiency, carbon reduction), or targets of high potential benefit for relevant green technology development to improve outcomes of NbS. Our study focuses on modeling the potential opportunities to apply NbS to address specific risks to communities, ecosystems, and infrastructure that can be operationalized, managed, measured, tracked and reported. We evaluate the drivers, benefits, and challenges to operationalizing NbS in a variety of contexts in the natural and built environments. We address the following questions: 1) What is the current status of research and applications to NbS for climate adaptation, ecosystem hazard mitigation, sustainable buildings, and communities, including frameworks, applications, case studies, and efforts to synthesize current activities on the ground? 2) What are the potential ways to model, track, measure, and report on NbS from an engineering, economic, cost-benefit, and spatial perspective to gain insight on which projects are bringing strong benefits? And 3) What are some key growth areas to target for implementation of NbS that will bring multiple benefits?

Keywords: Nature-based Solutions, Frameworks, Valuation, Benefts, and Tradeoffs

B10c-6 The MaCoBioS Blue NbS Toolbox - breaking the ground for marine and coastal NbS design and implementation

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Nature-based Solutions in marine and coastal environments (blue NbS) can contribute to alleviating biodiversity loss and shaping human health and well-being. Providing a framework to integrate actions designed to protect and restore the health of marine and coastal ecosystems, and sustainably manage human impacts on them, blue NbS embed nature and people into decision-making through multifaceted thinking. However, their implementation lags behind terrestrial NbS and advances are required to accelerate blue NbS. We introduce the MaCoBioS Blue NbS Toolbox, a collection of multidisciplinary tools and products to help inform the design and implementation of interventions in marine and coastal environments. Tools draw on research conducted through the European Horizon 2020 project 'Marine Coastal Ecosystems Biodiversity and Services in a Changing World' (MaCoBioS). The MaCoBioS Blue NbS Toolbox includes a variety of evidence-based products and guidelines, developed with stakeholders, to help practitioners at different blue NBS implementation stages answer questions like: 'What happens to an ecosystem and its services if…?'; 'Will a community be able to adapt to change and how can we help?'; 'When, where, and how could we act?'. Accessible and well-designed tools are crucial to support stakeholders in identifying suitable interventions in the evolving blue NbS landscape.

Keywords: Nature-based Solutions (NbS); Marine and Costal Ecosystems; Biodiversity; Ecosystem Services; Decision-making design

B10c-7 City Explorer Toolkit – a planning tool to translate Ecosystem Service science into urban planning guidance

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Whilst Ecosystem Service (ES) science has rapidly progressed, allowing us to model benefits in a spatially explicit and context-sensitive way, this science is still rarely applied in the formulation of city plans, due to a lack of suitable tools for planners and policy makers. The benefits of urban green and blue space are widely discussed, but rarely take into account local conditions or contexts. Although spatial assessment methods increasingly consider the demand for services, they tend to only map the spatial pattern of pressure and lack a wider understanding of where the beneficiaries are located and who will benefit most. In addition, many ES assessments assume all greenspace provides the same level of benefit, regardless of where it is located. Here, we demonstrate a new interactive modelling tool that will be able to take into account spatial patterns in the socio-demographic demand for ecosystem services and to calculate ecosystem service metrics that vary with local context. The City Explorer Toolkit planning support app maps the expected benefits of ecosystem services associated with urban green or blue space, and allows users to add new greenspace into the urban environment to compare the relative benefits of different locations (i.e. scenario comparison). Further, the toolkit provides maps of potential, identifying the best locations for new interventions, or Nature-Based Solutions. Focal demographic group vulnerability, or importance, can be used to weight the final outputs, allowing users to identify optimal spatial configurations, tailored to the specific requirements of the city or region being assessed. We demonstrate the core elements of functionality, and describe how we will further develop the app to add more ecosystem service models.

Keywords: Urban, Ecosystem Service, NBS, Sustainable Cities, Planning

B10c-8 Quantify and evaluate the multi-benefit provided by wetlands in different spatial context

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Compared to other types of ecosystems, wetlands cover a relatively small area of the entire Earth's surface. Especially many natural wetlands have been globally drained up or severally deteriorated in quality due to different human actions such as intensification of agricultural activities and widespread urbanization processes.

However, wetlands supply strategic ecosystem services: carbon sequestration, water flow regulation, maintenance of life cycle of migratory species, aesthetic and recreation values are some of the ecosystem services, are provided by natural and artificial wetland, thus producing key benefits to the environment and society.

The development of methods for the qualification, quantification end economic evaluation of benefits from wetlands, benefits is fundamental to encourage policy makers to achieve innovative protection policies and programs.

This contribute starts from a review of the relevant existing methodologies to quantify and evaluation of benefits provided by wetlands (i.e performance indicators, benefit transfer methods, willing to pay and hedonic methods).

A methodology which integrates the previously analysed approaches is then applied on a set of real case studies of natural and constructed wetlands, located in different geographical contexts in Italy, to identify and quantify specific socio-ecological factors that determine the provided benefits.

Increasing the general cognition of benefits provide by wetland is fundamental for both, to encourage the protection of natural wetlands and to promote the planning of new constructed wetland in order to maximise and distribute strategically the benefits.

Keywords: wetlands, ecosystem services, multi-benefits, sustainable planning

B10c-9 The Management of rainwater runoff in urban areas for tackling extreme hydroclimatic events (Springiness)

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The Springiness project at the Czech University of Life Sciences (CZU) addresses critical climate change challenges through innovative water management and ecosystem services. Implemented within the CZU campus in Prague, the project integrates green-blue infrastructure (BGI) to mitigate the adverse effects of increasing temperatures, evaporation rates, changing precipitation patterns, and soil moisture variability.

A key component is the use of constructed wetlands, engineered to mimic natural processes, improving water quality, managing stormwater, and providing wildlife habitats. These wetlands enhance soil health, reduce pollutants, and boost biodiversity.

The project employs innovative water management strategies, including:

Rainwater Harvesting Systems - Collecting and storing rainwater in modular tanks for irrigation and non-potable uses.

Green Roofs - Capturing rainwater, reducing runoff, and providing insulation.

Rain Gardens - Allowing rainwater to infiltrate naturally, managing stormwater.

Permeable Walkways - Reducing surface runoff and recharging groundwater.

Bioswales - Filtering rainwater and directing clean water into the ground.

The project develops tools for stormwater retention and reuse, upgrading the "STORM" software with water quality modules, and proposing proxy water contaminants representative of stormwater quality. It evaluates the safety of rainwater reuse and assesses water purification efficiency by BGI. This initiative advances knowledge in integrating BGI with urban water management systems and contributes to ecohydrology and water management research. It

creates tools for managing stormwater retention and reuse, demonstrating BGI applications within a university campus and promoting broader urban adoption.

The societal impact includes environmental benefits through improved climate, biodiversity, and air quality. It enhances urban water provision and promotes rainwater reuse for non-potable uses, addressing floods, sewer overloads, droughts, and groundwater decline, thereby enhancing urban resilience against hydroclimatic extremes.

Combining advanced technologies, nature-based solutions, and community involvement, the CZU project creates sustainable, resilient landscapes capable of adapting to future climatic challenges, fostering a culture of sustainability and innovation.

Keywords: Green-Blue Infrastructure (BGI), Water Management, Constructed Wetlands, Climate Change Adaptation, Nature-Based Solutions (NBS)

B10c-10 Urban Wastelands: Hidden Biodiversity Sources and Ecosystem Service Providers in City Planning

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Urban wastelands, often neglected and seemingly useless spaces in cities, are considerable sources of biodiversity within the dense urban fabric. Studies conducted in Warsaw have shown that the vegetation in these areas forms stable forest and non-forest communities. Despite the dominance of invasive species, these areas provide numerous important ecosystem services, such as temperature and humidity regulation and air quality improvement. Management practices for spontaneous vegetation within these areas can significantly impact species diversity, particularly depending on the degree of intervention and proximity to larger forest complexes.

Unfortunately, despite the growing amount of data and research on urban vegetation and habitats, only a small portion of this information is reflected in the planning documents of

Polish cities. Detailed habitat mapping and better integration of these data into spatial planning could significantly improve urban environmental management, biodiversity conservation, and public health. This highlights the value of urban wastelands in the sustainable development of cities.

Keywords: urban biodiversity, urban spontaneous vegetation, urban habitat mapping, regulating ecosystem services

B10d-1 Ecosystem services in the eyes of urban residents: a study of green spaces

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Ecosystem services, the benefits provided by natural ecosystems, are crucial for human well-being and ecological health. With increasing urbanization and environmental degradation, understanding community perceptions of these services is essential for effective green space management. This study was aimed at investigating people's perceptions of ecosystem services in selected vegetated areas.

The research evaluated various aspects of green spaces, including visit frequency, purposes of visits, and preferences for the type of green space (wild or managed). Participants also assessed the quantity and quality of greenery in their living areas and the biodiversity of the visited sites. Among the ecosystem services particularly valued by participants were opportunities for relaxation, air purification, temperature regulation.

Results indicate significant variation in the perception of green spaces depending on people’s place of living, reflecting different levels of access to and quality of urban greenery. The study revealed considerable interest in recreational opportunities and the ecological functions of green spaces, as well as their value for educational and aesthetic purposes. This study provides valuable information on people's perceptions of ecosystem services, which can be used by urban planners and policymakers to create and manage urban green spaces in ways that best meet community needs. Incorporating these results into further discussions can contribute to a

better understanding of the value of green spaces and their role in improving the quality of urban life.

Keywords: ecosystem services, urban greenery, community perceptions, ecological health

B10e-1 What spatial quantitative digital tools are used to support the planning of green infrastructure for biodiversity?

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Green infrastructure (GI) has become a frequently used spatial planning framework for integrating natural and semi-natural green spaces into landscapes impacted by human activities to promote biodiversity. In GI planning, quantitative digital tools are often utilized to identify and delineate habitat networks to be maintained as GI. However, there is a risk that GI planning may be disconnected from ecological expert knowledge, because it needs to be completed relatively quickly and many digital tools are available. To build an overview of the level of integration between ecological knowledge and GI planning, we carried out a systematic survey of literature on GI planning for biodiversity, summarising geographic location, spatial extent, quantitative methods, data availability and sources, and software used. We found that published GI plans considered widely different spatial extents and used a variety of approaches and software. Most studies were from Europe, and an increasing number of recent papers were from China. While the empirical data on habitat quality, quantity and movement capability to parameterize the tools were scarce, habitat connectivity received a great attention. In the face of insufficient data, it appears crucially important to enhance the scientific knowledge on species' demands on their landscapes, and to evaluate the performance of planned GI.

Keywords: green infrastructure, digital planning tools, biodiversity, connectivity, literature survey

B10e-2 Ecosystem Service Assessment in Kabul City: Integrating Remote Sensing and Spatial Analysis Techniques

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Ecosystem services are crucial for human well-being but face significant threats in regions experiencing rapid population growth and poverty, such as South Asia. Afghanistan, particularly its capital city Kabul, has undergone unprecedented urbanization over the past two decades, leading to substantial land use changes and posing severe risks to the state of ecosystem services.

This study aims to provide a comprehensive spatial assessment of four key ecosystem services in Kabul city: annual water yield, urban cooling, urban nature access, and urban flood risk mitigation. It also seeks to explore the spatial relationships and interdependencies among these services.

Utilizing the InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) model and ArcGIS, we quantified the supply of these services and analyzed their spatial distribution through hotspot and coldspot analysis. Additionally, we calculated Global and Local Moran's I using ArcGIS and GeoDa to examine spatial relationships, and employed Spearman correlation analysis to explore interrelationships between different services.

Our findings reveal a high degree of spatial correlation, highlighting significant spatial interactions among the ecosystem services studied. The results underscore the spatial dynamics of these services, with particular areas identified as hotspots and coldspots. This study provides novel approaches for ecosystem services mapping and assessment using remote sensing in a data-scarce region.

This comprehensive assessment offers valuable insights into the spatial dynamics of ecosystem services in Kabul city, providing a critical foundation for sustainable urban planning and policy development aimed at mitigating the adverse effects of rapid urbanization. The study's novel

methodologies and findings contribute to the broader context of landscape ecology and urban ecosystem service management.

Keywords: Urban ecosystem services, Sustainable spatial planning, Planning support, Hotspots and coldspots, Synergies and trade-off

B10f MuGIP: an Index to assess multifunctionality of nature-based solutions in a World Heritage City

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In the actual climate crisis, cities need to adapt to the new challenges they are facing such as high temperatures or storm-water runoff. Moreover, cities also need to contribute to maintain and promote biodiversity due to its worldwide decline. The use of urban green infrastructure projects is a strategy that is becoming very common to address these challenges. We developed a conceptual framework that allowed for the creation of an index, MuGIP, based on ecosystem services that allows to evaluate the contribution of a project of Nature based Solutions (NBS) to multifunctionality. MuGIP assessed four types of NBS (tree plantig, naturalisation of non-tree greenspaces, greening of buildings and bioretention sites) and can be used for one NBS or for a group of them. The proposed conceptual framework is divided in three socioeconomic and seven environmental criteria. These criteria are assessed by different descriptors and the environmental criteria related to different ecosystem services. A minimum value of MuGIP is indicated for the selected NBS to contribute to meeting the city's challenges. The index also helps to improve the multifunctionality value by showing the deficiencies of the project. Finally, MuGIP was applied in Salamanca, World Heritage City.

Keywords: Multi-criteria analysis, street trees, urban planning, citizen participation, urban challenges

Sectoral Working Group Posters (S)

S1a-1 Integrating Circular Bio-Based Solutions in European Rural Areas: Insights from the BioRural Workshop on Ecosystem Services and Agroecological Transitions

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The BioRural project aims to integrate circular bio-based solutions in European rural areas, fostering agroecological transitions by leveraging ecosystem services. This abstract details the insights and outcomes from a BioRural workshop held in Alcobaça, Portugal, focused on accelerating sustainable practices in forestry and agriculture through stakeholder dialogue and capacitation. The workshop brought together 25 stakeholders from the agrifood and forestry sectors, including producers, associative leaders, technicians, and researchers, to create a multidisciplinary platform for knowledge exchange and innovation. The main objective was to explore linear value chains and propose strategies for achieving circular designs using guided exercises.

The activity highlighted the critical role of nutrient cycling and resource management in supporting sustainable agricultural practices. Participants identified challenges related to the linear economy, such as resource depletion, economic losses, and environmental degradation. Groups designed circular value chains for key regional products like Alcobaça apples and maritime pine, proposing innovative uses for by-products, such as biopesticide and biofertilizer production from apple waste. Additionally, the integration of carbon capture technologies and renewable energy sources was proposed to reduce greenhouse gas emissions and improve sustainability. Common challenges included legislative barriers, lack of certification for novel circular products, and resistance to innovation. Solutions focused on increasing awareness, promoting demonstration sessions, and fostering collaboration to drive policy changes.

The workshop demonstrated that leveraging ecosystem services in agricultural practices can significantly contribute to agroecological transitions. By promoting circular bio-based solutions, BioRural enhances biodiversity conservation, economic resilience, and social well-being in rural

areas. The outcomes provide a framework for harmonizing ecosystem services with sustainable agricultural practices, underscoring the importance of interdisciplinary approaches and stakeholder engagement in achieving sustainable and resilient agricultural systems.

Keywords: Agroecological Transitions, Ecosystem Services, Circular Bioeconomy, Sustainable Practices, Stakeholder Collaboration

S1a-2 Harnessing Thyme Species' Ecosystem Services as Bioherbicides to Enhance Biodiversity Conservation and Support Sustainable Agroecosystems

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The transition to sustainable agroecological systems is currently a necessity supported by several EU initiatives and projects. The European Research project GOOD – Agroecology for weeds (https://www.goodhorizon.eu/), with which this study's objectives align, aims to explore and search for sustainable and efficient solutions for weed control. Among others, the development of biopesticides is one of the most promising areas of study. Biopesticides offer a promising alternative to conventional chemical pesticides, which have been under stricter regulations and bans due to being associated with human health problems and environmental disturbances. Biopesticides are based on nature-derived compounds and are potentially safer and more environmentally friendly. In this field, plants have become an attractive source of natural compounds. Thyme plants (Thymus L.), known for their potent antimicrobial and antifungal properties, present a valuable and promising resource. The essential oils extracted from thyme contain compounds such as thymol and carvacrol, demonstrating interesting bioactivity. This potential is especially significant for Portugal and the Iberian Peninsula, where several endemic thyme species, including Thymus albicans and Thymus camphoratus, are threatened. We aim to explore these species' phytotoxic capacity for future herbicide production while supporting their conservation through biotechnological solutions, such as in vitro culture, and maintain their ecosystem services.

Integrating thyme-based biopesticides into agroecological practices can help control weeds while maintaining soil health, promoting pollination, and enhancing nutrient cycling. Moreover, the cultural ecosystem services linked to the use of native plant species, such as heritage preservation and agrotourism, further enrich the socioeconomic landscape of rural communities.

By emphasising the use of thyme plants, particularly endangered Portuguese species, as biopesticides, this study aims to contribute to the broader goals of agroecological transitions. This approach highlights the importance of biodiversity conservation in combating environmental degradation, enhancing resilience, and fostering sustainable food production patterns.

Keywords: Biodiversity, Biopesticides, Agroecology, Ecosystem services

S1b Deforestation-induced changes in rainfall decrease soybean-maize yields in Brazil

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Whereas the global demand for food is increasing, the capacity of ecosystem services to sustain agricultural production is being compromised worldwide. Brazil is a global food supplier that has benefited from agricultural intensification in the past decades. At the same time, expansion of croplands has led to deforestation that, in turn, is increasingly affecting rainfall patterns, thereby influencing crop yields. This study examines how loss of forest cover has impacted agricultural yields through changes in rainfall. To do so, we use modeled data on changes in rainfall patterns due to deforestation as input to a crop model. We assess yield changes within the soybean-maize double cropping system, the country's most relevant agricultural system, in five states within the Amazon and Cerrado biomes. Findings revealed that soybean and maize yields would have been respectively 6.6% and 9.9% higher per year in the last decade if rainfall patterns hadn't been altered by deforestation from 1982 onward. Although agricultural efficiency improved between 2011-2020, it was insufficient to offset the negative effect on yields caused by altered rainfall. Our paper reveals the link between deforestation and crop yields, emphasizing the need to preserve forest cover for agricultural resilience and food

security. It reinforces the critical role of forests in regulating the water cycle, particularly in the face of climate change-induced warmer and drier conditions that can impact agricultural production and other human activities.

Keywords: Brazil, forest, deforestation, rainfall maintenance, agriculture

S1c Restoring Aquatic Vegetation as a Nature-Based Solution in Po Delta Drainage Canals: Exploring the Potential for Payment for Ecosystem Services Schemes

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Restoring aquatic vegetation in drainage canals is increasingly recognized as a nature-based solution to enhance ecosystem services, particularly in human-modified landscapes. Traditional management practices often involve routine mowing of drainage canals to maintain water flow and prevent vegetation overgrowth. However, these practices can inadvertently disrupt natural processes, such as denitrification, which is crucial for nitrogen removal from aquatic systems, thus hindering the achievement of the Water Framework Directive goals.

Using the drainage canal network of the Po delta in Northern Italy as ideal case study, this work explores the concept of avoiding mowing to restore aquatic vegetation, i.e. common reed, as a nature-based solution to enhance water quality regulation by increasing denitrification rates.

Nitrogen removal capacity was estimated by scaling up field measurements to the entire canal network. The monetary value of nitrogen removal and the management costs associated with mowing activities were evaluated under different scenarios, including one, two, or no mowing events and varying vegetation coverages. The potential application of payment for ecosystem services (PES) schemes was explored by identifying beneficiaries and providers.

The results indicate that avoiding mowing and restoring aquatic vegetation can significantly increase the capacity to mitigate diffuse nitrate pollution compared to current conditions. Management costs can be largely offset by the avoided costs for water purification.

Additionally, this approach promotes biodiversity, enhances landscape beauty, and increases ecosystem resilience, thereby expanding the range of potential beneficiaries.

Practical considerations, benefits, and challenges associated with implementing this nature-based solution are discussed, highlighting its potential as a sustainable strategy for managing nitrogen dynamics in aquatic environments.

Keywords: Aquatic vegetation, Nitrogen removal, Water quality regulation, Drainage canals, Payment for Ecosystem services

S1e-1 Linking soils in agroecosystems to human wellbeing through a data-driven modelling approach

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Soils underpin health and wellbeing in many ways, which are not always obvious. Even in agroecosystems which prioritise food-production, the links to human health and wellbeing span more than production of food and fibre, and include regulation of processes (green house gases, flooding, disease and pathogens), as well as culturally-linked benefits provided at a landscape scale which all influence human health.

Here we present a Soil and Wellbeing Framework which links soil biodiversity and soil physico-chemical properties through to health and wellbeing via complex inter-linked sets of processes and the interactions with people at all stages which underpin ecosystem services and disservices. Our application is in arable ecosystems, but the principles can be extended to any system. The modelling sequence uses a combination of data-driven and machine-learning approaches to predict microbial diversity from soil properties, and from that to predict functional genes, linked via an ontology of higher-level gene functions ultimately to ecosystem services and health. We illustrate this data-driven approach with examples from arable systems in different parts of Europe.

Keywords: One health concept, data-driven approaches, agroecosystems, wellbeing framework, bioinformatics

S1e-2 The BIOTICHS project: Diagnosing biodiversity, ecosystem services and human health using big data and joint modelling approaches.

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Biodiversity is exposed to multiple pressures, i.e., nutrient oversupply, chemical pollutants, desiccation and habitat loss. The type and intensities of pressure vary widely among sites, hampering diagnosis and effective management of biodiversity loss. Biodiversity is inherently linked to healthy ecosystems and the provision of ecosystem services. For the transition to a sustainable environment, it is essential to characterize local biodiversity patterns, diagnose dominant causes of impacts, and develop optimized strategies for sustainable societal uses of ecosystems and their services including human health. Improved scientific insights are fundamental in order to 'bend the curve' of biodiversity decline and foster global change.

The BIOTICHS project focuses on knowledge gaps related to local pressure-biodiversity-ecosystem service-human health relations and aims to develop diagnostic and predictive tools to aid policy in making knowledge-based decisions. The foundation for these tools will be based on data-driven insights from a spatiotemporal datalake.

By combining datasets on biodiversity and pressures from the datalake using inferential machine learning techniques, it is possible to locally diagnose major causes of biodiversity decline and prediction of optimal measures to halt this decline. Embedding this diagnosis in tooling for end-users (i.e. policy makers) would enable them to conduct scenario-analysis, comparing the effect of different management strategies on both biodiversity and ecosystem service provision at different scales. This will allow for the making of informed decisions based on stakeholders preferences and sustainable management.

Call for collaboration

We invite researchers to collaborate to BIOTICHS, either by (a) sharing relevant datasets for the FAIR data lake, (b) by discussing the use of diagnostic-site specific studies, big data or innovative approaches and (c) to explore application-oriented tools to integrate future results. Collaboration and input from other researchers will help to increase the scope and robustness of this project and to help further the science in this topic.

Keywords: Biodiversity, Ecological Pressure Factors, Ecosystem services, Data lake, Human health

S3a-1 Towards better management of human altered-ecosystems: forest roads as providers of ecosystem (dis)services in Latvia

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In countries with developed forest industry, linear forest infrastructure objects, such as forest roads constructed primarily to improve accessibility for management and protection purposes, are among the most widespread examples of human-altered ecosystems. The shift in ecosystem processes caused by infrastructure construction is often irreversible, and therefore it is necessary to identify, protect and enhance their remaining natural functions that may contribute to biodiversity preservation and overall sustainability of forest management. While forest roads and road verges are anthropogenically created and maintained landscape elements, they may still support diverse environmental conditions and provide both ecosystem services and disservices (ESs and EDSs), including those related to human health.

The objective of our study was to identify the multiple ESs and EDSs related to managed forest roads and road verges. As a part of a wider research programme, a representative nation-wide survey (>1000 respondents) was carried out in summer 2024. We asked the respondents to assess the importance of forest roads in providing aesthetic and recreation services, non-wood products, human health-related aspects and biological diversity. The survey included examples of different types of forest roads, to distinguish between various levels of management impact. Our results provided information on general societal perception of forest roads, their importance in providing different benefits, such as non-wood forest products, specifically berries, mushrooms and medicinal plants, recreation and sports opportunities and amenity

services, as well as their role in enhancing negative aspects of nature, such as pollen allergies and insect-borne diseases. The conclusions drawn from the study will contribute to forest infrastructure management recommendations in areas important for society.

The study was supported by Latvia Council of Science, grant No. lzp-2023/1-0558, 'Forest roads as multifunctional ecosystems: biodiversity, ecosystem services and disservices´.

Keywords: forest infrastructure, non-wood forest products, recreation, biodiversity, human health

S3a-2 Impact of forest management and abandonment on the multifunctionality of forest systems in the Urdaibai Biosphere Reserve

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Different studies report that intensive plantation forestry degrades several ecosystem services (ES) due to its focus on maximising timber production at the expense of biodiversity and soil health. In the Basque Country (northern Spain), Pinus radiata plantations have been intensively managed for decades, but recent red and brown band infestations have made them less profitable. As a result, these plantations have started to be replaced by faster growing species, such as Eucalyptus, or have even been abandoned. In this study, the ES provided by four different forest systems in the Urdaibai Biosphere Reserve (northern Basque Country) have been analysed: Atlantic mixed forests (native forests), managed pine plantations, unmanaged pine plantations (due to abandonment) and Eucalyptus plantations. Extensive sampling was carried out in 10 stands of each forest system, measuring vegetation diversity in different strata, bird diversity, forest structure and performing soil chemical and genomic analyses. The data collected was used to identify indicators of different ES: 2 provisioning (wood provisiong and edible fungi), 10 regulating (carbon storage, habitat mantainance, air regulation, hidric regulation, erosion control, pest control, phytopathogen control, soil fertility, nutrient cycling and wind protection) and 2 cultural (bird watching potential and traditional knowledge). These indicators were standardised and aggregated to assess the multifunctionality of each forest system. The results indicated that, in general terms, mixed forests were more multifunctional than managed plantations, although no more than the abandoned pine plantations. In almost

all ES assessed, mixed forests and abandoned pine plantations showed a higher ES provisioning capacity compared to managed pine plantations and eucalyptus plantations, except for wood supply and carbon storage. The main conclusion is that the abandonment of plantations favours understorey regeneration towards a mixed forest state, resulting in a multifunctionality comparable to that of Atlantic mixed forests. This suggests that, in order to maximise multifunctionality, it would be beneficial to promote natural regeneration and reduce management intensity in plantation forests. These findings underline the importance of considering multifunctionality in forest management to optimise long-term ecosystem benefits.

Keywords: exotic plantations, ecosystem services, natural regeneration, native forests, biodiversity

S3a-3 Habitat provision for plants and birds in native forests and exotic plantations of the Basque Country

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The conservation of biodiversity is essential for the maintenance of a diverse range of ecosystem services. Forests are indispensable habitats, as they protect a considerable number of species and provide a multitude of ecosystem services. Nevertheless, the area of native forests has experienced a significant reduction in the past centuries on a global scale. Conversely, forest plantations have become a significant feature of the landscape in numerous regions. In the Basque Country (north of the Iberian Peninsula), pine plantations represent the most significant feature, although in recent decades eucalypt plantations have expanded considerably. The intensive management of forests using exotic species has been demonstrated to have adverse effects on biodiversity and ecosystem services. Consequently, it is necessary to learn about those forest systems in order to implement sustainable management strategies. The objective of this study was to compare the three forest systems (20 stands of each type: native Atlantic mixed forests, eucalypt plantations and pine plantations) in terms of their ability to provide habitat for plant and bird species. We compared the richness, diversity and composition of plants and birds among the forest systems. The findings indicated that native forests exhibited a higher diversity of plants and birds than plantations. Additionally, pine plantations exhibited greater diversity than eucalypt plantations. Furthermore, the plant and

bird composition of the three forest systems was found to be distinct, with the native forests and eucalypt plantations exhibiting the greatest distinction. Pine plantations were found to be more similar to the native forests than the eucalypt plantations. In conclusion, native forests are the optimal forest systems for the protection of plant and bird diversity and the provision of a wide range of ecosystem services. Finally, pine plantations could offer an adequate habitat, whereas eucalypt plantations should not be considered in this territory.

Keywords: avian, biodiversity, eucalypt, pine, vegetation

S3a-4 Forest Ecosystem Services: Perspectives on Human Demand, Ecological Supply, and Societal Values in the Himalayas

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Understanding how socio-environmental factors influence stakeholders' preferences and utilization of Forest Ecosystem Services (FES) is essential for understanding the dynamics between human demand and ecological supply of these services. Different stakeholders have varying preferences for FES, leading to potential trade-offs in management strategies. Involving stakeholders like local residents and forest managers in participatory governance tends to be more sustainable and successful than top-down approaches. This study evaluates the preferences and utilization of FES among these influential stakeholders in the Western Himalayan region of India, spanning an elevational range from 1500 to 3000 meters asl. We conducted household surveys with 120 residents across three villages with varying access to forest resources and surveyed 10 forest managers to understand their perceptions of FES. Species availability was quantified by measuring species density and regeneration status across 18 quadrats of 0.1 hectares at 150-meter elevation intervals, and a species usage index was calculated to identify species with high utilization despite low density. We found that residents preferred fuelwood and fodder as FES, while forest managers prioritized fresh air, water quality, and carbon sequestration. Principal Component Analysis of FES bundles showed that timber, fuelwood, and construction services clustered together, whereas fodder and grazing formed another distinct cluster. We observed a negative correlation between demand (species usage) and supply (species availability) at higher elevations (2000-2500 m asl), suggesting potential mismatches. Residents identified distance and time constraints as primary challenges in

accessing forest resources. This study highlights the importance of considering local preferences and ecological data in forest management and conservation strategies. Given that forest managers are mandated to preserve forests and increase carbon stock, there is a clear conflict with residents' preferences. Integrating these insights into national policies could enhance sustainable forest resource utilization and harmonize the differing priorities of local stakeholders.

Keywords: Forest ecosystem services, socio-environmental factors, species availability, stakeholder preferences, sustainable resource management.

S3a-5 Lessons from Local community perspectives on Ecosystem Services and Disservices from Invasive Alien plant species in the Lake Zone, Tanzania

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While acknowledging the well-documented impacts of environmental change drivers, such as invasive plant species, our study fills a significant gap in the literature by providing a local community perspective on Ecosystem services (ES) and Disservices (DS) due to invasion. The local community played a crucial role in our study, as we used social surveys and interviews to identify the ES and DS of the selected invasive plant species. Our investigation was based on five invasive plant species: Argemone mexicana, Chromolaena odorata, Lantana camara, Ipomoea hildebrandtii, and Eichhornia crassipes. We found that 80.83% of the respondents acknowledged the negative impacts of the species, and 19.17% acknowledged the positive effects. The noted disservices were resource competition and costly control methods (78.3%), biodiversity loss (76.8%), Loss of pasture grazing areas (65%), and interference harvesting (61.7%). The services reported were source of income and fuel (46.7%), source of livestock fodder (40.8%), medicinal value, and house construction (23.3%). They also mentioned Eichhornia crassipes as the species that most impacted their livelihoods. On the other hand, the results from the logistic regression model suggest that education level and village location are significant predictors of the likelihood of experiencing Ecosystem Services and Disservices from Invasive plant species at 0.05. At the same time, age and gender do not influence this context significantly. This study, with the active involvement of the local community, contributes to the literature on incorporating their knowledge and perspectives in invasive species management. It

provides significant insights that can inform future conservation planning, equipping policymakers and conservationists with the necessary information to make informed decisions.

Keywords: Alien Invasive species, Ecosystem services, Ecosystem disservices, biological invasion, livelihoods,

S3b-1 Network of demonstration sites for forest ecosystem services in Portugal

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The provision of forest ecosystem services depends on the interaction between societies and ecosystems (Sorge et al., 2022). This interplay results in regionally differentiated governance approaches that support the adoption of specific measures to promote these services. Here, we present five examples that form part of a network of best practice demonstration sites for Portuguese forestry – the Melhor Floresta project (Agenda Transform, PRR C644865735-00000007). This project aims to invite stakeholders to visit each site and explore the social, economic, and environmental motivations behind best forestry practices, including FSC® certification for Forest Management (FSC-STD-PRT-01-2016) and Ecosystem Services (FSC-PRO-30-006-V1-2PT) under the 2B_Forest_Group (SA-FM/COC-005773).

The first two demonstration sites illustrate corporate environmental responsibility supporting ecosystem services. In Alto do Lindoso, a hydropower plant implements measures to preserve biodiversity and carbon storage near a large dam. In Serra da Estrela, a water bottling factory invests in hydrological regulation by planting autochthonous species, obtaining Portugal's first FSC® Ecosystems Services certificate for Watershed services (ES3.4).

The next two sites explore socio-ecological motivations. In Marrazes, the local administration body contributes to the quality of life of the population by storing carbon in a public forest, and in Castelo Branco, an NGO invests in carbon stocks by preserving native forests.

The last sites highlight the importance of individual economic interests. In Arouca, a private landowner is investing in renaturalizing a non-profitable forest plantation, resulting in

Portugal's first FSC® certificate for Biodiversity conservation (ES1.1-1.3), Carbon storage/sequestration (ES2.1-2.2) and Recreational services (SE5.1). And lastly, in Alferce, a private landowner has decided to invest in carbon storage and sequestration to improve the market value of his "medronho" brandy.

In a world of increasing environmental concerns, this is an example of how new governance approaches are putting in motion private and public fundings to create opportunities for ecosystem services certification in Portugal.

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Keywords: Biodiversity conservation, Carbon storage, Carbon sequestration, Recreational services, Watershed services

S3b-2 Valuation of small private forest land through Ecosystem Services certification

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One of the key issues when addressing forest land valuation through ecosystem services certification is the difficulty in involving private landowners (Górriz et al., 2014). In recent years, Portugal has witnessed a pioneering example of a small private land being valued through ecosystem services certification. Located in the northern part of the country, in the steep margins of river Paiva, the land occupies 24.53 ha and is legally classified as an ecological natural reserve, a site of community interest and an ecological corridor. The property has good access roads and the river Paiva brings many ecotourists to the area (walkways and suspension bridge).

The landowner obtained an FSC® certificate for Forest Management (FSC-STD-PRT-01-2016) in 2018 under the 2B_Forest_Group (SA-FM/COC-005773). Nonetheless, given the various legal

constraints and the steep terrain, he was unable to optimize timber harvesting – rendering the business to become non-profitable. Thus, to avoid land abandonment, he sought alternative ways to value the land.

2BForest suggested that the landowner should convert the area to a natural forest, under the ES_Sponsor project – a pioneering initiative for FSC® Ecosystem Services certification in Portugal. A theory of change was proposed based on the plantation and natural regeneration of autochthonous species, exotic species eradication and growth control, and vegetation management to simultaneously avoid forest fires and sequester carbon. As a result, in 2021, the land obtained the first Portuguese FSC® Ecosystem Services certificate (FSC-PRO-30-006-V1-2PT) for Biodiversity conservation (ES1.1-1.3), Carbon management/restoration (ES2.1-2.2) and Recreational services (ES5.1). Today, the area has received support from more than 30 entities, with the aim of investing in the plantation of autochthonous species and developing the landscape for ecotourism. This is a prime example of how small private owners can voluntarily rehabilitate forest plantations, contributing to higher levels of biodiversity, promoting native forests, and increasing carbon storage.

Keywords: Biodiversity, Carbon sequestration, Carbon storage, Portugal, Sustainable management

S3b-4 Forest management impacts on fauna: the role of forest certification

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Anthropogenic activities and climate change pose a threat to forests worldwide, prompting the development of conservation efforts to protect these ecosystems and their services. Forest certification emerged as an initiative to promote sustainable forest management, with schemes like Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC). These standards include measures of biodiversity conservation, soil and water protection, by ensuring the sustainability of management practices. This analysis aims to review the existing literature and clarify the effects of forest certification on animal communities and habitat conservation. We conducted a literature search on the databases

Scopus and Web of Science, focusing on studies related to wildlife in certified forests. Most of these publications where focused on European countries and in areas certified by FSC, in relation to PEFC. Our findings reveal that mammals and birds were the most studied animal groups in certification-related works, while invertebrates, reptiles, amphibians, and fishes were less addressed. Our results also showed that prescribed fire is one of the practices that needs further investigation in certification-related studies. Overall forest certification shows a positive impact on fauna and habitat conservation, but its relation to specific forest practices is not always clear. Continuous monitoring and evaluation of animal communities and habitat conservation in certified areas, and their relationship to various forest practices is highly relevant, to find out the real impacts of certification on the biodiversity of forest areas.

Keywords: Wildlife, Ecosystem Services, Sustainable Forestry, Conservation

Open Session Posters (O)

O1-1 Evaluation of regulating ecosystem services in urban landscapes: a case study of Sofia, Bulgaria

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Urban landscapes are the environment where most of the population live and perform their usual everyday activities. They also provide a number of benefits for the human society through their ecosystem services. Mapping of ecosystem services has broad application potential since it is an extremely valuable method for visual representation of qualitative and quantitative spatial data. Following MAES framework, a methodology for mapping and assessment of urban ecosystems and their services in Bulgaria was developed. It consists of three main parts: mapping of ecosystem types; assessment of ecosystems condition; and assessment of ecosystem services. The ecosystems database developed during the implementation of the

methodology was used to evaluate the ecosystem condition and ecosystem services indicators related to the regulation of air quality, local climate and flood mitigation.

Keywords: Urban landscapes, MAES, indicators, ES maps

O1-2 The role of researchers in fostering transformative change

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Tackling the intertwined environmental and societal crises of climate change, biodiversity loss, and other sustainability challenges while working towards the global vision of 'One Health' requires system-wide transformations of society. Researchers carry a crucial responsibility in contributing to these transformations, as scientific expertise remains essential for their success. While this is of interest for researchers at all career stages, it is particularly relevant for Early Career Researchers (ECRs), whose professional careers overlap with the window of time in which these transformations will have to take place to address these crises successfully. Here, we, an international group of ECRs belonging to the Young Ecosystem Services Specialists Network (YESS), want to reflect upon the role(s) of researchers in transformative change, focusing in particular on research fields (biodiversity, ecosystem services and sustainability) more closely linked to this transformation. The ESP Conference 2024 presents an opportunity to capture the motivations, ideals and impacts that researchers have in this field. Therefore, we invite researchers of all career stages to participate in our research: what motivates researchers to pursue their field of study and career? Do researchers aspire to play a role in transformative change? What kinds of role(s), if any, do they aspire to play with respect to transformative change? What are the most important enablers that could unleash the researchers' potential to make an impact? The survey aims to understand how researchers' motivations and roles evolve across career stages, fields of study, and geographic areas. It will also identify key enablers that could facilitate researchers' contributions to a sustainability transformation, including interdisciplinary collaboration, knowledge co-production, participatory approaches, capacity building, funding and resources allocation. The findings of this study will provide insights into

the research community's potential to drive transformative change and inform strategies for promoting a sustainability transformation.

Keywords: Transformative change, sustainability, role of researchers, youth, positionality

O1-3 Linking land use intensification to assess ecosystem health in Lithuania

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The European Union Biodiversity Strategy until 2030 focuses on areas of high biodiversity value, including natural grasslands and wetlands. In Lithuania, unlike in the whole of Europe, the areas of natural grasslands and pastures are increasing, because as agriculture intensifies and the area of grasslands used for this is decreasing. The area of wetlands in Lithuania is relatively stable, but due to factors related to climate change, their functions are changing. Areas of open wetlands are rapidly decreasing due to the overgrowth of reeds, shrubs and trees. Wetland, natural grassland, and rangeland ecosystems play a vital role in sequestering carbon dioxide from the atmosphere and stabilizing the irrigation regime, and are important habitats for many species of organisms, including birds and natural plant pollinators. The purpose of the research was to investigate how changes in land use influenced ecosystem health and provision of ecosystem services in Lithuania, using the vigour, organization and resilience method.

Keywords: ecosystem health, driving factors, ecosystem services, Lithuania

O1-4 Habitat Status of Wild Food Plants during the Syrian Crisis: An Abundance Assessment

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The use of wild food plants in the Levant (Greater Syria) dates back to the Early Pre-Pottery Neolithic age around 10,000 BC, where species such as Malva spp. were gathered. This activity is still practised in most regions around the Levant and Fertile Crescent. Studies conducted in the past years showed a significant revival of wild food plants foraging during the conflict in Syria. Such wild-sourced food formed one of the main coping strategies for food insecurity across the country. However, the increase in wild food plant use raises crucial concerns about the sustainability and abundance of these species. The present study seeks to assess the potential impact of the current turbulent conditions on the environmental status of wild food plants. We aim to highlight the current abundance of wild food plants through the participants' assessments and observations. The data was collected over several field visits between spring 2020 and spring 2024. In-depth interviews were conducted with 56 wild food plant foragers. Participants were asked about wild food plants that usually foraged, and how abundance changed over the conflict period (since 2011) by evaluating each species as decreased, staple, or increased. Participants were also asked to assess the current species abundancy by evaluating it as absent, rare, moderate, and common. Results revealed that the majority of the highly reported species witnessed a decrease in the past 13 years ranging from a slight decrease (e.g., Scandix pecten-veneris) to a severe decrease (e.g., Gundelia tournefortii). Overharvest and unsustainable foraging practices, which are both directly related to the economic crisis during the conflict in Syria, are likely the main reasons for such a decrease in abundance. However, further reasons related to environmental changes and some agricultural practices may play a role in such disturbance for wild plant habitat.

Keywords: conflict; economic crisis; food insecurity; sustainability; traditional knowledge; war-ware environment; wild vegetables

O2-1 Knowledge Co-Creation for Enhanced Ecosystem Services Management on Islands

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Effective ecosystem services (ES) management is vital for biodiversity conservation, livelihood support, and economic growth amid escalating environmental challenges. Engaging citizens, stakeholders, and societies in research enhances decision-making and community resilience. Our study investigates knowledge co-creation methodologies for enhanced regional planning in La Réunion, a French Outermost Region in the Indian Ocean.

Our study provides a tiered, mixed-methods approach. Community members, stakeholders, and experts participated in a flexible knowledge co-creation process to define cultural ecosystem services (CES) such as landscape aesthetics, recreation, and ecotourism. Initial interviews and focus groups enabled the community to identify and prioritize ES. Thereafter, a participatory GIS mapping exercise involved the community in visually representing ecosystem services and their spatial relationships. Expert elicitation validated community-generated knowledge with insights from local and regional professionals, applying a matrix approach to capture ES supply capacities. The InVEST Recreaction module was applied to assess the actual use of cultural ES, ensuring a comprehensive understanding of ecosystem interactions and sustainable development options.

Our results include multiple ES maps showing strong correlations with landscape features. The coastline, with its scenic cliffs and rocky beaches, was highly appreciated, while the inland areas offered significant potential for recreational activities and tourism, including hiking, mountain biking, horse riding, bird watching, and botany. Geotagged photo analysis highlighted popular trails and locations, indicating the magnitude of visitors.

However, co-creation in research presents challenges. Defining the research focus jointly and the approach's flexibility diverge from conventional environmental (social) science methods. Stakeholder engagement requires substantial time and dedication. Despite these challenges, co-creation fosters community learning and empowerment. The insights gained provide a foundation for applying similar methodologies in diverse socio-ecological contexts, enhancing community engagement in ES research.

Keywords: Participatory approach, island, EU OVerseas, MAES, planning

O2-2 Co-design to maximise urban ecosystem services of blue and green spaces for vulnerable urban populations

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Blue and green spaces provide multiple ecosystem services that benefit human health; they not only enable adaptation to climate extremes by providing cooling effects and absorbing excess rainwater, but they are also key to safeguarding mental and social wellbeing by providing restoration and stress relief and facilitating social connectedness. These benefits are of particular importance in cities where residents are increasingly facing extreme heat and rainfall, and where mental health issues, including social isolation and loneliness, are at an all-time high.

Although the development of blue and green spaces has been pointed out as a promising strategy, all too often the most vulnerable people (including frail elderly and homeless people) miss out on nature's benefits due to a lack of such spaces nearby and additional barriers related to infrastructure, social stigma, and lack of involvement in urban planning processes.

An important objective of this project is to counteract these barriers by considering the needs and preferences of vulnerable people and by including them in urban planning processes supported by geoinformation systems (GIS), and rapidly emerging digital technologies such as Virtual Reality (VR) which open up possibilities for visualizing and exploring potential changes to the city landscape.

I will present the participatory co-design approach that we are developing. This approach aims to enhance reflexive planning processes that include consideration of ecosystem services for mental and social wellbeing of vulnerable residents in future heatwave and flooding scenarios.

Keywords: Urban Green Spaces, climate sensitive design, inclusive planning processes, co-design, reflexive planning

O2-3 Lessons learned: Stakeholder participation in environmental evidence syntheses

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Systematic literature syntheses are a key element in the scientific realm, considering the steadily growing amount of available knowledge. Involving stakeholders in the research process brings a wide range of advantages, like expanding the perspectives on the problem in question, increasing the relevance of results for policy- and decision-making, the public and other end-users and thus enhancing the impact and acceptance of research. While participatory approaches are on the rise, reflections on stakeholder involvement in systematic syntheses on environmental management are scarce.

The poster reflects on the process of involving stakeholders during three literature syntheses with different foci of marine and coastal ecosystem services in the Baltic Sea. It highlights the challenges encountered and lessons learned to support the planning of effective stakeholder engagement in future synthesis projects. The participatory approach, involving stakeholder identification, communication, collaboration, and knowledge translation, is highlighted as being both time- and resource-intensive. Additionally, it emphasizes the need for appropriate training and experience to design, execute, and evaluate tailored participatory methods at each project stage.

The importance of carefully considering the necessary resources during project planning and implementation is underlined. Furthermore, to promote and support meaningful stakeholder engagement and knowledge exchange between the research community and policy and practice actors, a greater recognition of these efforts by funding institutions and within the broader scientific community is advocated. This call to action aims to foster a more inclusive and impactful evidence synthesis for the scientific community and policy makers alike.

Keywords: Evidence synthesis, systematic review, systematic map, science-policy interaction, policymakers

O2-4 Cultural ecosystem services of landscape elements and application in spatial planning

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The research focuses on landscape elements as the smallest integral parts of the planned landscape and a reflection of the natural and human activity in the environment, and finally, as a subject of regulation in spatial planning acts. Thus, the research tries to integrate the concept of ecosystem services in spatial planning, specifically cultural ecosystem services (CES). The aim was to identify a set of landscape elements most relevant to CES and to examine to which CES the specific elements contribute most, where in Slovenia, and how this may be applicable in spatial planning.

The research is performed through a field census on 18 landscape patterns in Slovenia with interviews and an online survey. The results are examined at the level of landscape patterns by comparing the data from the field interviews and the online survey. The approach is tested through a case study with a field focus group on a specific example of the economic zone development. Recommendations linked to the integration of landscape elements into spatial planning acts are also examined.

Aesthetic value is the most prominent CES as expected, as visual perception of the landscape is an essential prerequisite for its valuation. Interestingly, identity is common to the largest number of landscape elements. However, some elements specific to particular landscape patterns have been identified as important for heritage rather than identity. Visually less attractive landscape elements were difficult to evaluate for participants especially in the focus group. Nevertheless, naturally preserved landscape elements are essential for social amenity as they represent a visual and acoustic barrier. Accordingly, recommendations for including landscape elements into spatial acts highlight the conservation principle, which states the types of landscape elements to be preserved according to the landscape pattern and the CES provided.

Keywords: cultural ecosystem services, landscape elements, spatial planning, focus group