THE BOOK OF ABSTRACTS

8th Scientific Symposium
‘Ecosystem Services in Transdisciplinary Approach’

Eco serv
Poznań 2025

18-20 SEPTEMBER

POZNAŃ, POLAND 2025

Adam Mickiewicz University Poznań

ESP Ecosystem Services Partnership

Society for Urban Ecology SURE

PENSOFT Publisher of 40+ open access journals in ecology

SCIENTIFIC COMMITTEE

MAŁGORZATA STĘPNIEWSKA

Adam Mickiewicz University in Poznań, Poland - Co-chair

DAMIAN ŁOWICKI

Adam Mickiewicz University in Poznań, Poland - Co-chair

JUERGEN BREUSTE President of the Society for Urban Ecology

BENJAMIN BURKHARD Leibniz University Hannover, Germany

MARIO BALZAN Institute of Applied Sciences, Paola, Malta

MAREK DEGÓRSKI Institute of Geography and Spatial Organization, Polish Academy of Science, Poland

DAGMAR HAASE Humboldt Universität Berlin, Germany

LUIS INOSTROZA Mendel University in Brno, Czech Republic

ADAM KALISZEWSKI Forest Research Institute, Sękocin Stary, Poland

SYLWIA KULCZYK University of Warsaw, Poland

JUNXIANG LI Shanghai Jiao Tong University, Shanghai, China

IEVA MISIUNE Vilnius University, Lithuania

ANDRZEJ MIZGAJSKI Calisia University, Poland

DAVINA VAČKÁŘOVÁ The Global Change Research Institute of the Czech Academy of Sciences – CzechGlobe, Czech Republic

ORGANIZING COMMITTEE

Małgorzata Stępniewska, Co-chair

Damian Łowicki, Co-chair

Katarzyna Fagiewicz

Iwona Zwierzchowska

Lidia Poniży

Piotr Lupa

Marta Mazurek

Patryk Kaczmarek

CONTENTS

PLENARY SESSIONS

PARALLEL SESSIONS

CULTURAL ECOSYSTEM SERVICES ACROSS LANDSCAPES AND SCALES

ECOSYSTEM SERVICES FOR SUSTAINABLE FOOD SYSTEMS

ADVANCING ECOSYSTEM ACCOUNTING FOR NATURE-POSITIVE FUTURES

BROADENING OUR PERSPECTIVE ON ECOSYSTEM BENEFITS

ENGAGING COMMUNITIES IN RECOGNIZING AND MANAGING ECOSYSTEM SERVICES

UNDERSTANDING AND ENHANCING URBAN ECOSYSTEM SERVICES

Making natural capital visible in municipal decision-making through ecosystem accounting

Leena Kopperoinen[1], Emmi Nieminen[2], Erkka Hurtola[3], Tin-Yu Lai[1], Elise Järvenpää[1], Pinja-Liina Jalkanen[1], Maria Söderholm[1], Kaisa Mustajärvi[2], Kalle Salovaara[3], Vesa Vanninen[3], Jonna Luukinoja[3],

[1]*Finnish Environment Institute, Latokartanonkaari 11, 00790 Helsinki, Finland*
[2]*City of Tampere, P.O. Box 487, 33101 Tampere, Finland*
[3]*Pirkkala Municipality, P.O. Box 1001, 33961 Pirkkala, Finland*

E-mail: leena.kopperoinen@syke.fi

Ecosystem accounting (EA) is a complex, yet highly promising, approach to making the value of ecosystems and biodiversity visible and accountable in municipal planning and decision-making. While prior Finnish projects and international initiatives provide a useful foundation, there are still no established standards for thematic urban ecosystem accounts, and much remains to be clarified, tested, and reported. Critically, municipalities need clear guidance on how to initiate ecosystem accounting, what the entire process entails, and how the accounts can be implemented to support practice—be it in land use planning, green space management, political decision-making, or raising public awareness.

Our vision is that EA will become increasingly familiar as a component of general municipal accounting, fostering a better understanding of biodiversity and ecosystems—both for their intrinsic value and as fundamental elements of human well-being.

Urban ecosystem accounts hold considerable potential for making natural capital visible in municipal processes. To explore this potential, we collaborated with four Finnish municipalities in piloting different types of ecosystem accounts over three consecutive projects, each funded through different mechanisms. The pilot municipalities selected which types of ecosystem accounts to test based on topical priorities—ranging from climate adaptation measures to the construction of new tram infrastructure and related urban development. It is vital to understand the varying contexts in which ecosystem accounting can support spatial planning, green and blue space management, and political decision-making.

We also benefited from engagement with the broader Nature Municipalities Network in Finland. Through a series of online workshops, we addressed municipalities' practical needs and challenges—spanning policy issues, inter-sectoral collaboration, data availability, methodological understanding, internal capacity, and institutional communication.

The result is a co-created municipal ecosystem accounting model and guidance, to be published online in autumn 2025. While not exhaustive, the guidance has been designed for future expansion. It offers municipalities a clear framework for conducting ecosystem accounting that supports planning and decision-making processes. Concrete examples from urban ecosystems and good municipal practices help to make biodiversity and its value more tangible and easier to comprehend.

The model outlines the benefits of ecosystem accounting for municipalities, based on collaborative work, and includes step-by-step guidance aligned with the SEEA EA. It also provides recommendations on suitable data and methods. As not all ecosystem accounts can yet be covered in detail, the guidance focuses on the most relevant ones to start with and promotes their gradual adoption in practice. Further evidence and refinement will emerge through ongoing national and international research.

In our presentation, we will introduce the model and guidance, accompanied by insights on the feasibility and utility of ecosystem accounting from the perspectives of municipal practitioners in Tampere and Pirkkala.

Landscape as a Reflection of Human Action: Tracing Ecosystem Service and Identity Shifts in (Post)Authoritarian Lithuania

Ieva Misiune[1], Darijus Veteikis[1], Ričardas Skorupskas[1], Julius Mačiulaitis[1], Jurgita Mačiulytė[1]

[1]*Dept. of Geography and Land Management, Institute of Geosciences, Faculty of Chemistry and Geosciences, Vilnius University, M.K. Čiurlionio str. 21, Vilnius, LT-03101, Lithuania*

E-mail: ieva.misiune@chgf.vu.lt

This study explores how long-term land use change patterns reflect evolving human–landscape relations in the context of (post)authoritarian transformation. Focusing on two contrasting Lithuanian regions — the lowland area around Skaistgirys (Northern Lithuania) and the upland area around Suginčiai — we analyse landscape changes at a fine scale along 1 km wide and 15 km-long sample areas, divided into 1 km segments radiating from settlement centres. Using historical aerial imagery (1950s, 1970s, 1990s) and official vector data (2020), we reconstruct land use and land cover (LULC) trajectories to identify interactions among ecosystem services (ES). Seven ES were selected: crop and timber provision, carbon sequestration, pollination, water purification, soil retention, and habitat and species maintenance (all currently used in EU-level ES accounting). Changes in ES provision are evaluated using a scoring system based on land cover interpretation, supported by the descriptive and recognition capabilities of AI-assisted profiling. Additionally, we derive generalized identity (or *Genius Loci*) shifts based on ten spatial indicators (e.g., continuity, undisturbed nature, ecological reversal, built-up growth, and others) that reflect the landscape's structural continuity and transformation. In each segment, we also quantify two human-related indicators: the number of residential structures (serving as a proxy for human presence) and the length of former collective farm borders (indicating administrative periphery and potential neglect). These data are visualized along the axes of each sample area and analysed using correlation and principal component analysis to explore relationships between ES dynamics, human indicators, LULC transformations and identity shifts.

Preliminary results suggest significant differences not only between lowland and upland areas but also along internal spatial gradients — with outer segments often showing sharper trade-offs among ES and more fragmented identity patterns. The study highlights that landscape transformation, far from being ecologically neutral, reveals layered human behavioural patterns and long-term consequences of planning regimes. These findings stress the need to consider landscape as both a functional and symbolic record of collective action.

Valuing the Ecosystem Services of Urban Trees: A Remote Sensing Case Study from Wrocław, Poland

Zbigniew Szkop

Warsaw Ecological Economics Center, Faculty of Economic Sciences, University of Warsaw, ul. Długa 44/50, 00-241 Warsaw, Poland

E-mail: z.szkop@uw.edu.pl

Urban trees provide a wide range of ecosystem services - from air purification to climate regulation and water management. These benefits have real economic value, and being able to quantify them is key to helping local governments make informed, sustainable planning decisions. Traditionally, such valuations rely on detailed field inventories of trees, which are time-consuming and costly. This study presents a more innovative and scalable approach: using remote sensing to collect the data needed for large-scale ecosystem service valuation. As part of the LIFECOOLCITY project, we analyzed over 680,000 trees across a 60 km² area in Wrocław, Poland. High-resolution aerial imagery and LiDAR were used to derive key tree attributes, which were then processed through the i-Tree Eco model to estimate the physical value of three services: carbon sequestration, air pollution removal, and reduced surface runoff. Later, we applied the avoided cost method to calculate the monetary values of these services and the Net Present Value (NPV). The results show that urban trees in the study area deliver ecosystem services worth approximately 586 million PLN. More importantly, the study demonstrates how remote sensing can provide a fast, cost-effective alternative to ground-based inventories, making it possible to value the ecosystem services of urban trees to support real-world policy and investment decisions.

Moving beyond living places toward active mobility routes to ensure daily provision of urban ecosystem services

Edyta Łaszkiewicz[1]

[1]*Social-Ecological Systems Analysis Lab, University of Lodz, 3/5 P.O.W. Street, 90-25, Lodz, Poland*

E-mail: edyta.laszkiewicz@uni.lodz.pl

Active mobility such as walking improves physical and mental health, prompting urban planners and scientists to investigate which features of the built environment create supportive conditions for walking. One such feature is the presence of greenery, which provides multiple benefits, making walks more aesthetically pleasing and healthier, and offering opportunities to connect to nature. Children's daily walks, such as those to and from school, offer valuable opportunities to experience greenery and support active mobility from a young age [1]. However, the uneven distribution of greenery within cities results in socio-economic inequalities in exposure – both in children's living places and along their walking routes – limiting access to the various benefits that green spaces provide [2]. In addition, experiencing greenery may require children to take longer walking routes, thereby escalating spatial inequalities within city's landscape [3].

This study provides an overview of how exposure to greenery can be integrated into the promotion and planning of active mobility, using children's daily walks as a case in point. It offers a comprehensive approach to assessing and reinterpreting traditional understandings of green space exposure, with a focus on fostering a green, walkable urban environment. The aims of the study are: (1) to determine whether children's living environments or their walking routes offer better exposure to greenery; and (2) to explore whether socio-economic inequalities in children's exposure to greenery at home can be mitigated by greenery along their walking routes. Using Lodz (Poland) as a case study, these objectives were achieved through the application of GIS methods to multiple spatially explicit datasets, including information on children's living places, the pedestrian street network, and a high-resolution green space map.

This further contributes to the ongoing discourse on how to create greener and more sustainable cities. By focusing on children's exposure to greenery during their daily walks, it highlights the need to move beyond the traditional view that residential areas should be the primary providers of greenery and related benefits. Instead, it calls for greater emphasis on the potential of active mobility routes –a such as walking and cycling paths – to enhance the exposure to greenery and access to its associated benefits. Promoting awareness of the ecosystem services provided by urban greenery can help reshape paradigms of urban mobility, positioning greenery as an essential element of a walkable urban environment. While environmental and transportation goals are often seen as conflicting within urban planning, we argue that their integration is a necessary step toward ensuring sustainability for future generations.

References

1. Łaszkiewicz, E. and Sikorska, D., 2020. Children's green walk to school: An evaluation of welfare-related disparities in the visibility of greenery among children. Environmental Science & Policy, 110, pp.1-13.
2. Khanian, M., Łaszkiewicz, E. and Kronenberg, J., 2024. Exposure to greenery during children's home–school walks: Socio-economic inequalities in alternative routes. Transportation research part D: transport and environment, 130, p.104162.
3. Khanian, M., Łaszkiewicz, E., Kronenberg, J., & Sikorska, D. (2024). Urban heterogeneity of the trade-offs between exposure to greenery and walking distance in children's home–school routes. Applied Geography, 173, 103437.

Assessment of Cultural Ecosystem Services for Landscapes of National Importance in Latvia

Aiga Spage

Institute of Landscape Architecture and Environmeltal Engineering, Latvia University of Life Sciences and Technologies, Rīgas street 22, Jelgava, Latvia

E-mail: aiga.spage@lbtu.lv

Cultural ecosystem services (CES) play a key role in sustaining meaningful relationships between people and landscapes, especially in areas of national importance. This study focuses on assessing four categories of CES -symbolic, sacred, educational, and cultural-historical values - using several assessment methods in Gauja National Park, Latvia's largest and oldest national park. The park serves as a pilot area for testing methods applicable to the broader network of landscapes of national importance across the country.

A central aim of the research is to identify a CES assessment method that balances precision, relevance, and usability, particularly for integration into local and regional planning processes. To this end, three different approaches were applied and compared: (1) an online participatory mapping survey enabling residents and visitors to identify and assess georeferenced points of cultural value; (2) semi-structured interviews with experts from governance, spatial planning, tourism, and conservation sectors; and (3) GIS-based spatial analysis using publicly available and institutional datasets to model CES potential. The methodological comparison explores how each approach captures the spatial distribution and nature of cultural values, and to what extent they reflect community and expert perspectives. Simultaneously, the study critically evaluates each method in terms of resource requirements, technical complexity, and its potential for practical application by local governments without relying on external research expertise. Rather than aiming to determine a single "best" method, the study focuses on evaluating the trade-offs between methodological depth, data richness, and practical feasibility. While the combination of methods is expected to provide the most comprehensive and nuanced understanding of cultural ecosystem services, it is also clear that some approaches—particularly participatory surveys and expert interviews—are significantly more time-consuming and resource-intensive. In contrast, GIS-based analysis offers a more standardized and replicable tool, though it may lack contextual sensitivity when used in isolation.

Ultimately, the research aims to contribute to the development of a CES assessment framework that is both scientifically robust and practically applicable in landscape planning and governance. The study is carried out within the framework of the LBTU Doctoral Support and Development Initiative, ERAF project Nr. 1.1.1.8/1/24/I/002.

Mismatch Analysis of Cultural Ecosystem Services in Natural Areas: A Case Study in Southern Italy

Milena V. Sokolova[1], Severino Romano[1], Mauro Viccaro[1], Fabrizio Pedes[2], Costantino Sirca[2], Donatella Spano[2], Mario Cozzi[1]

[1] *Department of Agricultural, Forestry, Food and Environmental Sciences, University of Basilicata, Viale dell'Ateneo Lucano, 10, 85100 Potenza, Italy*

[2] *Department of Agricultural Sciences, University of Sassari, Viale Italia 39/a, 07100 Sassari, Italy*

E-mail: milena.sokolova@unibas.it

Natural landscapes provide a wide range of benefits to people, including recreational opportunities that support physical health, psychological well-being, and emotional resilience. These benefits are known as Cultural Ecosystem Services (CES). Despite their importance, CES are often underestimated due to their intangibility and lack of a market price, which leads to them receiving less scholarly and policy attention compared to provisioning and regulating services. As a result, CES are frequently overlooked in decision-making processes, despite their essential role in shaping cultural identity, mental health, and overall quality of life. In this context, identifying monetary assessment, which reflect supply and demand of CES as a part of economic evaluation, is crucial, — especially considering the limitations of natural resources. In metropolitan and suburban regions — characterized by dense urban development and limited ecological space — it's often economically and practically unfeasible (but not impossible) to expand natural land or improve connectivity between ecosystem service supply areas. Consequently, mismatches between the supply and demand of ecosystem services are common in rapidly urbanizing regions. To maximize the benefits of limited ecological resources, it is essential to identify critical areas with high CES supply and demand and understand their spatial interactions. This can help translate ecosystem service theory into practical strategies for ecological conservation and restoration.

Additionally, the Millennium Ecosystem Assessment (MEA), 2005 framework classifies CES as having weaker linkages to core aspects of human well-being, compared to other ES, which reflects the challenge of quantifying their benefits rather than a lack of importance. Addressing this gap requires innovative approaches that can represent and measure the less tangible aspects of human-environment interaction.

The present study focuses on Southern Italy, specifically 8 regions: Abruzzo, Apulia, Basilicata, Calabria, Campania, Molise, Sardinia, and Sicily, covering about 41% of the national territory. The research follows the MEA framework to assess CES supply and demand and explores peoples' preferences for recreational activities using geotagged data collected via *Greenmapper*, an online questionnaire focused exclusively on natural areas, with approximately 4,000 respondents from Southern Italy.

The methodology integrates geospatial data with a *Random Forest regression model*, a machine learning technique used to generate predictive maps in GIS. Random Forest builds multiple decision trees using different subsets of the data and averages their predictions to improve accuracy and reduce overfitting. Using training data and spatial predictors, the model estimates continuous variables across the study area. Key predictors will include several parameters (e.g., *population density, protected areas, distances from the main roads),* based on series of statistical assessments for further regression analysis.

The expected result is a spatial distribution map of CES supply and demand, highlighting potential mismatches, particularly in relation to recreation-related services. These findings will provide valuable insights into the distribution of CES in Southern Italy and inform more effective and inclusive urban and regional planning strategies. By quantifying CES and demonstrating their importance, particularly their recreational and aesthetic values, this study aims to support better policymaking, preserve cultural heritage, promote sustainable tourism, and enhance quality of life in Southern Italy.

Shifting patterns of cultural ecosystem service demand characteristics across spatial scales: a case study from Finnish urban areas

Anita Poturalska[1], Terhi Ala-Hulkko[2,3], Janne Artell[4], Katja Kangas[4]

[1]*Geography Research Unit, University of Oulu, Oulu, Finland*
[2]*Department of Built Environment, Aalto University, Espoo, Finland*
[2]*Kerttu Saalasti Institute, Nivala, Finland*
[2]*Natural Resources Institute Finland, Oulu and Helsinki, Finland*

E-mail: anita.poturalska@oulu.fi

Urban areas provide countless cultural ecosystem services (CES) that are vital to our well-being and quality of life. Due to rapid urbanization, the demand for CES has increased significantly, putting pressure on urban ecosystems destabilizing the quality and availability of CES for everyone [1]. Exploring CES demand characteristics helps us understand how demand intensity affects urban ecosystems and supports the development of ecosystem-based management plans to enhance urban sustainability [2,3].

In our study we examine how different groups of characteristics influence the CES demand at the local urban scale across three Finnish cities: Espoo, Kuopio, and Jyväskylä. We use public participation geographic information systems (PPGIS) survey data, a tool that explores patterns of human perceptions, behaviors, and preferences. The annual number of visits to a given location marked by PPGIS survey respondents serves as a proxy for CES demand. The demand characteristics examined in the study include the socio-demographic background of CES users; CES-related activities and motivators, such as recreation, berry picking, and beautiful landscapes; spatial factors, such as accessibility or distance to the visited location; and environmental and infrastructure characteristics of the surroundings, such as availability of recreational roads, green or blue spaces, as well as the presence of highly biodiverse forests. Additionally, we conduct a comparative analysis of the impact of the studied characteristics across geographical scales, considering neighborhoods close to and farther from the homes of survey respondents. This allows for a multiscale assessment of the role of these characteristics across urban neighborhoods.

The results of our study suggest that CES demand characteristics play a different role across scales and distances. At the same time, accessibility remains the most important factor in deciding whether to visit a place across all studies neighborhoods. Our findings indicate that access to service-providing areas is crucial for CES users and underscore the importance of caring for urban ecosystems, particularly those affected by increasing urbanization.

References

1. Holt, A.R., Mears, M., Maltby, L., Warren, P. *Understanding spatial patterns in the production of multiple urban ecosystem services*, 2015, Ecosystem Services v.16.
2. Krsnik, G., Illán-Fernández, E.J. *Assessing indicators and preferences of cultural ecosystem services in urban areas: a case study of Murcia, Spain*, 2024, Landscape Ecology v.39, 190.
3. Milcu, A.I., Hanspach, J., Abson, D., and Fischer, J. *Cultural ecosystem services: a literature review and prospects for future research,* 2013, Ecology and Society v.18(3).

Integrating cultural ecosystem services into the EnhancES toolbox

Harald Zepp[1], Malte Bührs[1], Lars Gruenhagen[1],
Kathrin Specht[2], Barbara Schröter[2], Chiara Iodice[2], Emilie Schätte[2]
[1]***Institute of Geography, Ruhr University Bochum, Germany, Universitätsstr. 150, 44810 Bochum, Germany***
[2]*ILS Research gGmbH, 44135 Dortmund, Germany*

e-mail: harald.zepp@rub.de

The ecosystem services "Activities promoting recuperation through active interaction with nature" (CICES 3.1.1.1), "Activities promoting recuperation through passive interaction with nature" (3.1.2.2), and "aesthetic experiences in nature" (3.1.2.4) bundle what is often referred to as recreation ecosystem services. There was a demand to integrate cultural ecosystem services into EnhancES, the toolbox for assessing, mapping and enhancing ecosystem services (Zepp et al. 2025). EnhancES is jointly created by the Institute of Geography, Ruhr-University Bochum and ILS Research gGmbH, Dortmund (Germany) as an open source GIS-based resource open to the public.

Commonly, the strength of ecosystem services flows is quantified by on-site observations, questionnaires or by social media analyses of selected urban green spaces. The results are usually site-specific and not transferable to regions not studied. In our study, the perception of urban green spaces by the local people was based on social media analyses in the cities of Bochum and Gelsenkirchen, Germany, which were presented earlier at ECOSERV (Busch et al. 2024). We combined them with readily available predictor variables derived for 287 green and open spaces that derived from the GIS-environment of EnhancES. In this presentation, we explain how we operationalized the variables and test functional relations using correlation analyses.

The final models are multiple regressions for each of the three ecosystem services. Our task was to develop some reasonably transferable models that would work across large parts of western and central Europe. The models have considerably high goodness-of-fit criteria. Their bundling into a recreation ecosystem service is possible, but not always justified. We discuss the validity and limitations of the models using examples from the two cities where the models were created.

References

1. C. Busch, K. Specht, L. Inostroza, M. Falke, H. Zepp, *Ecosystem services* **2024**, *70*, 101675.
2. H. Zepp, L. Inostroza, M. Bührs, L. Gruenhagen, C. Busch, N. Dong, *Ecosystem services* **2025,** 74,101744.

Assessment of the potential for providing of Recreational Forest ecosystem service in National Park Poloniny region

Maros Sedliak[1], Zuzana Sarvasova[1], Robert Sedmak[2]

[1]National Forest Centre, [1]National Forest Centre, [2]Technical University in Zvolen

e-mail: maros.sedliak@nlcsk.org

The paper deals with the topic of an integrated approach to assess the potential for provision of the Forest ecosystem service Recreation in forest stands in the Poloniny National Park region. The assessment of the potential for provision is based on more than 20 indicators classified into four dimensions – Environment, Forest Appearance, Forest Management and Technical Infrastructure in the forest and its surroundings. The assessment was based on data about forest stands stored in the Forest management plans, data about forest naturalness, their accessibility for recreation and localization of recreational infrastructure, which was identified in maps and in the field too. Data processing was carried out either using database tools or using spatial analyses in GIS, which represents an original approach to their assessment in forest stands. The result is represented by geospatial layer of the potential of provision the recreational Forest ecosystem service on the forest stand (stand compartment) spatial resolution. Each forest stand was classified into 1 of 5 classes from very low to excellent potential. The advantage of this approach is the use of available forest data, while the results can be easily updated, e.g. after the renewal of the Forest management plan. Results use consist in raising public awareness on the importance of Forest ecosystem services, designing possible support instruments to forest managers (payments for Ecosystem services), and in building consensus among different stakeholders on priorities in the use of Ecosystem services.

Urban riverscapes and well-being: What attracts visitors and deters non-users?

Tomasz Grzyb[1], Sylwia Kulczyk[1],

[1]*Faculty of Geography and Regional Studies, University of Warsaw, Krakowskie Przedmieście 30, Warsaw, Poland*
[1]*Faculty of Geography and Regional Studies, University of Warsaw, Krakowskie Przedmieście 30, Warsaw, Poland*

E-mail: t.grzyb@uw.edu.pl

Intentional interactions with urban green and blue spaces are essential for shaping residents' physical and mental well-being. While the beneficial outcomes of such interactions are often analyzed through the lens of cultural ecosystem services, a complete understanding requires acknowledging the other side of the coin – namely, the disturbing or unpleasant nature-related phenomena, negative effects associated with human-made facilities, and visitors' behavior. For effective management of urban green and blue spaces, it is vital to identify and understand the synergies and trade-offs among various well-being agents, along with their environmental and social contexts. Despite widespread recognition of benefits associated with human-nature interactions, some of the urban residents do not visit green and blue spaces for various reasons. In contrast to the extensive studies of users of these spaces, relatively little research has focused on the motivations of non-visitors, particularly with respect to specific types of spaces. This study addresses these gaps by drawing on data from a representative survey conducted in Warsaw, Poland. It provides a conceptually integrated evaluation of interrelationships between riverscapes and well-being of city residents. The findings reveal substantial socio-demographic differences between frequency groups. Regular and occasional visitors are most attracted by the protection status of the river, a well-developed network of pedestrian and cycling paths, and its diverse landscape. At the citywide scale, visitors clearly differentiate between comfort and discomfort agents. However, local-scale associations are more nuanced, with agents grouping into four ways how urban riverscape can shape visitors' well-being. These ways highlight (1) difficulties in loving riverine nature; (2) chilling despite dissatisfying facilities; (3) mixed feelings about other visitors, and (4) sports performed despite safety concerns. All of them are influenced by both the characteristics of the visited places (such as viewshed size and area homogeneity), and visitors' temporal preferences. In contrast, non-visitors tend to be older, more rooted in the city, and less likely to be in stable employment. Their most commonly cited motivations for avoiding the riverscape include a preference for spending time elsewhere, engagement in different activities, and a general disinterest in the river. Importantly, none of these motivations were substantially associated with a willingness to reconsider visiting. This study offers new insights for policymakers in riverine cities. It explores substantial and spatial interrelationships between positive and negative experiences of visitors, and sheds light into the objective and preferential motivations of non-visitors.

This work was supported by the National Science Centre, Poland, under Grant Nr 2022/45/N/HS4/01276.

Urban Allotment Gardens In Post-Communist Czechia: Spatial Analysis, Typology, And Ecosystem Services Assessment

Barbora Duží[1], Petr Dvořák[2], Šimon Jelínek[3]

[1]*Department of Environmental Geography, Institute of Geonics, Czech Academy of Sciences, Drobného 28, Brno, Czechia*
[2]*Department Environmental Geography, Institute of Geonics, Czech Academy of Sciences, Drobného 28, Brno, Czechia*
[3]*Department of Geography, Masaryk University, Kotlářská 2, Brno, Czechia*

E-mail: barbora.duzi@ugn.cas.cz

This contribution examines recent trends in the development of urban allotment gardens (UAGs) in the Czech Republic, a post-communist country in Central and Eastern Europe (CEE). We focus on the adaptation of urban gardening to contemporary pressures of urban development and evolving lifestyles, including shifting urban planning priorities over time. Urban allotment gardens represent multifunctional spaces utilized by approximately 8% of the urban population [1,2].

UAGs contribute to ecosystem services in various ways, primarily through provisioning services (food production and ornamental plant cultivation) and cultural services (recreation activities and leisure spaces). Depending on location, plot organization, and gardening management practices, they can also contribute to regulating ecosystem services and biodiversity support. The importance of UAGs is formally recognized by the Gardening Act (Act No. 221/2021 Coll.), which acknowledges gardening as a publicly beneficial activity and highlights positive environmental impacts such as land protection, water conservation, biodiversity preservation, climate change mitigation, and community building. Furthermore, the legislation encourages municipalities and the state to support allotment gardens through favourable lease arrangements and active establishment of new garden spaces [1,2].

Our research aimed to conduct a comprehensive spatial analysis of UAGs, develop an innovative typology of urban allotment gardens from geographical and socio-environmental perspectives, identify key development patterns in selected gardens, and provide practical recommendations for gardeners and local authorities regarding the management and supervision.
Initially, we identified UAG locations through combined analysis of maps, territorial plans and field research in Uherské Hradiště, Opava, Olomouc, and Ostrava. UAGs are classified under various land-use categories, typically as agricultural or recreational areas, though occasionally as settlement or protection greenery. These designations establish permitted uses, restrictions, and building limitations. Using vectorized 2022 orthophotos, we mapped current land use within allotments, categorizing areas as production zones (vegetable beds), intensification features (greenhouses), built structures (sheds and houses), nature-like areas (dense vegetation), pathways, and recreational spaces, using ArcGIS Pro 3.3. Moreover, we conducted spatio-temporal analysis of selected UAGs, based on ortho-photos and aerial imagery from the 1950s, 2012, and 2022, along with 1971 and 1993/1994 aerial surveys.

Based on our findings, we propose four dominant UAGs types: predominantly productive, balanced productive-recreational, predominantly recreational with housing potential, and climate-adapted. We emphasize the crucial role of urban gardening as part of green and blue infrastructure and its contribution to food security, while critically evaluating certain gardening practices that may contribute to environmental degradation of these urban ecosystem components. We conclude by providing recommendations to local authorities and urban planners on maintaining and developing UAGs to optimize ecosystem services delivery.

References

1. Smutná, Z., Vávra, J., Duží, B. An insight into market and non-market alternative food networks in Czechia during Covid-19 and beyond. *Frontiers in Nutrition*, 2024, 11, 1327308.
2. Duží, B., Johanisová, N., Vávra, J. (Eds.) *Allotment gardens: Losing ground*? 2021, Ostrava: Institute of Geonics

Understanding Perceptions: Farmers' And Public Prioritization Of Es In Czech Agricultural Landscapes

Lenka Dubová[1], Jiří Louda[1], Jan Macháč[1]

[1]*Institute for Economic and Environmental Policy, Faculty of Social and Economic Studies, J. E. Purkyne University in Usti nad Labem, Pasteurova 3544/1, 400 96, Usti nad Labem, Czech Republic*

E-mail: dubova@ieep.cz

Ecosystem services (ES) play a crucial role in sustaining agricultural productivity, supporting biodiversity, and ensuring the resilience of rural landscapes. However, the reliance on synthetic fertilisers, pesticides, and intensive technologies has led to biodiversity loss and reduced the capacity of landscapes to provide essential ES (e.g. Watson et al., 2021). These pressures, coupled with the increasing risks of climate-induced natural hazards, demand a shift towards sustainable farming practices, including the adoption of nature-based solutions (NBS). Understanding how farmers perceive and prioritise ES is vital for developing policies and interventions that foster sustainable transitions in agriculture.

This research, conducted in the Czech Republic during 2023 and 2024 and framed within the IPBES ecosystem services classification, examines the perceptions of conventional and organic farmers regarding ES. Using semi-structured interviews and ES prioritisation exercises, farmers consistently ranked provisioning services (e.g., food production, soil formation) as more critical to their livelihoods than regulating services (e.g., hazard mitigation, climate regulation). Differences between conventional and organic farmers' perceptions of ES were also found. Barriers to adopting NBS were identified, including administrative burdens, fragmented land ownership, and economic constraints.

A similar survey was carried out among the population across the Czech Republic to determine the perceived importance of the ES for agriculture. Our findings reveal distinct prioritization patterns in the perception of ecosystem services (ES) by the general public. Cultural services, such as physical and mental experiences, were ranked among the most important alongside provisioning and regulating services, including food production, and water quality regulation. Conversely, supporting and less tangible services, such as soil formation, hazard regulation, and learning opportunities, were perceived as least important. These results may indicate the need for awareness campaigns to foster public understanding of the critical role of all ES in ensuring long-term landscape resilience.

These findings highlight the need for policy measures tailored to the Czech agricultural context, including reducing bureaucratic obstacles, streamlining land management processes, and providing targeted financial incentives for adopting sustainable practices. Enhancing farmer education on the long-term benefits of regulating services and integrating ES awareness into agricultural policy can better align farmers' priorities with landscape resilience goals. Decision-makers should focus on simplifying administrative processes and fostering collaboration between stakeholders to accelerate the transition towards sustainable, ES-based agricultural systems. The research demonstrates the potential of ES-focused strategies to address environmental challenges while delivering economic and social benefits for farming communities in the Czech Republic.

References

1. S. Watson, A. Ch. Newton, L.Ridding, *Landscape Ecology, Does agricultural intensification cause tipping points in ecosystem services?*,**2021**, *36(1)*, 3473-3491

Mapping local food heritage in Poland

Alina Gerlée[1], Małgorzata Harasimowicz[1], Maria Zachwatowicz[1], Marta Grzywacz[1], Sylwia Kulczyk[1], Marta Derek[1]
[1]*Faculty of Geography and Regional Studies, University of Warsaw, Krakowskie Przedmieście 26/28 00-927 Warsaw, Poland*

E-mail: a.gerlee@uw.edu.pl

The concept of 'local food' seems to address some of the problems with food which we face nowadays: it is associated with sustainable and healthy production and consumption patterns, supports "weak" actors in the system (farmers in particular), and is more environmentally-friendly (lower carbon footprint). 'Local food' is not only about geographical proximity; it is also about farming what is strongly tied to the environmental conditions of a place. Heritage is a key concept here: at the local level, food heritage is usually based on the availability of natural resources, present or historical, as well as local people's attitudes to nature.

The aim of this research is to identify and map local heritage food in Poland, as well as to explain its distribution with ecological, economic and social data. To achieve this goal we used the "List of traditional products", which is developed by the Ministry of Agriculture and Rural Development. It includes over 2100 products and dishes from different categories: meat, dairy, bakery and confectionery products, honey, fruit and vegetables, ready meals and dishes. By mapping all those products, we want to identify clusters of local food in Poland, and explain their location by a set of geographical factors.

The research is conducted within the project: Localinary. "Linking people and nature in local heritage food. A social-ecological system approach", funded by the National Science Centre, Poland" (UMO-2023/49/B/HS4/00769)

Nature's contribution to food. How local food studies assess the co-production of ES?

Marta Derek[1], Sylwia Kulczyk[1], Ada Górna[1], Alina Gerlée[1], Luis Inostroza[2]

[1]*Faculty of Geography and Regional Studies, University of Warsaw, Krakowskie Przedmieście 26/28 00-927 Warsaw, Poland*
[2]*Department of Environmentalistics and Natural Resources, Mendel University in Brno, Zemědělská 1665/1 Brno, 613 00, Czech Republic*

E-mail: m.derek@uw.edu.pl

Under a capitals approach, the delivery of ecosystem services occurs as a result of the interaction between natural, built, social and individual capital. In food systems as well, ecosystem services are co-produced through the interaction of natural and non-natural capitals. In this paper, we examine how the natural landscape elements, that serve as prerequisites for ecosystem services, are assessed in studies focusing on local food. Specifically, we explore the methods and indicators used to evaluate the values of ES, using the IPBES methodology.

Our work is based on a systematic review of articles from the Scopus database. We searched for articles using "local food" in the title or the keywords. After reviewing all abstracts, and in some cases all articles, we selected articles focusing on food products, groups of food products, or meals. We first analysed how these articles referred to the elements of the social-ecological system, which helped us identify articles that included natural landscape elements into the research.

Out of 1.580 articles which were extracted from Scopus, only 279 focused on specific food products. In 87 articles natural landscape elements related to the food product were taken into account. The results of our analysis show that half of them (43) assessed values of ES. The methods used the most often include nature-based valuation methods (especially using species lists and statistical data), which appeared in 21 research papers, and statement-based valuation methods (with surveys and interviews as the most popular), which appeared in 20 papers.

These results show that studies which focus on local food rarely acknowledge the natural landscape components and their contributions. The 'local food' approach mainly focuses on non-natural capital (e.g. cultural heritage, types of distribution, or consumers' interests and preferences), often overlooking the role of nature in the co-production of ecosystem services related to food.

The Impact of Agricultural Activities on the Ecological Footprint in Eastern European Countries: Application of the NARDL Model

Daiva Makutėnienė[1], Valdemaras Makutėnas[1], Algirdas Justinas Staugaitis[1], Vardan Aleksanyan[2]

[1]*Department of Applied Economics, Finance and Accounting, Vytautas Magnus University Agriculture Academy, Universiteto str. 10, LT-53361 Akademija, Kaunas dist., Lithuania*

[2]*Faculty of Economics and Management, Yerevan State University, 1 Alex Manoogian, 0025, Yerevan, Armenia*

E-mail: daiva.makuteniene@vdu.lt

The research explores the relationship between agricultural activities and the ecological footprint in selected Eastern European countries – Lithuania, Latvia, Estonia, and Poland – through the application of the non-linear autoregressive distributed lag (NARDL) model. The research aims to identify key agricultural factors influencing environmental degradation and assess the potential for ecological footprint reduction through sustainable agricultural development. Results do not support the environmental Kuznets curve hypothesis in any of the analyzed countries. Trade openness in agriculture is found to generally increase the ecological footprint, while greater use of renewable energy is associated with its reduction. Additionally, a declining share of agricultural employment appears to correlate with a rise in environmental impact. These findings suggest that improvements in agricultural production efficiency alone are not sufficient to mitigate ecological harm, emphasizing the need for targeted policy interventions. The study contributes to the existing literature by employing ecological footprint as a comprehensive metric of environmental degradation, offering nuanced insights into the agricultural-environment nexus in the Eastern European context.

Towards Sustainable Finance: Examining Green Bond Issuance Drivers and Pathways for Advancing the SDGs

Vilma Kazlauskienė[1], Algirdas Justinas Staugaitis[2]

[1-2] *Faculty of Business, Kauno kolegija Higher Education Institution, Pramonės av. 20, LT-50468 Kaunas, Lithuania*

E-mail: vilma.kazlauskiene@go.kauko.lt

With the accelerating global emphasis on sustainable development, green bonds have become essential tools for channeling investment towards achieving the Sustainable Development Goals (SDGs). Despite growing interest, the factors driving green bond issuance and their relationship with broader sustainability performance remain complex and not fully understood, particularly across diverse institutional and fiscal contexts within the European Union. This study aims to investigate the key institutional, fiscal, and policy-related determinants that influence green bond issuance across EU countries, providing insights into their role in advancing sustainable finance. Analyzing panel data from 24 EU countries over the period 2018–2024, the study employs fixed effects regression models to examine the relationships between green bond issuance and variables including sustainability performance, fiscal capacity, and other economic indicators. Contrary to conventional expectations, higher sustainability performance does not necessarily lead to greater issuance of green bonds, suggesting that entities with advanced sustainable governance may prefer alternative financing mechanisms. Additionally, countries with stronger fiscal capacity tend to favor direct public funding for sustainability initiatives rather than relying on market-based green financing. These findings highlight the nuanced dynamics shaping green bond markets and underscore the need for tailored policy approaches. Future research should explore qualitative aspects such as regulatory frameworks, investor behavior, and impact measurement to enhance green bond effectiveness. Comparative analyses across different economic contexts could further inform strategies to optimize the role of green bonds in achieving the SDGs and guide the development of sustainable financial architectures.

Implementing a Water-Related Payment for Ecosystem Services Between a Protected Area and a Water Service Operator

Francesca Visintin[1], Stefano Santi[2], Francesco Marangon[3], Stefania Troiano[3]

[1]*eFrame ltd, Via Linunssio 51, 33100 Udine, Italy*
[2]*Department of Economics and Statistics, University of Udine, Via Tomadini 30 A, 33100 Udine, Italy*
[3]*Julian Prealps Nature Park, Piazza del Tiglio 3, 33010 Prato Resia, Italy*

E-mail: francesca.visintin@eframe.it

The ecosystem service (ES) of drinking water provision represents a key element in the relationship between natural ecosystems and human well-being. This study examines a Payment for Ecosystem Services (PES) scheme to be implemented between a water-utility company, responsible for managing the integrated water service, and a nature park (NP) from which the water resource is extracted. The payment mechanism is intended to support land management measures within the catchment area, ensuring the maintenance of both the quantity and quality of the water resource, going beyond the actions already outlined in the current management plan of the NP, thus ensuring the principle of additionality.

The approach adopted follows the criteria proposed by Wunder [1] for PES schemes: (a) Voluntary transaction: the water-utility company recognizes the value of the ES provided by the NP and is willing to collaborate with the park authority to develop projects for the sustainable management of water resources and biodiversity conservation; (b) Well-defined ES: the ES refers to the provision of drinking water through water abstraction from springs located within the park; (c) Bought by at least one ES buyer: the water-utility company acts on behalf of end-users; (d) Provided by at least one ES provider: the park authority represents the service providers; (e) Conditionality: payment occurs only if the ES provider ensures the actual provision of the ES.

Operationally, the PES scheme is being developed through the following phases: (1) The catchment area of the springs within the park has been identified; (2) The most suitable management measures are being defined to ensure the functionality of the ecosystems that support the drinking water provision service. These measures include: active conservation actions for ecosystem protection and restoration, active monitoring of anthropogenic pressures and their underlying drivers, territorial surveillance, and the implementation of monitoring systems; (3) Service providers are then identified, including landowners, public or private entities, or other stakeholders responsible for implementing the management measures; (4) In cases where potential dysfunctions are reported, appropriate actions will be selected from the management measures listed in point (2), including: practices aimed at preserving ecosystem functionality, conversion strategies to be agreed upon with the providers, and actions eligible for economic compensation or support measures.

To determine the maximum value of economic compensation, a choice experiment was conducted to estimate the utility surplus that consumers attribute to drinking water sourced from a protected natural area. Out of a population of 331,000 households, the survey was administered to a statistically representative sample of 511 respondents. The results enabled the monetary valuation of the added value perceived by citizens, expressed as "management measures that safeguard water quality and potability guaranteed for 50 years." Each household estimated an annual surplus of €105.64 associated with the opportunity to access drinking water from the protected area.

From a regulatory perspective, the design of this PES scheme is consistent at the European level with Directive 2000/60/EC (Water Framework Directive), particularly regarding the principle of water pricing; and at the national level with Ministerial Decree No. 39 of 24 February 2015, "Regulation establishing the criteria for defining environmental and resource costs for different water use sectors," as well as with the Operational and Methodological Manual for the Implementation of Economic Analysis, published in 2018 by the Italian Ministry of the Environment. This framework provides a solid empirical basis for the development of a PES scheme that is fair, effective, and sustainable in the long term. The study contributes to the ongoing discourse on integrated water resource management and the use of economic instruments to recognize and enhance the value of ES.

References

1. Wunder, S., Revisiting the concept of payments for environmental services, *Ecological Economics* ***2015,*** *117*, 234-243.

Applying a PPGIS survey for urban ecosystem service accounting: educational and recreational services in Pirkkala municipality, Finland

Tin-Yu Lai[1], Erkka Hurtola[2], Kalle Salovaara[2], Vesa Vanninen[2], Jonna Luukinoja[2], Leena Kopperoinen[1], Pekka Hurskainen[1], Elise Järvenpää[1], Maria Söderholm[1]

[1]*Finnish Environment Institute, Latokartanonkaari 11, 00790 Helsinki, Finland*

[2]*Pirkkala Municipality, PO Box 1001, 33961 Pirkkala, Finland*

E-mail: tin-yu.lai@syke.fi

Urban nature plays a key role in nature visits from kindergartens and schools, as well as in people's recreation in Finland. The study used two public participation geographic information system (PPGIS) surveys to evaluate the educational and recreational ecosystem services provided by green and blue areas in the municipality of Pirkkala, Finland. The survey results were further used to compile urban ecosystem service accounts. For educational services, a survey was distributed to teachers or managers of day-care centers as well as primary and secondary schools in Pirkkala between October 2021 and February 2022. Respondents were asked to map the locations of nature visit by the classes and provided the information on visit frequency, duration, number of children, and types of activities conducted. Depending on the institution, the visits per children ranged from 22 – 111 visits per year in day-care and 3 – 12 visits per year at school level. The corresponding visiting times were 138 – 201 hours/year per child and 6.8 – 8.5 hours/year per student, respectively. When survey results were extrapolated to the municipal level, children's and students' total annual visits and time spent in nature at day-care centers and schools were estimated to be 80,989 – 103,467 visits and 181,908 – 280,563 hours in total. The educational services were valued by using the resource rent method based on the price of 17 environmental activities and outdoor education programs which do not need any specific equipment in Finland and the part-time salary of an environmental educator. The estimated resource rent was 0-60% of the activity price, resulting in the highest unit value of the education services at 2.1 EUR/child/hour. By linking mapped locations to ecosystem types, ecosystem service supply and use accounts were compiled with the estimated visit numbers, time, and service value. When measured by number of visits as the physical term, coniferous forests provided the highest service level, followed by recreational forests and recreational urban parks. In contrast, when measured by time or monetary value, sports and recreation sites ranked highest, followed by coniferous forest and recreational forests. For recreational ecosystem services, a similar PPGIS survey with additional questions on travel time, distance, and mode was open to everyone from August to October 2024 and sent to 4,000 residents (representative sample) living in Pirkkala from December 2024 to January 2025. With 388 respondents living in Pirkkala and 1,486 markings, the survey gave an average of 53 recreational visits/person/year. A travel cost model was applied to estimate the unit value of recreational services resulting in 6.6 EUR/visit/person for visiting the forest ecosystem types and 6.17 EUR/visit/person for non-forest ecosystem types. Considering the population structure of the Pirkkala municipality, total weighted recreational visits were estimated at around 3 million/year, with a total service value of approximately 20 million EUR. The accounting results showed that the highest recreational service value was provided by coniferous forests, which is four times more than the next most valuable ecosystem type, non-irrigated arable land. The results of both survey and accounts have been used by Pirkkala municipality for their latest biodiversity program. The PPGIS survey was piloted as a method for urban ecosystem accounting in this study. Empirical experience of compiling educational services provided by nature into ecosystem accounts has previously only appeared in grey literature from Estonia. In the experience of recreational service accounts, national accounts typically rely on tourism statistics or non-GIS surveys, which are too coarse for municipal-level planning and compiling municipal ecosystem accounts. STRAVA data have also been tested in urban ecosystem accounting, but the data characteristics and limitations of public accessibility make it often unsuitable for municipal use. Through collaboration with Pirkkala municipality, this study established a practical strategy for applying PPGIS surveys to compile educational and recreational service accounts at the municipal level, with lessons learned.

From Maps to Services: Evaluating Other Wooded Lands for the EUDR with evidence from the Cerrado biome.

Mathew Tello[1,2], Juliana Freitas Beyer[1], Margret Köthke[1], Melvin Lippe[1]

[1]*Thünen Institute of Forestry, Leuschnerstraße 91, 21031, Hamburg, Germany*
[2]*Agroparistech, 648 rue J-F Breton, BP 7353, 34086, Montpellier, France*

E-mail: mathew.tello@thuenen.de

The EU Deforestation Regulation (EUDR) aims to reduce deforestation in forest ecosystems, but it is being criticized for potentially displacing pressure to non-included land cover categories such as other wooded lands (OWLs). In the current EUDR framework, only forests are included as relevant land cover category, while an upcoming review assessment will decide whether OWLs should be considered by the framework too. Having accurate OWL mapping at place is thus crucial for both future EUDR compliance monitoring and ecosystem service assessments. However, using remote sensing-based maps in heterogeneous land systems such as OWLs remains a challenging task due to a risk of misclassification with grasslands, shrublands, or savanna-type ecosystems. Subsequently, the aim of this study is to assess a) how the extent of OWL obtained from different land cover maps reflect different levels of fragmentation at landscape-level and b) given these potential discrepancies, what are the functional consequences of fragmentation for key OWL ecosystem services, using as case study the Cerrado Biome in Maranhão State, Brazil?

Results showed large discrepancies of OWL extents and in fragmentation metrics (patch area, edge density, connectivity), with some maps portraying OWLs as highly fragmented and others as more aggregated. Examining the relationships between ecosystem service proxies (aboveground biomass – AGB, biodiversity intactness index – BII), landscape fragmentation metrics (patch area, connectivity, and edge density), and environmental covariates (soil and fire) revealed that BII was influenced by cation exchange (CEC) capacity and fire, with a moderate effect from connectivity. Similarly, AGB was primarily driven by soil (clay and soil organic content) with a moderate effect from patch area.

These findings highlight that the choice of land cover dataset will strongly determine monitoring and policy outcomes, and that soil conditions can be decisive for ecosystem service provision in case of OWL. At a broader scale, the dataset chosen for EUDR compliance checks may determine which OWLs and ecosystem services are effectively protected, having consequences on whether deforestation and degradation of important ecosystems such as OWL can be truly avoided in the future by the EUDR or not.

Law as a Factor Affecting the Implementation of Knowledge on Ecosystem Services Interactions into Practice

Justyna Goździewicz-Biechońska[1], Anna Brzezińska-Rawa[2]

[1]*Department of Agricultural, Food and Environmental Protection Law,Faculty of Law and Administration, Adam Mickiewicz University, al. Niepodległości 53, 61-714 Poznań, Poland*

[2] *Department of Environmental Protection and Public Economic Law, Faculty of Law and Administration, Nicolaus Copernicus University, Władysława Bojarskiego 3, 87-100 Toruń, Poland*

E-mail: jusgoz@amu.edu.pl; rawa@umk.pl

The implementation of the ecosystem services concept particularly in its interaction dimension is a complex process influenced by numerous factors. This presentation aims to define the role of law in that process. We adopt the perspective of European Union (EU) law, as the concept of ecosystem services is already embedded in the EU's environmental policy, as reflected in both legislation and soft law documents.

First, we assess the current stage of policymaking in this area. Policymaking refers to the process by which environmental issues are transformed into collectively binding decisions and encompasses three sub-stages: policy formulation, decision-making, and policy shaping [1]. In our research, we focus on environmental legislation as a form of collectively binding decisions and examine its importance in promoting the practical application of the ecosystem services concept. We, therefore, analyse how the concept of ecosystem services has been integrated into EU environmental policy and assess its current status in the context of binding standards for implementation.

The second part of the study focuses on implementation as a process resulting in national policy outputs (i.e. administrative products produced by implementing actors) and policy outcomes (i.e. behavioural changes among addressees). This section aims to explore the connection between EU legislation on ecosystem services and national-level management practices. Both existing and potential legal pathways for fostering the ecosystem services approach in practice are discussed, taking into account the various types of services ecosystems provided and their interactions.

References

1. H. Deters, Policy making, in: *Environmental policy in the EU. Actors, Institutions and Processes,* Eds. A. Jordan, V. Gravey, 2021, Routledge; 186-202.

The mapping and assessment of ecosystem services within the Integrated Monitoring of the Natural Environment program in Poland

Piotr Lupa[1], Andrzej Kostrzewski[2]

[1]*Department of Integrated Geography, Adam Mickiewicz University, Poznań, Krygowskiego 10, 61-680 Poznań, Poland*

[2]*Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, Poznań, Krygowskiego 10, 61-680 Poznań, Poland*

E-mail: piotr.lupa@amu.edu.pl

The Integrated Monitoring of the Natural Environment program (IMNE) has been operational in Poland as part of the State Environmental Monitoring Program since 1994. Its primary task is to conduct long-term research on the natural environment's abiotic and biotic components, utilising planned and organised stationary measures. This nationwide research employs standardised methods across 12 IMNE Base Stations (research catchments). The location of these Base Stations considers the diversity of landscapes and ecological zones, reflecting Poland's dominant forms of land cover (Kostrzewski et al. 2014, Kostrzewski 2022).

Since 2015, monitoring efforts have expanded to include the mapping and assessment of the potential of ecosystems in these twelve research catchments to provide eleven ecosystem services, nine of which are regulating services and two are provisioning ones (Stępniewska 2021). The studies utilise land cover and land use data, the ecosystem service potential matrix proposed by Burkhard et al. (2014), and data collected through IMNE action.

The conference presentation will outline the process of updating the ecosystem service potential matrix based on survey results conducted in 2024 among the staff of the twelve IMNE stations. The research aims to adapt the matrix by Burkhard et al. (2014) to the specific conditions of ecosystem metabolism in Poland, drawing on the experiences gained from implementing the IMNE.

References

1. Burkhard B., Kandziora M., Hou Y., Müller F. **2014**. Ecosystem Service Potentials, Flows and Demands – Concepts for Spatial Localisation. Indication and Quantification. Landscape Online 34: 1-32.
2. Kostrzewski A., Mizgajski A., Stępniewska M., Tylkowski J. **2014**: The use of Integrated Environmental Programme for ecosystem services assessment. Ekonomia i Środowisko 4(51), Białystok: 94-101.
3. Kostrzewski A. 2022. The concept of organization and implementation of the Integrated Monitoring of the Natural Environment program in the years 1992–2022. In: Współczesne przemiany naturalne i antropogeniczne środowiska przyrodniczego zlewni rzecznych i jeziornych. Kostrzewski A., Szpikowski J., Majewski M. (Eds.). Biblioteka Monitoringu Środowiska, Warszawa, Bogucki Wydawnictwo Naukowe, p. 14-24.
4. Stępniewska M. **2021**. Świadczenia geoekosystemów /*Ecosystem services*/. In: Zintegrowany Monitoring Środowiska Przyrodniczego. Organizacja, system pomiarowy, metody badań. Wytyczne do realizacji. Kostrzewski Andrzej, Majewski Mikołaj (Eds.), Biblioteka Monitoringu Środowiska, Warszawa, Bogucki Wydawnictwo Naukowe, p.320-327.

Green Gentrification in Chile: A Socio-Ecological Framework

Ernesto López-Morales[1], Luis Inostroza[2], Nicolás Herrera[1], Ana Luisa Araos[3], Vicente Mosso[4]

[1]Association of Property Appraisers of Chile (ASATCH).
[2]Mendel University, Brno, Czech Republic
[3]Universidad Austral de Chile
[4]University of Chile

E-mail: lopezmorales.ej@gmail.com

For over sixty years, gentrification has been a crucial subject in urban geography and sociology. Central hypotheses related to gentrification encompass: (A) supply-side explanations that emphasize the private appropriation of land value and urban opportunities; (B) cultural and sociological demand-side perspectives that reveal the emergence of new class interests in long-neglected or undervalued neighborhoods; and (C) concerns about displacement and the reduced spatial opportunities for marginalized communities affected by gentrification. The increasing socio-ecological injustices driven by climate change have introduced the concept of 'green gentrification', which focuses on unequal access to environmental advantages, often leading to social displacement of long-term, low-income residents. (1, 2). While many studies typically analyze green gentrification in urban contexts, linking it to residential transformations around parks and amenities, this research pivots toward two expansive regions and rural areas in southern Chile that are experiencing an influx of 'ecologically awakened' urban dwellers seeking localized environmental benefits.

The study employs a blend of Delphi panels and a Burckhardt matrix to conduct a structured evaluation of 21 regulating ecosystem services (RES) and 11 cultural ecosystem services (CES) across various Structural Land Types (SLT). (3). Expert knowledge was harnessed to quantify the levels of service provision. A mapping of structural land types onto a hexagonal tessellation was executed, along with an evaluation of spatial proximity to ecosystem service sources utilizing inverse-distance functions. In addressing Hypothesis (A), the research analyzes over 80,000 georeferenced land plot transactions from 1999 to 2023 to ascertain correlations between land valuation and 32 ecosystem services, employing a hedonic pricing model in the analysis. Land value serves as a proxy for socioeconomic status, which relates to Hypothesis (B). To enhance the understanding of socioeconomic shifts among residents, census data from three distinct periods (2002, 2017, and 2024) were also incorporated. The findings suggest a discernible preference among gentrifiers for specific ES, as indicated by their residential choices, in contrast to low-income individuals (Hypothesis C).

Studies seldom appraise the interplay between changes in natural, social, and economic capital and their repercussions on the provision of vital ecosystem services mediated by social class. The relationship between nature and market dynamics, coupled with class-driven residential transitions in rural communities, may prompt us to reconsider whether the concept of disservices should be replaced by the question of 'services for whom?' On the other hand, assessments of ecosystem services informed by class analysis play a crucial role in promoting spatial justice and fostering equitable land policies, particularly in ecologically vulnerable areas affected by climate change, the interests of wealthy newcomers, and real estate development.

References

1. Anguelovski, I., J. Connolly, L. Masip, and H. Pearsall (2018) Assessing green gentrification in historically disenfranchised neighborhoods: a longitudinal and spatial analysis of Barcelona, Urban Geography, 39:3, 458-491.
2. Anguelovski, I., Brand, A. L., Connolly, J. J. T., Corbera, E., Kotsila, P., Steil, J., … Argüelles Ramos, L. (2020). Expanding the Boundaries of Justice in Urban Greening Scholarship: Toward an Emancipatory, Antisubordination, Intersectional, and Relational Approach. Annals of the American Association of Geographers, 1–27. https://doi.org/10.1080/24694452.2020.1740579
3. Burkhard, B., & Maes, J. (2017). Mapping Ecosystem Services (B. Burkhard & J. Maes, Eds.). PENSOFT Publishers. https://doi.org/10.1016/s0731-9053(07)00016-3

Using social media data and eye tracking in landscape preference analysis

Monika Lebiedzińska[1]

[1] *Institute of Spatial Management, Wroclaw University of Environmental and Life Sciences, Norwida 25, 50-375 Wrocław, Poland*

E-mail: monika.lebiedzinska@upwr.edu.pl

Photographs published on social media, such as Instagram, can be a valuable source of data for analyzing landscape preferences. Location-tagged photos shared on social media can identify how users actually use a space, providing information on both activities undertaken in the landscape and aesthetic tastes and perceptions of the environment. The assumption is that the published photography corresponds to an individual's preferences. The study combined analysis of Instagram photos with visual attention measurement (eye tracking) and questionnaires, obtaining a multifaceted picture of landscape perception. The case study was two Polish cities - Wroclaw and Poznan along with their suburban zones, analyzing the data in relation to landscape units of metropolitan, urban and suburban types. Instagram photos from 2020 and 2023 that were geotagged within the boundaries of landscape units were collected. Locations that were too general or related to indoor activities were eliminated. Each photograph was assigned labels describing the content of the frame and the activities observed, which made it possible to identify forms of human interaction with the landscape. The data obtained were used to analyze the intensity of activities, their distribution in space and the dominant types of behavior in different landscapes. Selected photos were used in an eye tracking study to see if the location and duration of gaze fixation indicated aesthetic preferences. In addition, participants rated the emotion of viewing the photographs to determine which visual elements are important to them and influence their personal perception of the landscape.

Ships Passing in the Night: Legal Scholarship and the Neglect of Ecosystem Services

Karolina Karpus[1]

[1]*Department of Environmental Law and PEL, Nicolaus Copernicus University, ul. Gagarina 11, Toruń, Poland*

E-mail: kkarpus@umk.pl

Legal scholarship has largely overlooked the concept of ecosystem services (ES), creating a significant barrier to the effective implementation of the System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA-EA). It is not merely a statistical tool – it generates data that has implications for liability, compensation, taxation, licensing, planning, and rights. Thus, this indifference limits SEEA-EA normative legitimacy, institutional integration, and juridical utility. Without doctrinal engagement, SEEA-EA remains a descriptive exercise, disconnected from binding legal norms governing environmental protection, liability, compensation, land use, and planning. The law – being the formal language of governance – must absorb and interpret the concept of ES [1,3,5] if SEEA-EA is to meaningfully shape environmental decision-making [2]. This analysis draws on Polish and EU hard law examples, where *expressis verbis* references to ES remain rare and conceptually underdeveloped [4,6]. It identifies legal academia's preference for rights-based or regulatory frameworks over ES valuation and accounting, as well as the absence of ES in legal education, as structural causes of this neglect. Consequently, the hypothesis that the law is under-prepared to interpret, apply, or critique SEEA-EA outputs is well founded. This state of affairs results in practical hindrances, such as lack of normative legitimacy of SEEA-EA, no institutional translation of the ES concept (without embedding in hard law, it remains descriptive and non-binding), poor doctrinal fit (legal constructs are underdeveloped for the translation of the ES concept into legally actionable terms, e.g. harm, duty, standing), conflict resolution gap (it may be already assumed the SEEA-EA will trigger legal disputes; however, courts and regulators lack guidance on how to weigh, interpret, or apply ES data). To address these deficits, a multi-step interdisciplinary methodology is being employed: (1) an literature review maps the conceptual use of ES across disciplines; (2) doctrinal analysis identifies existing legal touchpoints and disparities; (3) a legal-ecological 'crosswalk' proposes linkages between types of ecosystem services and legal constructs (e.g., flood regulation and land use law); (4) jurisprudential analysis explores tensions between instrumental and intrinsic values, market-based tools and regulatory approaches, technocratic governance and legal accountability; and (5) case-based probing tests entry points for ES in regulatory and litigation contexts. Lastly, an integrative analysis allows for synthesising the outcomes and proposing concrete ways ES can be absorbed or critically interrogated in the legal framework. In summary, as the law determines what is counted, how it's used, and who is accountable, legal scholars must not only translate the ES concept into actionable legal categories but also critically interrogate its use. Therefore, legal scholarship's detachment in that regard is a systemic barrier because engaging law is not optional – it is essential to legitimise, operationalise, and democratise SEEA-EA.

References

1. J. Goździewicz-Biechońska, Prawny system ochrony zieleni i zadrzewień w świetle teorii usług ekosystemów i koncepcji zielonej infrastruktury, *Państwo i Prawo* 2021, Issue 6, 99–114.
2. J. Hauck et al., Benefits and limitations of the ecosystem services concept in environmental policy and decision making: Some stakeholder perspectives, *Environmental Policy and Science* 2013, 13–21.
3. K. Karpus, The 'Ecosystem Services' Concept in Environmental Law, *Journal of Agribusiness and Rural Development* 2017, vol. 46, 779–786.
4. K. Maczka et al., Application of the ecosystem services concept in environmental policy – A systematic empirical analysis of national level policy documents in Poland, *Ecological Economics* 2016, vol. 128, 169–176.
5. M. Nyka, *Koncepcja usług ekosystemowych w międzynarodowoprawnej ochronie środowiska morskiego Bałtyku*, in: *Prawo międzynarodowe: idee a rzeczywistość*, Editor E. Cała-Wacinkiewicz, C. H. Beck, 2018, Warszawa, 631– 650.
6. M. Stępniewska, I. Zwierzchowska, A. Mizgajski, Capability of the Polish legal system to introduce the ecosystem services approach into environmental management, *Ecosystem Services* 2018, vol. 29, 271–281.

Exploring Sustainable Consumption: A Study of Shopping Habits in Lithuania

Algirdas Justinas Staugaitis[1], Gintarė Vaznonienė[2], Bernardas Vaznonis[3]

[1-3] *Faculty of Bioeconomy Development, Vytautas Magnus University, Universiteto g. 10, LT-53361 Akademija Kauno r., Lithuania*

E-mail: algirdas.staugaitis@vdu.lt

Despite increased public knowledge of climate change and environmental conservation, there is still a large gap between consumers' stated environmental ideals and their actual food shopping behaviour. This study looks into the sociodemographic characteristics that influence sustainable consumption habits in Lithuania, with a particular emphasis on food buying behaviour from an environmental standpoint.

The study is based on survey data acquired from a representative sample of 410 Lithuanian people, who were asked a structured questionnaire about their attitudes and behaviours towards sustainable food purchase. Key variables include respondents' environmental concern, consideration of sustainability in purchasing decisions, use of eco-products, preference for locally sourced items, and food waste behaviour. Responses were graded on a 5-point Likert scale and analysed using descriptive statistics, correlation, and multiple regression methods.

The findings show that, while environmental concern is commonly acknowledged, actual sustainable behaviors—such as purchasing eco-products or eating local food—are less consistently performed. Gender differences emerged prominently: women were nearly twice as likely as men to use eco-products and to prioritize buying local food. Younger respondents (18-29) were the most hesitant to make sustainable choices, particularly when it came to using eco-products, indicating a gap between understanding and action that could be due to scepticism, price sensitivity, or a lack of perceived benefits. Educational attainment positively connected with environmentally conscious behaviour, but income had a more nuanced effect: only the lowest income group (<500 EUR/month) was considerably less likely to purchase sustainably.

Statistical study revealed that age is the most consistent and important predictor of sustainable eating behaviour, with younger people demonstrating lower engagement across several variables. Gender strongly influenced environmental sentiments but had a less impact on actual shopping behaviour. Other sociodemographic variables, including income, education, and location (urban vs. rural), had low or marginal statistical relevance.

These findings highlight the need for more targeted and diverse approaches to promoting sustainable consumption. For example, emotional pleas emphasising family and health benefits may resonate stronger with women, particularly mothers. Conversely, interactive and technology-driven communication styles may be more effective in engaging sceptical younger people. Lower-income customers may benefit more from rational incentives that emphasise long-term savings and health, but higher-income groups may benefit from prestige and value alignment.

In conclusion, the transition to sustainable food consumption necessitates not just broad awareness campaigns, but also sophisticated approaches suited to diverse sociodemographic groupings. While public interest in sustainability is increasing, closing the intention-action gap remains a significant problem for policymakers, marketers, and educators seeking to promote more sustainable consumer behaviour in Lithuania and elsewhere.

Beyond The Hype: What Can Citizen Science Really Do For Urban Planning?

Gabriel O. Vânău, Diana A. Onose, Mihai R. Niță, Athanasios A. Gavrilidis

Department of Regional Geography and Environment, University of Bucharest,
Șoseaua Panduri, nr. 90, Sector 5, 050663, Bucharest, Romania

E-mail: gabriel.vanau@geo.unibuc.ro

In the face of escalating environmental challenges, such as climate change, air pollution, biodiversity loss, and extreme weather events, urban planning must evolve to be more inclusive, adaptive, and data-informed.

Citizen science, which involves the active participation of non-professionals in scientific processes, is increasingly promoted as a democratic and innovative tool for improving urban planning. By enabling residents to collect and interpret data about their own environments, citizen science helps planners better understand hyperlocal conditions, such as urban heat islands, wildlife presence, green space distribution, or air quality levels, often overlooked by conventional top-down approaches. These community-generated insights are vital for shaping climate-resilient, socially responsive urban strategies. Moreover, citizen science fosters environmental stewardship, empowering individuals to participate in the transformation of their cities while strengthening trust in institutions. From tracking invasive species coverage to mapping vulnerable infrastructure, such collaborations can lead to more equitable, sustainable, and future-proof urban environments.

But how is it actually perceived by those working in the field? This presentation explores the practical relevance and perceived value of citizen science based on a study involving 50 urban planning professionals. Through a structured questionnaire, we examined where experts believe citizen science can contribute meaningfully, what limitations they foresee, and under what conditions it should be applied. The results highlight key areas where citizen involvement is seen as beneficial, respectively data collection, awareness-raising, and fostering community engagement, while also revealing skepticism regarding its capacity to influence strategic decision-making. This empirical perspective helps move the conversation "beyond the hype" and provides guidance on integrating citizen science into planning in a more targeted and effective way.

How people perceive the accessibility and attractiveness of formal and informal green spaces?

Magdalena Anna Biernacka[1]

[1]*Social-Ecological Systems Analysis Lab, University of Lodz, POW 3/5 Street 90-255, Lodz, Poland*

E-mail: magdalena.biernacka@uni.lodz.pl

Whether urban green spaces (UGS) are recognized and used by people depends not only on their physical presence but also on their perceived accessibility and attractiveness. The former is typically connected to safety, free entry, proximity to one's place of living, and convenient transportation options, while the latter is usually linked to small-scale infrastructure, decorative planting, and water features. Most studies assume that this simplified understanding of accesibility and attractivenenes is consistent across all UGS categories as among different city inhabitans. However, as UGS encompass a wide range of vegetated areas that differ in ownership, management, and amenities, the meaning of accessibility and attractiveness may vary significantly between formal and informal UGS.

The aim of this study is to explore how accessibility and attractiveness along with their meaning differ for formal and informal UGS among individuals from diverse socio-demographic backgrounds. For this purpose, we geo-surveyed a representative sample of N = 407 inhabitants living along the Jasien and Karolewka river corridors in Lodz (Poland). The respondents were asked to spontaneously indicate the UGS they considered accessible/inaccessible and attractive/unattractive. We captured their perceived accessibility and attractiveness of fourteen categories of formal and informal UGS along with their broader interpretations of UGS accessibility and attractiveness.

The findings revealed that perceptions of accessibility and attractiveness are shaped both by the type of UGS and by the characteristics of individual users. Both formal and informal green spaces were commonly associated with walking infrastructure and social amenities, while informal green spaces were additionally valued for their wild and natural character. Notably, respondents' interpretations of accessibility and attractiveness often diverged from those in the academic literature, which itself lacks a unified perspective. These perceptions also varied by life stage: pensioners prioritized walking infrastructure (e.g., even paths), young people valued natural features and access, and families with children emphasized the importance of social infrastructure (e.g., benches, toilets) and play infrastructure, reflecting evolving needs and preferences over the course of life.

This study contributes to the broader literature on UGS classification by demonstrating how the recognition and perception of accessibility and attractiveness vary between formal and informal green spaces. Additionally, the social and demand-related dimensions of UGS use, often overlooked in previous research, were highlighted. Different elements of UGS can be viewed positively or negatively depending on the space's character and the users' individual characteristics, such as cultural background, current needs, past experiences, and physical abilities. Therefore, understanding users' perspectives can significantly enhance the planning of sustainable cities.

Between the Perception of Temperature, Building Characteristics and Green Areas: A Study Tool Concept

Zuzanna Z. Kurowska[1]

[1] *Faculty of Sociology, Adam Mickiewicz University, Szamarzewskiego 89C, 60-568 Poznań, Poland*

E-mail: zuzanna.kurowska@amu.edu.pl

In cities, green areas provide valuable regulating ecosystem services, such as shade provision and climate regulation. Vegetation, especially trees, can reduce the air temperature and impact evapotranspiration, regulating the microclimate in a city. Climate regulation is a critical ecosystem service for city residents, who are at risk of experiencing effects of Urban Heat Islands. Warmer thermal conditions strongly impact individuals' well-being, and can contribute to the increased heat-induced illnesses and mortality, especially among the elderly, mainly due to their decreased thermoregulation abilities and pre-existing health conditions, which exacerbate risk of mortality. However, while vegetation can influence the overall temperature of cities, it is unclear to what extent it can improve thermal comfort, especially relative to building characteristics. For individuals who spend the majority of their time indoors, which is common among elderly, it isn't known whether urban greenery or building quality has a bigger impact on thermal comfort. Longitudinal research, which allows better understanding of within-person variation of thermal comfort, usually considers only students or young adults. Elderly, who suffer the most heat-induced illnesses, are usually studied in cross-sectional research, failing to capture the full context of their thermal comfort. With the increasing temperatures affecting urban areas, it is important to understand the impact of greenery and buildings on the temperature regulation in cities.

In this presentation, I will outline a concept of the research tool designed to understand the impact of green areas and inhabited buildings in the regulation of individual human thermal comfort, conducted among elderly population. The research tool will be based on a literature review of human thermal comfort studies conducted longitudinally.

Review will focus on the existing longitudinal studies of human thermal comfort, pointing to the limitations of those studies and gaps that weren't addressed in previous research. I will outline factors that are significant for assessing thermal comfort and that should be controlled for in a study. Additionally, the inclusion of building characteristics and green areas in longitudinal studies will be presented.

As a result of the literature review, I will present a research tool that can be used in studies on human thermal comfort of elderly. This tool will combine a structured questionnaire with an Experience Sampling Method component. The research tool will collect both subjective and objective characteristics. Subjective dimensions will include personal characteristics, measuring social and health factors, collecting information on the proximity to green areas, inhabited building characteristics and Local Climate Zone where one's housing is located. Subjective data, which will be collected over the span of several weeks, will include perceived thermal comfort, preference and adaptive behavior. Objective data collected longitudinally, such as temperature and humidity, will be included to strengthen the interpretation of the results.

This study concept includes the most important factors, identified through a literature review. Such study could support urban planning and climate change adaptation policies, focused on green infrastructure and management of green areas.

GeoSenEsm: A Mobile Application for Enhanced Experience Sampling with Temperature and Humidity Sensors

Marcin Witkowski[1]

[1]*Department of Discrete Mathematics, Faculty of Mathematics and Computer Science, Adam Mickiewicz University, Poznan, Poland*

E-mail: mw@amu.edu.pl

The subjective nature of parameters like thermal comfort poses significant challenges for assessment, particularly when objective, high-resolution environmental data is lacking. Existing data sources, such as sparsely distributed weather stations or satellite imagery, often fail to represent the nuanced microclimatic conditions (temperature, humidity) experienced by individuals, especially indoors, at low altitudes, or in areas affected by urban green infrastructure.

To address this gap, as part of the UrbEaT project (https://urbeat.site/), we have developed GeoSenEsm to investigate urban heat island mitigation through a comparative study of Beijing and Warsaw. This open-source mobile application innovatively combines Experience Sampling Method (ESM) surveys with real-time, localized temperature and humidity data acquired from portable Xiaomi and Kestrel temperature and humidity sensors. A large-scale deployment was conducted in Summer 2025, involving over 200 participants who simultaneously reported subjective perceptions and recorded their immediate environmental conditions.

This presentation will introduce the GeoSenEsm application, detailing its architecture and the data collection framework utilized. We will discuss practical challenges encountered and solutions implemented concerning sensor connectivity, data integrity, and the influence of diverse factors on sensor accuracy during the study. On the other hand, we will highlight the benefits of using the mobile application, including the ability to track the study's progress in real time.

Willingness to pay for landscape benefits: Examining variation by landscape type in Lower Silesia, Poland

Piotr Krajewski[1], Katarzyna Zagórska[2], Marta Sylla[1], Marek Furmankiewicz[1], Iga Kołodyńska[1], Monika Lebiedzińska[1], Mikołaj Czajkowski[2]

[1]*Institute of Spatial Management, Wroclaw University of Environmental and Life Sciences, Grunwaldzka 55, 50-375 Wroclaw, Poland*

[2]*Department of Microeconomics, University of Warsaw, Długa 44/50, 00-241 Warsaw, Poland*

E-mail: piotr.krajewski@upwr.edu.pl

Like ecosystems, landscapes provide significant benefits that influence human well-being. However, these benefits are often taken for granted and not accounted for in economic terms. This study examines how local communities in Lower Silesia, Poland, use different landscape types and assesses their willingness to pay (WTP) for improved landscape services. The research combines participatory mapping and a discrete choice experiment (DCE) to evaluate preferences for six key landscape services: accessibility to essential services, outdoor recreation, physical and mental health benefits, social integration, educational opportunities, and aesthetic experiences.

The study was conducted in six municipalities representing diverse landscape types, including urban, suburban, rural, and forest-dominated areas. A total of 617 residents participated in structured face-to-face interviews using the Computer-Assisted Personal Interviewing (CAPI) method. Respondents were asked to mark locations where they engage in various outdoor activities on pre-prepared maps divided into landscape units. This spatial data was then analyzed to identify patterns of landscape use. The discrete choice experiment (DCE) assessed WTP for improvements in landscape services, with attributes such as reduced travel time to basic services, expanded recreational infrastructure, increased public forest areas, new social integration spaces, educational trails, and scenic viewpoints.

The results indicate that residents are most active in landscapes near their homes, with forest landscapes being the most valued and perceived as multifunctional. Urban, suburban, and rural respondents demonstrated significant differences in their landscape preferences, particularly regarding accessib ility and social interaction spaces. The highest WTP was recorded for increasing public forest areas (+4%: €28,12 per year per household) and reducing travel time to basic services (-20%: €23,77 per year). Respondents were least willing to pay for new educational trail (€13.70 per year) and all new viewing points (in forest landscape – €16.21 per year, in rural landscape – €13.12 per year, in urban landscape - €11.23).

These findings highlight the importance of incorporating residents' preferences into spatial planning and landscape management. The study provides valuable insights for policymakers, supporting the development of landscape policies that balance economic, social, and environmental factors. The methodology applied in this research—integrating participatory mapping with DCE—offers a robust framework for assessing landscape values and guiding sustainable land-use planning.

Understanding The Impacts Of Climate Change And Landscape Changes On Urban Ecosystem Services

João D. David[1], Carlotta Quagliolo[2], Meng Li[3], Luiz Filho[2], André Mascarenhas[4], Manuel Wolff[1], Sebastian Scheuer[1], Elena Ferrari[1], Felipe S. Campos[5], Pedro Cabral[6], Dagmar Haase[1]

[1]*Geography Department, Humboldt-Universität zu Berlin, Rudower Chaussee 16, 12489 Berlin, Germany*

[2]*Department of Environment and Planning, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal*

[3]*Institute of Environmental Sciences CML, Leiden University, Einsteinweg 2, 2333 CC Leiden, The Netherlands*

[4]*ILPÖ - Institute of Landscape Planning and Ecology, University of Stuttgart, Keplerstraße 11, 70174 Stuttgart, Germany*

[5]*Centre de Recerca Ecològica i Aplicacions Forestals (CREAF), Universitat Autònoma de Barcelona, 08193 Cerdanyola Del Vallès, Catalunya, Spain*

[6]*School of Remote Sensing and Geomatics Engineering, Nanjing University of Information Science and Technology, 210044 Nanjing, China*

E-mail: joao.david@geo.hu-berlin.de

Ecosystem services are essential for sustainable and resilient city living. As urban areas expand, UES become ever more fundamental in buffering environmental stress and providing benefits for humans and species. However, urban ecosystem services (UES) are under constant pressure from two global change drivers: climate change and land use changes. Rising temperatures, altered precipitation regimes, and more frequent extreme events directly affect ecosystem processes, whereas urban expansion, densification, and green space loss reduce the capacity of these ecosystems to deliver services. Although each of these environmental drivers of change have been studied individually, there is a critical lack of systematic evidence on their joint impacts across diverse urban contexts. To address this gap, we undertake the first global systematic review of studies (1990–2024) that examine how climate change and land use changes co-influence UES using CoPEOS (Context-Population-Exposure-Outcome-Study Type), a framework developed to distinguish ecological context from the geographic setting. Our primary question is: How do climate change and land use changes impact ecosystem services across diverse urban contexts?. The study also addresses the following complementary questions: a) Which UES are least and most vulnerable to climate change and land use impacts?; b) What are the interactions between climate and land use drivers in shaping specific UES outcomes?; c) What are the dominant research patterns, recurring themes, critical gaps, inconsistencies, missing links and redundancies in UES studies?; d) What strategies have been proposed to enhance the resilience of UES?. Meta-analytical methods quantify response magnitudes of selected UES to climate and land use change impacts. Beyond conventional systematic reviews that primarily summarize existing findings, our study uncovers gaps and hidden issues in the literature, including overlooked urban vulnerabilities, underexplored aspects of UES, and missing links between climate change adaptation, landscape planning, and urban resilience. We evaluate whether existing research adequately addresses urgent urban challenges, exposing inconsistencies in the literature and identifying topics that are overrepresented versus those that remain neglected. Additionally, we identify areas requiring further investigation and provide rationale for their importance. This approach delivers actionable insights to advance scientific understanding and guide future research priorities, highlighting what is currently forgotten and redundant on the topic.

Tree-based Solutions (TBS) to Improve the Provision of Ecosystem Services from Urban Forests

Vahid Amini Parsa[1], Babak Chalabiyani[2]

[1] *Social-Ecological Systems Analysis Lab, Faculty of Economics and Sociology, University of Lodz, Lodz, Poland*

[2] *School of Environment, College of Engineering, University of Tehran, Tehran, Iran*

E-mail: vahid.parsa@uni.lodz.pl

Urban trees as nature-based solutions, referred to as tree-based solutions (TBS), can address climate-related disturbances in rapidly evolving urban environments while meeting growing population demands. While the creation and management of trees as TBS have been promoted as urban planning tools, optimal tree species selection remains crucial for improving ecosystem services (ES). This study introduced a novel TBS approach to optimize urban tree potential in Tabriz city, Iran, by selecting tree species based on their environmental functions (both services and disservices) from a comprehensive species pool. Three main TBS scenarios (with six sub-scenarios) were developed to assess the long-term effectiveness of introducing selected species compared to existing species in improving urban tree structure and ES provision. Results demonstrate that the benefits of introducing selected trees exceed those of existing species, regardless of planting quantity. Furthermore, increasing the annual planting rate of recommended species correlates with greater improvements in projected tree characteristics and ES delivery. This approach provides urban forest managers and policymakers with evidence-based tools for species selection when implementing TBS to enhance urban wellbeing.

Supply And Demand Of Ecosystem Services In Urban Forests Through An Integrated Assessment Framework

Koushki Bita[1], Grande Umberto[1,2], Monteleone Chiara[1], Francessco Rendina[1], Buonocore Elvira[1], Franzese Pier Paolo[1]

[1]*International PhD Programme / UNESCO Chair "Environment, Resources and Sustainable Development", Department of Science and Technology, Parthenope University of Naples, Centro Direzionale Isola C4 (80143), Naples, Italy.*

[2]*Department of Geobotany and Landscape Planning, Nicolaus Copernicus University, ul. Lwowska 1, 87-100, Toruń, Poland.*

E-mail: bita.koushki001@studenti.uniparthenope.it

The environmental effects of urbanization are having a growing impact on human well-being. Urban metabolism continually leads to environmental pollution, and present green infrastructures are frequently insufficient to mitigate this impact through ecosystem services (ES). In this context, the goal of this study is to provide a novel approach that combines ES assessment with LCA to evaluate the supply and demand of ES in the urban context. The provinces of Salerno and Naples in Southern Italy were chosen as case studies. Regulating ES provided by tree vegetation, such as air pollution removal, carbon sequestration, and avoided runoff, was quantified in both biophysical and economic terms using the i-Tree Canopy software. LCA was used to evaluate the environmental impacts of urban metabolism, and therefore, the demand for ES. The findings showed significant disparities between the two provinces. Salerno has a higher tree cover (63.4%) than Naples (24.4%), and also a bigger potential for areas that can be planted. The total economic value of ES in both provinces resulted in 13,537 million Euros per year (M€). The supply of ES in Salerno was higher, notably in terms of carbon sequestration, which greatly surpassed the demand, resulting in a surplus. In contrast, in Naples's case, a serious mismatch emerged, with ES supply covering only a fraction (4-5%) of the demand. The proposed model can be useful for urban planners and policymakers to achieve sustainability goals.

Inclusive nature-based solutions in urban ecosystems: Lessons learned from case studies across Europe

Cristina Gabriela Mitincu, Constantina Alina Hossu, Ioan Cristian Iojă, Maria Alexandra Calotă, Mihai Răzvan Niță

Centre for Environmental Research and Impact Studies, University of Bucharest, 1 Nicolae Balcescu Blvd., Sector 1, Bucharest, Romania

E-mail: cristina-gabriela.mitincu@geo.unibuc.ro

The complex development patterns pursued by urban ecosystems brought vulnerabilities in relation to climate risks, with substantial disservices for human well-being and biodiversity conservation. Nature-based solutions (NbS) are practical approaches that support urban adaptation to climate change while simultaneously providing multiple ecosystem services. However, recent studies have raised concern about NbS practices, emphasizing the challenges of ensuring human welfare, social justice, and ecosystem integrity. This study conducts a systematic literature review on NbS at the European level to identify the intersecting factors for ecologically and socially inclusive NbS. A total of 13.027 publications were retrieved from Web of Science and Scopus databases. Ultimately, 280 publications were selected for the final analysis. We therefore identified (i) NbS types across Europe (ii) scale patterns of inclusive NbS, (iii) barriers and enablers for inclusive NbS, and (iv) specific human and nonhuman groups potentially affected by NbS implementation. Our results suggest the importance of NbS to be tailored to the site-specific dynamics while considering the broader urban ecosystem context to ensure integrated social, economic, and ecological approaches. We found that engaged NbS types (e.g., community and allotment gardens) are recognized for their potential to mitigate inequality and safeguard biodiversity while also providing additional ecosystem services to local communities. We further found that incorporating the needs and values of all social groups into NbS planning and implementation, along with adopting collaborative approaches (e.g., living labs, learning alliances, open dialogue), can help prevent inequalities in access to ecosystem services and other NbS benefits. Therefore, the vulnerabilities of certain social groups (e.g., elderly, racial and ethnic minorities, disabled, low-income people) can be reduced through inclusive practices that enable accessibility and recognition (e.g., bottom-up initiatives, mosaic governance, anti-displacement policies). Moreover, particular attention should be given to the equitable treatment of nonhuman species and ecosystems that have been marginalized or overlooked, an underrepresented topic in the assessed papers. We further concluded the lessons that can be learned from the case studies where NbS are either integrated in favour of the local communities or their design and implementation are ineffective and unjust.

Integrating Ecosystem Services into Campus Planning: A Conceptual Proposal for Morasko Campus, Poznań

Katarzyna A. Niemier

Faculty of Human Geography and Planning, Adam Mickiewicz University in Poznań, Poland

E-mail: kniemier.contact@gmail.com

This presentation explores a conceptual redevelopment proposal for the western part of the Morasko Campus in Poznań, developed in response to the goals and principles of the UN's New Urban Agenda. The project investigates how broad, often aspirational policy goals can be translated into concrete spatial solutions, even at the limited scale of a university campus. While not all recommendations of the Agenda can be fully applied in such a context, the design seeks to interpret selected priorities in a way that strengthens the campus's role as a multifunctional and socially inclusive urban space.

Inspired by green architecture, social housing strategies, and nature-based solutions, the proposal includes a redesigned road system, increased development density, and a reorganization of functional and spatial zones. Key emphasis is placed on the integration of green-blue infrastructure to support ecosystem services such as stormwater retention, climate regulation, biodiversity, and the creation of spaces for recreation and social life.
The concept envisions the Morasko Campus as more than just a place for education and work. It aims to transform it into a complete, livable environment - a setting where students, staff, and residents can not only study and work, but also live, grow food, shop, relax, and connect with others. Through elements such as rain gardens, fruit orchards, shared gardens, playgrounds, and outdoor art spaces, the project highlights how even modest-scale interventions can contribute to a campus that functions as a micro-city - compact, resilient, and community-oriented.
Beyond proposing specific spatial changes, this concept also aims to spark a broader discussion about what makes a university campus function well - not only as an educational facility, but as a holistic, inclusive, and sustainable part of the city. It may serve as a reference for other monofunctional campuses or small-scale urban areas that seek to evolve into more integrated and vibrant environments.

Linking Emotional Well-being and Ecosystem Services in University Green Spaces

M. Viota[1], L. Menatti[2], I. Ametzaga-Arregi[1]

[1]*UNESCO Chair on Sustainable Development and Environmental Education, University of the Basque Country (UPV/EHU), Barrio Sarriena s/n, 48940 Leioa, Basque Country, Spain.*

[2] *Université Paris 1 Panthéon-Sorbonne & CNRS, 13 Rue du Four, 75006 Paris, France.*

E-mail: viota.maria@gmail.com

The contributions of urban green spaces to ecological functions and human health and well-being have been increasingly recognized [1,2]. In university campuses, they may serve as multifunctional landscapes that support learning, social interaction, and restorative experiences, while enhancing biodiversity or microclimate regulation and become key components of campus design. This study explores how visits to green spaces can relate to emotional well-being and the perception of ecosystem services at the University of the Basque Country (UPV/EHU, Spain). Through an online survey composed by close and open questions, we examined visit, affective responses (using the Positive and Negative Affect Scale, PANAS [3]), and perceived ecosystem services among university community members. Results suggests that visits to campus green spaces, especially those with more trees were associated with improved emotional states and appear stronger for women, as well as greater recognition of benefits such as relaxation, aesthetic enjoyment, and thermal comfort. Moreover, visitors seeking relaxation show ecosystem service recognition (higher benefits) than those mainly due to proximity. Higher valuation of cultural and regulating ecosystem services may be highlighting that the exposure to tree environments could have a restorative effect and thermal-comfort which redound positively in affect and strengthens recognition of campus ecosystem benefit [4-10]. These findings highlight the potential of green space planning not only for biodiversity or climate regulation, but also as a tool to support emotional health in academic environments [4,7-10]. The integration of affective measures may provide insight into how emotional responses could serve as mediators in the perception and valuation of ecosystem benefits [6]. Moreover, the promotion of connections emotional or affective to nature may also improve pro-environmental attitudes and serve to inform more inclusive and health-oriented campus planning [4-10]. This research contributes to the emerging dialogue between ecosystem service frameworks and environmental psychology, offering implications for sustainable, equity-sensitive design and restorative campus design that could in addition amplify both emotional well-being and the perceived value of campus nature.

References

1. GN Bratman, CB Anderson, MG Berman, B Cochran, S de Vries, J Flanders, GC Daily, *Sci. Adv.* 2019, 5, eaax0903.
2. T Hartig, R Mitchell, S de Vries, H Frumkin, *Annu. Rev. Public Health* 2014, 35, 207–228.
3. D Watson, LA Clark, A Tellegen, *J. Pers. Soc. Psychol.* 1988, 54, 1063–1070.
4. V Jennings, O Bamkole, *Int. J. Environ. Res. Public Health* 2019, 16, 452.
5. CM Raymond, BA Bryan, DH MacDonald, A Cast, S Strathearn, A Grandgirard, T Kalivas, *Ecol. Econ.* 2009, 68, 1301–1315.
6. R Russell, AD Guerry, P Balvanera, RK Gould, X Basurto, KM Chan, T Satterfield, *Annu. Rev. Environ. Resour.* 2013, 38, 473–502.
7. RS Ulrich, *Science* 1984, 224, 420–421.
8. S Kaplan, *J. Environ. Psychol.* 1995, 15, 169–182.
9. DE Bowler, LM Buyung-Ali, TM Knight, AR Pullin, *BMC Public Health* 2010, 10, 456.
10. KM Korpela, K Borodulin, M Neuvonen, O Paronen, L Tyrväinen, *J. Environ. Psychol.* 2018, 58, 1–7.

A systematic review of the impacts of tourism on Marine and Coastal Ecosystem Services

Eglė Baltranaitė[1], Miguel Inácio[1], Luís Valença Pinto[1], Katarzyna Bogdziewicz[1], Jorge Rocha[2,3], Eduardo Gomes[2,3], Paulo Pereira[1]

[1]*Environmental Management Laboratory, Mykolas Romeris University, Lithuania*
[2]*Centre for Geographical Studies, Institute of Geography and Spatial Planning, Universidade de Lisboa, Lisbon, Portugal*
[3]*Associated Laboratory TERRA, Portugal*

E-mail: egle.baltranaite@gmail.com

Coastal tourism is among the key socioeconomic activities for many local communities. Marine and coastal areas take advantage of the opportunities provided by tourism. However, many connected pressures exist, such as rising population density, high seasonal fluctuation in tourist flows, land use change, and constrained supply of ecosystem services (ES). While rising, the research of tourism effects on coastal and marine ES leaves considerable gaps unaddressed. This study aims to conduct a systematic literature review on the impacts of tourism on coastal and marine ES. We present an overview of the most assessed ES. We applied a standardised approach for conducting and reporting systematic reviews - the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). By searching titles, abstracts, and keywords, we initially identified 640 studies. After the screening step, 50 studies met the criteria for inclusion in the review. The results showed that publications increased significantly between 2011 and 2023. Most studies were done in Europe, Asia, and North and Central America. The most applied ES classifications in the studies were the Millennium Ecosystem Assessment (MEA) and the Common International Classification on Ecosystem Services (CICES). Most studies concentrated on the ES supply dimension (43 studies; 86 %). The cultural ES section (47 studies; 94 %) was researched more than provisioning (28 studies; 56 %) and regulating & maintenance ES (29 studies; 58 %). In the case of cultural ES, the majority of studies focused on "Physical and experiential interactions with the natural environment" (34 studies; 68 %) and in the provisioning ES on "Wild animals (terrestrial and aquatic) for nutrition, materials or energy" (18 studies; 36 %). The most used methods applied in the reviewed studies were quantitative and mixed. In terms of identified pressures, most studies identified "Tourism, urbanisation, and population increase" (27 studies; 54 %) and focused on "Integrative/ common management strategies" (20 studies; 40 %). Very few studies included data validation (10 studies; 20 %). Studies with broader geographic representation and data validation techniques are needed.

The study was supported by the project MApping and Forecasting Ecosystem Services in Urban Areas (MAFESUR), funded by the Lithuanian Research Council (Contract: Nr. P-MIP-23-426).

Ecological Signals in the Landscape: A Biodiversity Mappinf Approach for Planning and Policy

Viktoria Takacs[1], Piotr Tryjanowski[1] ,Janusz Kloskowski[1], Aleksandra Langowska[1]

[1]*Department,of Veterinary Medicine and Animal Sciences, Poznan University of Life Sciences, Wojska Polskieg 71/c, Poznan, Poland*

E-mail: vikitakacs3@gmail.com

The rapid decline in biodiversity due to human-driven landscape changes threatens ecosystem stability and sustained provision of ecosystem services. Effective local planning and biodiversity management requires cost-efficient tools for rapid biodiversity assessment because long term monitoring methods are often resource-intensive. This study assesses the potential of mapping biodiversity and e ability of providing ecosystem services. Mapping process requires finding the link to land-use and land-cover (LULC) data from remote sensing. Using one-season monitoring data from 41 sites and three key taxa w —birds (Aves), bees (Apidae), and carabid beetles (Carabidae)—we evaluated the possibility of mapping e.g. how far LULC metrics explain biodiversity patterns and which metrics (species abundance, species richness, species diversity and functional diversity) are most responsive to main LULC how different land cover types influence biodiversity and ecosystem functioning. Results revealed weak to moderate associations between LULC and biodiversity indicators (, across taxa. Carabid beetles showed the strongest correlations (R^2=0.43, most indices remained under 0.3, with Maximum Abslout Error 0.65). Principal component based models performed better than regressions on LULC categories. We propose aggregated biodiversity indices, that improved model performance (similar R^2 but half less mean absolute prediction error) but still explained less than half of the observed variation, emphasizing the need for additional ecological variables. On the other hand, while LULC data alone cannot provide a complete picture of biodiversity, still offers a scalable, practical entry point for mapping, thus integrating biodiversity into spatial planning. This study contributes to the development of cost-effective biodiversity assessment and mapping tools, advancing spatial biodiversity modelling and data-driven conservation strategies. Simple mapping approaches could have applications in local decision-making on environmental policy, however, caution is required it requires caution.

Countrywide Mapping of Goldenrod Invasion and Assessing Its Impact on Ecosystems and Human Well-Being: Project Scope and Initial Results

Andrzej N. Affek[1*], Anna Kowalska[1], Ewa Kołaczkowska[1], Edyta Regulska[1], Jacek Wolski[1], Zofia Jabs-Sobocińska[1], Bożena Omeliańska[1], Martyna Zarzycka[1], Anna Jarocińska[2], Marlena Kycko[2], Edyta Woźniak[3], Marek Ruciński[3], Małgorzata Jenerowicz-Sanikowska[3], Szymon Sala[3]

[1] *Institute of Geography and Spatial Organization Polish Academy of Sciences, Department of Geoecology, Warsaw, Poland*

[2] *University of Warsaw, Faculty of Geography and Regional Studies, Warsaw, Poland*

[3] *Space Research Centre of the Polish Academy of Sciences, Earth Observation Department, Warsaw, Poland*

E-mail: a.affek@igipz.pan.pl

This presentation outlines the scope, objectives, and methodology of an ongoing research project on the invasion of North American goldenrod species (*Solidago canadensis* and *S. gigantea*) across Poland. Initially introduced for ornamental and nectar-related purposes, these species have become invasive, displacing native flora while still offering some benefits such as honey production and aesthetic value.

The project aims to: (1) map the spatial distribution and cover of goldenrod patches nationwide; (2) characterize invaded areas based on environmental and socioeconomic factors; and (3) assess their impact on ecosystem services (ES) and human well-being. We hypothesize that goldenrod's effects on ES vary by location and patch characteristics, producing both gains and losses.

Despite some local studies, no high-resolution, nationwide analysis has been conducted. This project addresses that gap using Sentinel optical and radar satellite imagery for cost-effective mapping across Poland's 310,000 km². Our approach combines two levels of remote sensing (UAV and satellite) with field validation to assess ecosystem conditions using bioindicators. This is supported by biophysical and preference-based ES assessments comparing invaded and non-invaded sites. Key outputs include a national distribution map, a model of goldenrod invasion, and an assessment of ES trade-offs to inform management.

In 2024, UAV imagery was collected at 80 sites (avg. 5 ha) across Poland during the goldenrod flowering season. Orthophotos were generated using Pix4Dmapper at 2.18 cm and 8.6 cm resolutions, along with Digital Surface Models (DSMs). At each site, 100–200 reference patches were delineated and verified by geobotanists using drone imagery, field photos, and notes. Patch number depended on vegetation complexity. Three Grey Level Co-occurrence Matrix (GLCM) texture layers per RGB channel and several vegetation indices were computed per orthophoto and merged for Random Forest classification. Results were strong: F1-scores for goldenrod exceeded 0.80 at 80% of sites and reached ~0.75 at others, confirming method reliability. A second UAV campaign is planned for August 2025.

Parallel to mapping, a systematic literature review explored the ecological impacts and drivers of goldenrod spread. Several hundred articles from Scopus were categorized into thematic groups using a standardized table for quantitative analysis. All articles have been reviewed; quantitative synthesis is ongoing.

In June 2024, the first of four ecosystem field campaigns will take place, collecting soil, vegetation, and faunal data from 20 invaded and 20 uninvaded sites in the Mazovian region. These data will inform indicators for provisioning and regulating ES, including pollination, soil quality, air purification, and carbon sequestration. Cultural services—such as recreation and scenic value—will be evaluated using structured interviews and questionnaires.

This contribution is funded by Poland's Ministry of Science and Higher Education (grant no. NdS-II/SP/0216/2024/01).

Beyond ecosystem services: Bird conservation narratives used around the world

Jakub Kronenberg[1], Erik Andersson[2], Chris Sandbrook[3]

[1]*Social-Ecological Systems Analysis Lab, Faculty of Economics and Sociology, University of Lodz, P.O.W. 3/5, 90-255, Poland*
[2]*Faculty of Biological and Environmental Sciences, Ecosystems and Environment Research Programme and Helsinki Institute of Sustainability Science (HELSUS), FI-00014 Helsinki, University of Helsinki, Finland*
[3]*Department of Geography, University of Cambridge, Downing Place, Cambridge CB2 3EN, United Kingdom*

E-mail: jakub.kronenberg@uni.lodz.pl

In this paper, we analyse the responses obtained during 70 semi-structured interviews with people working in bird conservation around the world. The interviews were carried out between November 2023 and May 2025, reflecting a diversity of bird conservation organisations in terms of size and location (more than half from the Global South).
Both in our research and in formal bird conservation, birds represent a relatively easy entry point to talk about broader nature conservation. They are everywhere and are relatively easy to connect to, both at the societal and individual level, offering a high leverage, compared to many other parts of nature.

While anthropocentric and instrumental arguments seem to prevail, and ecosystem services are an important topic featured in bird conservation narratives, some organisations still refer to non-anthropocentric and intrinsic arguments. One particularly important emerging theme is connectedness to nature, reflecting relational arguments.
In this paper, we structure the arguments that appeared in the interviews along the different gradients, such as anthropocentric–non-anthropocentric and cold-scientific–passionate. We suggest that the different bird conservation narratives reflect the persistence of the classic divide into pragmatic or practical and sentimental groups. The boundaries between these groups may be more blurry now than in the past, though, given that many organisations pragmatically use different arguments to talk to different audiences.

This research is part of the broader project entitled "A bird's-eye view of how the natural environment fits into economics: Searching for alternative paradigms by analysing bird conservation narratives" (BirdEcon) and funded by the National Science Centre in Poland. The project aims to forge new approaches to capturing the value of nature in the part of the sustainability discourse that has become dominated by economics.

Impact of climate change on the ecosystem services of high mountain wetlands in the Eastern Pamir

Monika Mętrak[1], Elżbieta Rojan[2], Marlena Kycko[2], Marcin Sulwiński[1], Małgorzata Suska-Malawska[1]

[1]Faculty of Biology, Biological and Chemical Research Centre, University of Warsaw, Żwirki i Wigury 101, 02-089 Warsaw, Poland
[2]Faculty of Geography and Regional Studies, University of Warsaw, Krakowskie Przedmieście 30, 00-927 Warsaw, Poland

E-mail: m.metrak@uw.edu.pl

The Pamir Mountains are situated in the southeastern part of Central Asia. Their eastern part is characterized by cold desert climate, with an annual sum of precipitation below 100 mm, high insolation, strong winds and the presence of permafrost. High-altitude wetlands located there at approximately 3800 m a.s.l., form near lakes and in the river valleys, and function as complex systems influenced by a combination of arid or hyperarid climate conditions alongside glacial, cryogenic, fluvial and shore processes. These wetlands, considered as wet habitat islands (sensu Flantua et al., 2020), perform vital ecological functions, including serving as water reservoirs, resting sites for migratory birds, and grazing areas for rare herbivore species. Moreover, they are crucial for local communities as the primary source of fodder for livestock such as yaks, sheep, and goats (Mętrak et al., 2015; Mętrak et al., 2023). Given the high micro-relief variability and complex water supply mechanisms observed in these wetlands, they may also act as refugia for species whose current ranges are limited by the climate changes projected for Central Asia. Such species typically inhabit less moist environments, often at lower elevations (e.g., steppe and meadow species).

Recent increases in mean annual air temperature – approximately 1°C higher compared to the 1950–1997 period for this region (Mętrak et al., 2023) – combined with altered precipitation patterns, may disrupt wetland ecosystem functioning and the services they provide. Therefore, we present the results of our decade-long research on high-mountain wetlands in the Eastern Pamir, focusing on potential changes in ecosystem functioning and services driven by ongoing climate change.

Both meteorological and satellite data on open water areas indicate that, with rising temperatures, the extent of lakes and small water bodies within the vegetation mosaic is increasing. These observations, together with the presence of shallow ground ice in the study area, suggest that wetlands may currently be sustained by thawing processes. Consequently, wetlands may temporarily retain their cold, wet, and mesic characteristics under changing climatic conditions and potentially serve as refugia for steppe and meadow species. Furthermore, vegetation is expected to further from water bodies in the near future, although its spatial composition may shift in favour of species adapted to brackish, stagnant water. Some habitats may also become restricted or damaged due to intensified river flow and local disturbances caused by cryogenic processes.

When temperatures rise sufficiently to inhibit ground ice renewal and significantly reduce the extent of impermeable permafrost, vegetation will retreat in response to receding shorelines, with drought- and salinity-tolerant species becoming dominant. These changes will profoundly affect the use of high-mountain wetlands as pastures. Alterations in the seasonality and duration of flooding will cause spring pastures to flood and summer pastures to dry out (Baradun et al., 2020), thereby limiting their usability. Simultaneously, shifts in vegetation will reduce the area of preferred pastures – such as small sedge and *Kobresia* meadows – and promote the dominance of salt marshes, which provide lower-quality fodder. Finally, the fragmented, uneven, and unstable microrelief resulting from intense cryogenic processes will increase the risk of leg injuries in sheep and cattle, complicating wetland utilisation.

References

1. M. Barandun, J. Fiddes, M. Scherler et al., *Water Security* **2020**, *11*, 100072.
2. S. Flantua, D. Payne, M. Borregaard et al., *Global Ecology and Biogeography* **2020**, *29(1)*, 1651-1673.
3. M. Mętrak, Ł. Chachulski, P. Pawlikowski et al., *CATENA* **2023**, *220A*, 106704.

Is International Free-Riding Immanent To Transboundary Spatial Conservation?

Sviataslau Valasiuk[1]

[1]*Warsaw Ecological Economics Centre, Faculty of Economic Sciences, University of Warsaw, ul.Długa 44/50, Warsaw, 00-241 Poland*

E-mail: svalasiuk@wne.uw.edu.pl

Despite their recent global expansion in nominal terms, many transboundary nature protected areas tend to avoid hands-on cross-border co-operation. One common explanation which is widely seen a major obstacle towards the concerted transboundary conservation is international free riding towards transboundary ecosystem services on the centralised decision-making level. I examine empirically whether international free-riding is embedded in citizens' stated preferences for extended protection in the case of two transboundary nature protected areas Białowieża Forest and Fulufjället. I scrutinise a sub-set of merged survey samples from the four countries involved, i.e. Belarus, Norway, Poland, and Sweden, including only the citizens assumingly incentivised to free-ride on unilateral foreign country's conservation action. I apply attitudinal indicators to form effect-coded variables that measure free-riding, and control for use value, nationality, individual socioeconomic characteristics, and incentive compatibility of the survey design. The results indicate no widespread tendency of international free-riding; the conclusion is maintained with varying modelling approaches or sampling strategy employed.

Hidden in the Shadow of Trees: Exploring Urban Residents' Perception of Tree-Related Ecosystem Service and Its Relation to Heat-Prone Areas

Abdurrahman Zaki[1], Patrycja Przewoźna[1], Piotr Jabkowski[2]

[1]*Department of Geoinformation, Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, Bogumiła Krygowskiego 10, 61-680 Poznań, Poland*

[2] *Department of Social Dynamics Studies, Faculty of Sociology, Adam Mickiewicz University, Augustyna Szamarzewskiego 89, 60-568 Poznań, Poland*

E-mail: abdzak@amu.edu.pl

Urban trees provide crucial cooling benefits, yet their role in thermal regulation is often undervalued in urban planning, with other services sometimes prioritized over functional aspects like shade [1, 2, 3]. Public acceptance of tree protection strategies' regulations often prioritizes trees' cultural and aesthetic values over functional benefits like shading [4]. This highlights a need to understand better how residents' subjective appreciation and need for trees, particularly for shade, relate to objective thermal conditions like Land Surface Temperature (LST) in heat-prone areas. This study, focusing on Poznań, Poland, aimed to investigate this relationship, exploring how it is influenced by the surrounding microclimate expressed with Local Climate Zones (LCZs) proposed by Stewart & Oke [5], the individual factors such as socio-demographics (age, sex, education) and environmental worldviews (New Ecological Paradigm - NEP). LCZs were widely used for research on thermal comfort [6]. However, such analyses are based mainly on environmental parameters, neglecting human-based approaches [7], and our research fills this gap. Data from a geo-questionnaire survey of 536 Poznań respondents were analyzed using nested regression models.

The findings revealed distinct patterns. Stronger pro-environmental worldviews (NEP) significantly increased appreciation for the appreciated existing shade trees. At the same time, older age (65+) was associated with reduced appreciation, and higher education levels were linked to increased appreciation. Higher LST was surprisingly associated with slightly lower appreciation for these existing trees. Regarding the perceived need for new trees (based on analyses of approximately 290 respondents with complete data for these outcomes), LST had no direct influence on the results. LCZ and residents' NEP scores were used instead as an explanatory variable. Stronger pro-environmental views were linked to wanting about twice as many new trees for various purposes, including along street edges and for shade. The LCZ also shaped this desire; for example, residents in denser LCZs (like compact mid-rise) and compact multi-family housing expressed a greater need for new roadside trees than those in less dense zones or dispersed housing. Socio-demographic characteristics such as age (with younger to middle-aged adults showing higher demand) and sex (males often expressing greater need) further fine-tune preferences for new trees. Including these personal views and local characteristics significantly improved the models' ability to explain residents' preferences.

These results underscore that the perceived value and need for urban greening are primarily dictated by residents' environmental attitudes, significantly shaped by both the physical characteristics of their living environment (LCZ, building type) and their life stage. Therefore, to make urban greening effective, planners should engage with residents to understand their views on nature and design green spaces that fit the specific conditions of each neighborhood, especially in densely built areas. This will help ensure new greenery meets both what people want and what is ecologically needed.

References

1. P. Przewoźna, K. Mączka, M. Mielewczyk, A. Inglot, and P. Matczak, *Ambio*, **2022**, 51, 2043–2057
2. C. Cortinovis and D. Geneletti, *Land use policy*, **2018,** 70, 298–312
3. C. M. Raymond *et al.*, *Ecol. Econ.*, **2009**, 68, 1301–1315
4. D. Paniotova-Maczka *et al.*, *Environ. Sci. Policy*, **2023**, 145, 1–12
5. I. D. Stewart and T. R. Oke, *Bull. Am. Meteorol. Soc.*, **2012,** 93, 1879–1900
6. S. Patel, M. Indraganti, and R. N. Jawarneh, *Build. Environ.*, **2024**, 249, 111130
7. R. Aghamolaei, M. M. Azizi, B. Aminzadeh, and J. O'Donnell, *Energy Environ.*, **2023,** 34, 2204–2227

Urban Heat Island in Warsaw: The Role of Urban Greenery in Its Modification

Magdalena Kuchcik[1], Kaja Czarnecka[1], Jarosław Baranowski[1], Katarzyna Lindner-Cendrowska[1], Sandra Słowińska[1]

[1] *Institute of Geography and Spatial Organization, Polish Academy of Sciences, Twarda 51/55, 00-818 Warsaw*

E-mail: mkuchcik@twarda.pan.pl

Research on the urban heat island in Warsaw dates back to the beginning of the 20th century, and its intensity has increased over subsequent periods as the city has grown. Between 1961 and 1980, the city centre was, on average, 1-2°C warmer than the suburbs [1,2]. By 2001-2002, it had increased to 2°C warmer [3], from 2009 to 2018, it was as much as 3.6°C warmer [4]. During the latter period, the annual mean UHI in the centre of Warsaw was highest in summer (4.5°C) and lowest in winter (2.3°C). The greatest air temperature contrast between the centre and the outskirts reached 12.2°C. In terms of land use, between 2009 and 2018, the UHI intensity in dense multi-family housing was 2.8°C, in residential areas it was 2.3°C, in industrial areas it was 1.4°C, and in inner-city parks, it was 1.2°C relative to a reference point on the outskirts of the city [4].

Urban greenery (parks, the Vistula valley, allotment gardens) and forests within the city boundaries account for 31% of Warsaw's total area. The average intensity of the urban heat island in these areas during the 2009-2018 period was 0.6°C. This underscores the significant role of greenery in influencing the city's thermal conditions, especially in summer.
A continuation of the study of greenery's role in shaping the city's climate is the research conducted within the CLIMPARK project. The CLIMPARK project aims to determine the impact of six urban parks of varying sizes, structures, and ages on the climate and bioclimate of their surroundings, as well as to assess the climatic variation within the parks. For the project, a network of meteorological measurements was established in and around the parks over two years. Additional measurements of temperature and soil moisture under different types of vegetation, which will be compared with satellite images and surface temperature values, will help to determine the extent of the cooling effect of the parks. Furthermore, a model will be developed to assess the perception of biothermal conditions in the city's green areas, considering the influence of the parks' sizes and developments and the respondents' personal characteristics on their individual definitions of thermal comfort.

Preliminary results indicate that, on average, the summer air temperature measured at meteorological stations in parks is 1.1°C to 1.5°C lower than in built-up areas. The average differences recorded between shaded and sunny areas during the summer measurement campaign in many parks exceed 3°C. In comparison, the differences in 10-minute values reach 5°C, and the temperature variation between shaded parts of the park and the built-up area exceeds 8°C.

References

1. W. Górczyński, S. Kosińska, 1916. O temperaturze powietrza w Polsce, *Pamiętnik Fizjograficzny 23, 262*
2. J. Wawer, 1992. The impact of weather conditions on the intensity of the urban heat island in Warsaw. *Miscellanea Geographica* 5, 65-69.
3. K. Błażejczyk, M. Kuchcik, P. Milewski, W. Dudek, B. Kręcisz, A. Błażejczyk, J. Szmyd, B. Degórska, C. Pałczyński, 2014. Miejska wyspa ciepła w Warszawie: uwarunkowania klimatyczne i urbanistyczne, Wydawnictwo Akademickie Sedno, Warszawa
4. M. Kuchcik, K. Czarnecka, K. Błażejczyk, 2024. Urban heat island in Warsaw (Poland): Current development and projections for 2050, *Urban Climate* 55, 101901.

Urban heat stress mitigation – cooling with trees and vegetation

Karolina Kais[1], Joanna Kosno-Jończy [1], Kacper Rybicki [1], Kinga Mazurek[1], Marzena Suchocka[1], Magdalena Błaszczyk[1]

[1]*Department of Landscape Architecture, Warsaw University of Life Sciences, Nowoursynowska 166, Warsaw, Poland*

E-mail: karolina_kais@sggw.edu.pl

Trees provide key ecosystem services, directly affecting the quality of urban life by improving environmental conditions and supporting the resilience of urban ecosystems to the effects of climate change. One of the most important services provided during climate change is heat island mitigation, provided at both the planning and individual tree scale. The presentation discusses the impact of different land cover types and species composition on hit island mitigation. Analyses indicate that it is more effective than increasing tree canopy cover to increase biodiversity in the context of trees.

Examples of practical green infrastructure solutions in cities such as pocket parks, sponge park, temporary garden, low budget parks, etc. were also presented. Additional benefits of urban tree planting such as noise reduction, temperature reduction and reduction of air pollution levels were highlighted. A case study was used to illustrate specific examples of ecosystem services provided by trees. Information was also provided on the potential for improving the habitat conditions of trees with a correlation to the ecosystem services provided.

Tree management in urban and rural areas with the Ecosystem Services approach - perspective and challenges based on the iTre-es project results

Patrycja Przewoźna[1], Piotr Matczak [2]

[1]*Department of Geoinformation, Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, Bogumiła Krygowskiego 10, 61-680 Poznań, Poland*
2 Department of Social Dynamics Studies, Faculty of Sociology, Adam Mickiewicz University, Augustyna Szamarzewskiego 89, 60-568 Poznań, Poland

E-mail: pwysocka@gmail.com

Trees provide many Ecosystem Services (ESs) to people. In addition to direct benefits (e.g., fruit and wood sales), they also affect health (clean the air of pollutants and provide oxygen), create beautiful landscapes, promote recreation, and even stimulate social interaction. Despite trees' vital role, many benefits derived from trees are usually not noticed or, if seen, treated as clear and free. Thus, the construction of regulations protecting trees is a challenge and needs to consider different stakeholders. In the iTre-es project, we analyzed this problem from several perspectives in case studies of Polish urban and rural areas, bringing essential insight to tree management strategies.
First, we proposed a method integrating field data from city parks and Airborne Laser Scanning to estimate tree-related ecosystem services (ESs), including private properties. Applied in Racibórz City, it revealed significant tree cover losses following 2017 legislation that temporarily allowed private landowners to remove trees without permits [1]. Long-term impacts remain unclear due to the policy's reversal within months, underscoring the need for sustained remote sensing monitoring for better management of urban greenery.

Secondly, our study highlights that policymakers must differentiate between rural and urban regions, considering geographical disparities, resident psychological profiles, and varying ES priorities to tailor effective tree management strategies. Residents of the rural municipality of Nysa, investigated in our project, valued provisioning services from trees, such as wood and fruit, more than residents of the urban municipality of Racibórz. They also tend to support landowner autonomy in tree management more strongly. However, this relation is affected by the emotional connection with the place of residence - when stronger, it implies residents' support for municipalities deciding to remove trees [2]. Apart from the wood provision, local experts also underlined the trees' role in wind protection, which might be an indication for considering the preservation of trees along roads and fields and the promotion of new plantings in rural municipalities. In the case of urban areas such as Racibórz, the crucial aim of tree management (based on their ESs) appeared to be preserving a natural animal habitat [3].

Thirdly, based on local experts from Nysa and Racibór, we also indicated eight ESs that may have universal relevance independent of location and thus should be monitored and protected by general regulations [3]. Moreover, the opinion that the municipality should decide to remove trees is positively associated with the perception of trees' cultural benefits regardless of the location [2, 4]. The relation was also proved in Poznań and Gdańsk research, highlighting the role of environmental worldviews related to this problem [4]. However, both cities also showed that cultural ESs are not among the most important in the daily life of their residents. More essential are regulating ESs and the accessibility of even small tree-covered areas in the direct vicinity of their places of residence [5]. We also showed that stakeholders' views on tree removal on privately owned land might change by deliberation, helping coalesce the narratives between residents in urban and rural areas [6].
Overall, the iTre-es project emphasizes the importance of ecosystem services–based approaches to tree management tailored to urban and rural contexts.

References

1. K. Zięba-Kulawik, P. Hawryło, P. Wężyk et al., *Urban For. Urban Green* **2021**, *63*, 127195
2. D. Paniotova-Maczka, P. Matczak, P. Jabkowski, *Front. Psychol*. **2021**, 12, 639830
3. P. Przewoźna, K. Mączka, M. Mielewczyk et al., *Ambio* **2022**, 51, 2043-2057
4. D. Paniotova-Maczka, P. Jabkowski, P. Matczak et. al., *Environ. Sci. Policy*. **2023**, 145, 1-12
5. P. Przewoźna, A. Inglot, M.Mielewczyk et al., *Ecol.Indic*. **2024**, 166, 112548
6. K. Mączka, P. Matczak, M. Mielewczyk et al., *Land Use Policy* **2023**, 133, 106843

Assessing Ecosystem Health in Lithuania: Key Drivers and Trends

Gintarė Sujetovienė, Giedrius Dabašinskas

Department of Environmental Sciences, Vytautas Magnus University, Universiteto 104, Akademija, Kaunas district, Lithuania

E-mail: gintare.sujetoviene@vdu.lt

Maintaining ecosystem health is essential for the continued provision of ecosystem services that support human well-being. Both natural and anthropogenic factors, such as land-use change, have a critical impact on ecosystem health. By incorporating an ecological vigor, organization, and resilience model for assessing ecosystem health (EH) in Lithuania through both qualitative and quantitative analysis. To identify the main factors influencing EH, land use changes, natural, social, and economic factors were assessed between 2000 and 2018. The spatial distribution of ecosystem health showed high and very high ecosystem health throughout the area. The level of EH was lower in some urbanized areas and in southern Lithuania. The highest values were observed in the western part of Lithuania. Overall, ecosystem health decreased from 0.79 in 2000 to 0.75 in 2018. The deterioration in EH was mainly due to a decrease in the proportion of total area classified as the highest health category at the expense of an increase in high and medium health over the study period. The proportion of built-up and natural land, population density, and land use intensity were the four main factors influencing EH in Lithuania, with the latter having the greatest and increasing over time explanatory power. The results can reveal the impact of urbanization on ecosystem health and provide an effective basis for sustainable development.

The impact of restoration of Lithuania's peatlands on the value ecosystem services

Giedrius Dabasinskas[1], Gintare Sujetoviene[1]

[1]*Department of Environmental Sciences, Vytautas Magnus University, Universiteto st. 10, LT-53361, Akademija, Kaunas District, Lithuania*

E-mail: giedrius.dabasinskas@vdu.lt

This study assessed spatial and temporal changes in the economic value of ecosystem services provided by Lithuanian peatlands and evaluated the benefits of restoring drained peatlands in comparison to the costs. Since 1900, Lithuania has lost approximately 75 % of its peatlands, most of which are drained fens (74 %) while most of the remaining peatlands are raised bogs (65 %). Forestry and agriculture were the main drivers of peatland loss. The examined ecosystem services provided by undrained peatlands, compared to drained ones, were mainly related to climate and water flow regulation, waste management, biodiversity, and recreation. Based on this selection of ecosystem services (ES), the value of ecosystem services provided by intact peatlands is $1336 million per year. Undrained peatlands, occupying less than half the area of drained peatlands, provide twice as many benefits in terms of ES as drained ecosystems. If these drained peatlands were restored by 2050, they would account for $4006 million per year. A cost-benefit analysis has shown that the benefits outweigh the costs, making restoration efforts economically justifiable. More effective management measures could achieve a balance between the use of these ecosystems and the benefits they provide to human well-being.

Cultural Ecosystem Services of Allotment Gardens (AG): Analysis of plot structure and use in Łódź, Poland

Konrad Budziński[1,3], Renata Włodarczyk-Marciniak[2], Agnieszka Bednarek[1].

[1]*UNESCO Chair on Ecohydrology and Applied Ecology, University of Lodz, Banacha Street 12/16 , Łódź, Poland*
[2]*European Regional Centre for Ecohydrology of the Polish Academy of Sciences, Tylna Street 3, Łódź, Poland*
[3]*Doctoral School of Exact and Natural Sciences, University, Matejki Street 21/23, Łódź, Poland*

E-mail: konrad.budzinski@edu.uni.lodz.pl

Allotment gardens (AG) represent an important component of formal urban green spaces, offering both ecological and social functions. Despite their longstanding presence in Polish cities, scientific knowledge regarding the actual uses of garden plots and the extent of ecosystem services they provide – particularly cultural services – remains limited, especially in comparison to other types of urban green spaces. This study aims to fill this research gap through a comprehensive spatial and functional analysis of selected allotment gardens in the city of Łódź.

The research encompassed 95 individual plots located within four allotment garden complexes in Łódź. Detailed field observations were conducted to document the spatial organization of each plot, including the percentage of area devoted to recreational and cultivation purposes, an inventory of recreational infrastructure, and the taxonomic and quantitative composition of vegetation (trees, shrubs, and herbaceous plants).

Custom indicators were developed to quantify the potential for providing three key types of cultural ecosystem services: active gardening (related to plant cultivation and care), passive interaction with nature (such as visual enjoyment and presence in a green environment), and recreation based on non-natural assets (e.g., using garden furniture, grilling, or spending time in garden pavilions). Based on these data, three dominant plot usage types were identified: cultivation-oriented, recreation-oriented, and mixed-use. The analysis showed that recreation-oriented plots exhibited the highest potential to provide the latter two services, while cultivation-oriented plots were dominant in terms of active gardening potential.

The study also included structured interviews with plot holders and allotment garden managers, focusing on the perception and subjective evaluation of ecosystem services delivered by the gardens. Respondents consistently emphasized the value of allotment gardens in terms of rest, tranquility, contact with nature, and neighborhood cohesion. The results confirm the role of allotment gardens as local hubs for delivering cultural ecosystem services and highlight their importance in enhancing urban quality of life and supporting the adaptation of urban spaces to climate and social challenges.

Ecosystem Services after forest dieback

Emilia Wysocka-Fijorek[1], Agnieszka Kamińska[1], Mariusz Ciesielski[1], Krzysztof Stereńczak[1], Adam Kaliszewski[1]
[1]*Instytut Badawczy Leśnictwa*

E-mail: e.wysocka-fijorek@ibles.waw.pl

Understanding the interrelationships between ES across different spatial and temporal scales is essential for informed and adaptive forest resource management. Ecosystem services and the interactions among them are shaped by numerous factors, including climate change, forest management practices, simulation scale, species composition, age-class distribution, forest stand structure, land-use history, location, site productivity, and geomorphological conditions. The growing risk of abiotic (e.g., wildfires) and biotic (e.g., pest outbreaks) disturbances due to climate change threatens the stability of forest stands and their ability to maintain ES provisioning. Natural and human-induced disturbances resulting in increased tree mortality or forest dieback can lead to rapid and significant shifts in the level and type of ES provided. Moreover, changes in species composition and age structure during post-disturbance recovery also influence the distribution and availability of ecosystem services.

This study investigates the provision and interactions of ES in forests affected by large-scale spruce dieback in the 1980s, where forest ecosystems have since undergone restoration through targeted forest management efforts. In forests affected by dieback, we found that ES formed three multivariate bundle types with different compositions and non-random spatial distributions, primarily characterized by forest stand age and species composition. Our findings suggest that forest management practices promoting structural and species diversity at the landscape level can enhance the simultaneous delivery of multiple ES. Furthermore, the methodological approach presented here, which is based on publicly available forest data and a universal set of indicators, is applicable beyond the study region and can be effectively transferred to other forest areas in Poland and Central Europe.

Why this forest and not another one? Why more often “me” than “others”?

Mariusz Ciesielski[1], Agnieszka Kamińska[1], Kamil Choromański

[1]*Department of Geomatics, Forest Research Institute, Sękocin Stary, ul. Braci Leśnej 3, 05-090 Raszyn, Poland, City, Country*
[2] *Warsaw University of Technology, Faculty of Geodesy and Cartography*
Plac Politechniki 1, 00-665 Warsaw, Poland

E-mail: m.ciesielski@ibles.waw.pl

Forests provide more than 100 different ecosystem services, including provisioning, regulating, supporting, and cultural services. Among these, recreation is consistently ranked as one of the most socially valued. Forests offer easily accessible spaces for daily leisure activities such as walking, running, cycling, dog walking, nature observation, and relaxation. These activities contribute not only to individual well-being but also reflect growing societal demands for health, quality of life, and a connection to nature.

From the perspective of sustainable forest management, it is essential to understand both the intensity and spatial distribution of recreational use in forested areas. Traditionally, monitoring forest recreation has relied on methods such as manual visitor counts, trail-based automatic counters, surveys, and direct observation. While useful, these approaches are often labor-intensive, limited in spatial coverage, and difficult to scale. Only in recent years has the potential of mobile phone data begun to be explored for environmental monitoring. In urban agglomerations such as the Warsaw metropolitan area—where forested landscapes face growing pressure from expanding populations—mobile data offer a valuable opportunity for more precise assessments of visitation patterns and user preferences.
In this study, mobile phone data were used to: (a) quantify the actual use of forest areas for recreation; (b) identify factors influencing the choice of recreational sites (i.e., the forest's potential to deliver ecosystem services); and (c) analyze factors affecting the frequency of visits by local residents (i.e., the demand for ecosystem services). The data covered a 12-month period and included only residents of the Warsaw metropolitan region. Nearly 200 explanatory variables were developed to investigate the determinants of both the supply potential of forest ecosystems and the demand for services.

The findings presented in the poster highlight the considerable potential of mobile phone data for mapping various dimensions of cultural ecosystem services. These insights can be effectively applied to forest management in Poland and support efforts to enhance public access to forested areas.

How Microclimate Shapes Bumblebee Behavior and Pollination: Insights from Automated Tracking

Andrzej Affek[1,2*], Anupreksha Jain[2], August Easton-Calabria[2], Nicole DesJardins[2], James Crall[2]

[1] *Institute of Geography and Spatial Organization Polish Academy of Sciences, Department of Geoecology, Warsaw, Poland*
[2] *University of Wisconsin-Madison, College of Agricultural and Life Sciences, Madison, USA*

E-mail: a.affek@igipz.pan.pl

Wild pollinators play a critical role in maintaining ecosystem services essential for agricultural productivity, biodiversity, and human well-being. This study investigates how microclimatic variation influences the functioning of wild pollinators, specifically focusing on bumblebee colonies. The primary objective was to assess how nest location and associated microclimatic conditions – such as temperature, humidity, and solar radiation – affect nest behavior, foraging activity, and overall colony performance.

To address this, we employed an automated behavioral tracking system (BumbleBox) to monitor individual bumblebees. Sixteen colonies of Bombus impatiens were deployed in two environments—a prairie and a forest—at the Lakeshore Nature Preserve in Madison, Wisconsin. Half of the colonies were placed below ground, while the other half – above ground. A total of 720 bumblebees were tagged with ArUco markers for precise visual identification and tracking. Over a three-week study period, we recorded more than 10 million individual tag detections within nests and 3,500 foraging trip events.

Preliminary results revealed that colonies located below ground, where daily temperature fluctuations were significantly smaller, performed better compared to those above ground. Foraging trip duration and the expected delivery of pollination ecosystem service was significantly influenced not only by immediate weather conditions – such as solar radiation, temperature, and relative humidity – but also by the nest's location in the landscape (prairie vs. forest) and its position relative to the ground (below vs. above). Additionally, notable variability in colony performance suggests that genetic differences and the inherent complexity of social insect colonies contribute to observed patterns.

These findings underscore the importance of microclimatic conditions in shaping the behavior and success of wild pollinators and their potential to deliver pollination. They highlight the need to consider habitat features and microclimatic stability when designing conservation strategies for pollinator populations in a changing climate.

This study was funded by Polish National Agency for Academic Exchange (grant no. BPN/BEK/2023/1/00370).

Landscape ecological plan - a basic tool for the sustainable use of ecosystem services

Zita Izakovičová[1], Veronika Piscová[1], Juraj Hreško[2]

[1] *Institute of Landscape Ecology, SAS*

[2] *Department of Ecology and Environmental Sciences, FPVaI UKF Nitra*

E-mail: zita.izakovicova@savba.sk

One of the most effective tools for optimal use of the landscape potential and ensuring its sustainable use is the landscape ecological plan. The landscape ecological plan represents a complex process of mutual coordination of the spatial requirements of economic and other human activities with the landscape ecological conditions of the territory (natural resources and potentials) resulting from the structure of the country. Such an arrangement ensures: satisfactory ecological stability of the spatial structure of the landscae, effective utilisation of ecosystem services, protection and rational use of nature and biodiversity, protection and rational use of natural resources and protection of the environment. It also ensures the protection and sustainable use of the landscape's rare archetypes. The landscape ecological plan represents the basic ecological regulation for spatial planning processes. In Slovakia, it is also legislated. The poster will focus on the presentation of the methodological procedure for processing the landscape ecological plan as a tool for ensuring sustainable utilisation of ecosystem services. The application of the methodological procedure will be presented in the case study Tatra Biosphere Reserve. Basic barriers to the application of ecological limits resulting from the landscape ecological plan in real practice will also be presented.

Key words: Landscape ecological plan, sustainable development, Tatra Biosphere Reserve

Acknowledgement: This research was funded by Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences, grant number VEGA-1/0504/25 "Classification of archetypes of the Slovak landscape in the context of socio-economic changes and current climate developments"

Resistance and species diversity of alpine vegetation under the influence of trampling (experimental study)

Veronika Piscová[1], Juraj Hreško[2], Michal Ševčík[2], Zita Izakovičová[3], Terézia Slobodová[2]

[1] *Institute of Landscape Ecology – branch Nitra, Slovak Academy of Sciences, Akademická 2, 949 01 Nitra, Slovakia*

[2]*Department of Ecology and Environmental Science, Faculty of Natural Sciences and Informatics, Constantine the Philosopher University in Nitra, Trieda A. Hlinku 1, 949 01 Nitra, Slovakia*

[3]*Institute of Landscape Ecology,, Slovak Academy of Sciences, Štefánikova 3, 814 99 Bratislava, Slovakia*

E-mail: veronika.piscova@savba.sk

In recent decades, the topic of recreation in protected areas has become increasingly important. After the Covid pandemic, as well as due to climate change, scientific articles have increasingly discussed the topic of the growing number of tourists in the colder alpine environment, which tourists seek as a place suitable for strengthening their health and gaining new experiences. The main research is the influence and impact of hiking on the alpine landscape. Almost no attention is paid to this topic in Slovakia. Therefore, we decided to conduct experimental research on trampling vegetation in the alpine environment. The research was conducted in the Belianske Tatras National Nature Reserve, in an area closed to tourists since 1978 due to the destruction of the area by a massive number of tourists. In 1993, one trail was opened in the area as a one-way trail, leading from the village of Ždiar, through Monkova valley and Široké saddleback, to Kopské saddleback. Since 2008, this trail has been registered as a two-way educational trail. In 2008, research on experimental trampling of vegetation took place in three selected native communities that occur in the vicinity of the opened trail. Research blocks were established in places near the trail that had not been attacked by trampling until then. In 2022, experimental trampling was repeated in the same, but already regenerated, communities. The aim of the research was to determine whether the community in the original (without human intervention) and regenerated state reacts to trampling in the same way. The research results bring valuable results that can be used in the decision-making process on the discussed reopening of the National Nature Reserve territory for tourism. Regenerated communities react more resistant to trampling, but at the expense of the disappearance of some species from trampled areas. Some species of hemicryptophytes, mosses and lichens in particular react very sensitively to trampling. In these, a delayed response to trampling in the form of disappearance on trampled areas was confirmed. If the Belianske Tatras National Nature Reserve were to be reopened to tourists, we consider it important not only to monitor the number of visitors, but also to monitor the movement of tourists outside the trails.

Acknowledgement: This research was funded by Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences, grant number VEGA 2/0031/23 Analysis and evaluations of the environmental history of selected types of Slovak landscape from the early prehistory to the present; by project KEGA 037UKF-4/2025 Integration of modern technologies and procedures into the teaching of spatial ecology; by the Project APVV-20-0108 Implementation of Agenda 2030 through biosphere reserves.

Landscape archetype as entity of landscape ecology research

Juraj Hreško[1], Gabriel Bugár[1], Veronika Piscová[2], Zita Izakovičová[3]

[1] *Department of Ecology and Environmental Science, Faculty of Natural Sciences and Informatics, Constantine the Philosopher University in Nitra, Trieda A. Hlinku 1, 949 01 Nitra, Slovakia*

[2] *Institute of Landscape Ecology – branch Nitra, Slovak Academy of Sciences, Akademická 2, 949 01 Nitra, Slovakia*

[3]*Institute of Landscape Ecology,, Slovak Academy of Sciences, Štefánikova 3, 814 99 Bratislava, Slovakia*

E-mail: jhresko@ukf.sk

Landscape research brings a whole range of new perspectives and possibilities, espacially in the context of changing landscape in time and space. Open sources of using remote sensing data, aerial and satellite images and their subsequent processing in a GIS environment offer various interpretations of landscape development. When solving the relationships between the elements and processes as well as their spatial arrangement, we encounter the problem of landscape genesis and its physiognomy, which is adressed by a number athors when they solve the issue of historical structures in the landscape, landscape scenery, visual quality and landscape perception, and recently we have also included the concept of landscape archetype. The importance of landscape archetypes is closely related to the issue of sustainable use and management of the landscape in accordance with the concept of the European Landscape Convention, which declares that "for the implementation of landscape concepts, each contracting party undertakes to introduce tools aimed at the protection, management and/or planning of the landscape" (European Convention on Land, Florence, 2000). One of the approaches to the fulfillment of the convention is also the definition of specific and representative territories, where people, through their historical use, have shown respect for the characteristics of the landscape and its components. Characteristic features of landscape archetypes are visually distinguishable regularities of patterns, arrangement of elements in space and their relationship to the properties of landscape components with respect for real and potential processes. The main criterion for defining landscape archetypes is the physiognomy of elements of the secondary landscape structure, which is characterized by the attributes of geometric patterns and various forms of positional properties of elements in space. In the contribution, we point out the possibilities of the definitions of landscape archetypes as the result of landscape genesis in various conditions European landscape types.

Acknowledgement: This research was funded by Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences, grant number VEGA-1/0504/25 “Classification of archetypes of the Slovak landscape in the context of socio-economic changes and current climate developments” VEGA 2/0031/23 “Analysis and evaluations of the environmental history of selected types of Slovak landscape from the early prehistory to the present”.

Green Redevelopment Aspects of Landfills – Geotechnical and Ecosystem Services Restoration Challenges for Real Estate Beneficiarie

Juris Burlakovs[1], Zane Vincevica-Gaile[2], Maija Fonteina-Kazeka[2], Maris Krievans[1,3], Martins Vilnitis[1], Mait Kriipsalu[4]

[1]*Institute of Civil Engineering, Riga Technical University, Kipsalas Str. 6A, LV-1048, Riga, Latvia*
[2]*Department of Environmental Science, University of Latvia, Jelgavas Str. 1, LV-1004, Riga, Latvia*
[3]*Department of Geology, University of Latvia, Jelgavas Str. 1, Riga, Latvia*
[4]*Chair of Rural Building and Water Management, Estonian University of Life Sciences, 51014 Tartu, Estonia*

E-mail: juris@geo-it.lv

The ongoing increase in global production has created substantial volumes of waste, accumulated in landfills, open dumpsites, brownfields of industry waste. Although advances in recycling, reuse, and natural biodegradation have reduced the burden, legacy and active and abandoned landfill sites remain critical environmental and urban planning challenges. Especially older or poorly managed sites - lack proper containment and post-closure care, resulting in unstable, degraded terrain often referred to as former dumps rather than engineered landfills. Real estate as well as municipal benefits can be gained in valuable lands with great developers interest, incorporating geotechnical engineering principles to ensure environmental safety, structural stability, and long-term viability for economic gains [1,2].

Case studies of an integrated, case-based evaluation of several closed or rehabilitated waste disposal sites that have transitioned from neglected, unusable land to ecologically functional green zones are proposed. These transformations are examined through the dual lenses of geotechnical redevelopment such as soil stabilization, waste mass behavior, ground settlement control, and surface sealing and ecosystem services restoration. The selected perspective case studies from Latvia, Poland, and Estonia highlight effective future strategies in turning environmentally degraded lands into valuable urban assets.

A multi-criteria evaluation framework is employed to estimate ecosystem service gains alongside geotechnical remediation outcomes. Furthermore, the paper quantifies the post-redevelopment uplift in land value, emphasizing the tangible benefits for urban planning and real estate stakeholders. These examples underscore the potential for landfill sites to be repositioned as integral parts of urban green infrastructure, delivering both ecological functions and financial returns.

References

1. J. Burlakovs, M. Kriipsalu, M. Klavins, A. Bhatnagar, Z. Vincevica-Gaile, J. Stenis, Y. Jani, V. Mykhaylenko, G. Denafas, T. Turkadze, M. Hogland, V. Rudovica, F. Kaczala, R. Møller Rosendal, W. Hogland, *Resources, Conservation and Recycling* **2017**, *123*, 73–84.
2. A.B. Cundy, R.P. Bardos, M. Puschenreiter, M. Mench, V. Bert, W. Friesl-Hanl, I. Müller, X.N. Li, N. Weyens, N. Witters, J. Vangronsveld, *Journal of Environmental Management*, **2016**, *184*, 67–77.