



Transilvania
University
of Brasov
FACULTY OF SILVICULTURE
AND FOREST ENGINEERING

12TH INTERNATIONAL SYMPOSIUM *FOREST AND SUSTAINABLE DEVELOPMENT*

BRAȘOV, ROMANIA, 15-16 OCTOBER 2026

Book of abstracts



Contents

Plenary session

Maurizio ACUNA: <i>Precision forestry for sustainable development: Connecting digital innovation with forest stewardship</i>	10
Alex GIURCĂ: <i>Co-creating the First Strategic Research and Innovation Agenda (SRIA): Research and funding gaps and the way forward</i>	11

Forest ecosystem management

Oral presentations

Valeriu BRAȘOVEANU, Ala DONICA: <i>The biological potential of edifying tree species from the Republic of Moldova green spaces in the context of environmental pressures and threats</i>	13
Cosmin COȘOFREȚ, Laura BOURIAUD, Olivier BOURIAUD, Ionuț BARNOAIEA: <i>Assessing climate change impacts on recreational ecosystem services: The case of Pătrăuți Forest District</i>	14
Branislav CVJETKOVIĆ, Milan MATARUGA, Libor JANKOVSKÝ, Tomáš ŽID, Petr MARTINEK, Jiří ROZSYPÁLEK, Vladan RIEDL, Katharina SCHWANDA, Gregor BOŽIČ, Saša BOGDAN, Srđan STOJNIĆ, Saša ORLOVIĆ: <i>Narrow-leaved ash (Fraxinus angustifolia Vahl.) in the Danube region – The question of sustainable regeneration</i>	15
Ala DONICA, Valeriu BRAȘOVEANU, Corina CERTAN: <i>Urban semi-natural ecosystems - integrative and sustainable approaches in the context of environmental changes</i>	17
Ionuț-Marian DRAGOMIR, Gabriela ISAIA, Mihai-Leonard DUDUMAN, Ion Catalin PETRITAN: <i>Trap bias or forest type? Ethanol baiting matters more than forest management effects in a beech-silver fir forest in Romania</i>	18
Mihai-Leonard DUDUMAN, Gabriela ISAIA, Ionuț Marian DRAGOMIR, Ion Cătălin PETRIȚAN: <i>Habitat gradients and the differentiation of saproxylic beetle communities in a Southern Carpathian beech-fir forest</i>	19
Laura ȚENIȚA, Ion Catalin PETRITAN, Ieva JAUNSLAVIETE, Didzis ELFERTS: <i>Do hemiboreal Norway spruce old-growth forest stands show similar old-growth characteristics to Carpathian old-growth forests?</i>	20
Milan MATARUGA, Branislav CVJETKOVIĆ: <i>Metapopulation-based design of ex situ conservation plantations for preserving evolutionary processes and genetic diversity: The case of Serbian spruce</i>	21
Ciprian PALAGHIANU, Ionuț BARNOAIEA, Alexei SAVIN, Cosmin COȘOFREȚ: <i>Democratizing soil data: Scaling up regional soil health assessment through the ECHO citizen science network</i>	22
Karolina STASZEL-SZLACHTA, Mariusz KORMANEK, Jacek BANACH, Stanisław MAŁEK: <i>Influence of the production method of Quercus robur, Fagus sylvatica, Pinus sylvestris seedlings on the development of the root system of the seedlings after two years of growth in the crop as a potential in managing climate change</i>	23
Emanuel STOICA, Alin Madalin ALEXANDRU, Georgeta MIHAI, Virgil SCARLATESCU, Alexandru Lucian CURTU: <i>Evaluating Douglas fir's provenances in Romania through multi-trait selection</i>	24
Dragoș TOMA, Gabriela ISAIA, Minodora MANU, Carol Dieter SIMON, Ion Cătălin PETRIȚAN: <i>Phoretic mites associated with Ips typographus (Coleoptera: Scolytinae) in Romanian Norway spruce forests: Diversity and relationships with stand characteristics</i>	25
Adrian TUDORA, Șerban CHIVULESCU, Ștefan LECA, Elena MIHĂILĂ, Mihăiță BÎTCĂ, Ovidiu BADEA: <i>Structural characterization of even-aged beech stands as a basis for conversion to selection forest</i>	26

management

Poster presentations

Alina ALEXANDRU, Mihnea CIOCÎRLAN, Flavius BĂLĂCENOIU: <i>Long-term assessment of forest health in the peri-urban forests of Bucharest, Romania</i>	28
Cosmin ROTARU, Dragoș TOMA, Alina ALEXANDRU, Mihnea CIOCÎRLAN, Flavius BĂLĂCENOIU: <i>A Geometridae outbreak in a peri-urban forest: Defoliation patterns and factors influencing tree vulnerability</i>	29
Florin-Alexandru BERAR, Any-Mary PETRIȚAN, Ion Catalin PETRIȚAN: <i>Growth and drought responses of four oak species in central Transylvania (Romania)</i>	30
Emanuel BESLIU, Marius BUDEANU, Alexandru Lucian CURTU: <i>Projected changes in the spatial distribution of European beech height growth potential in Romania</i>	31
Mihăiță BÎTCĂ, Dorina DRĂGAN, Adrian TUDORA, Elena MIHĂILĂ, Gabriel DUDUMAN: <i>Preliminary results on the impact of climate change and water deficit on forest sites and forest vegetation status in the Ialomița River floodplain</i>	32
Matteo BRACALINI, Lorenzo TAGLIAFERRI, Tiziana PANZAVOLTA: <i>Strategies and challenges in the containment of Tomicus destruens in Mediterranean pine forests</i>	33
Constantin BUDESCU, Marian TRISCIUC, Florin ISVORANU, Ionuț BALABASCIUC: <i>Dendrochronological evidence of gradual growth release in Taxus baccata L. following shelterwood (progressive) cuttings in a stand of management unit 2 Frumoasa, Tazlău Forest District (Eastern Carpathians, Romania)</i>	34
Tatiana CĂLUGĂRU-SPĂTARU, Svetlana SMEREA, Tatiana DELEAN, Alexandru DASCALIUC, Petru CUZA: <i>Genotype-specific in vitro initiation of downy oak (Quercus pubescens Willd.) for climate-resilient forest restoration</i>	35
Albert CICEU, Flavius BĂLĂCENOIU: <i>A decision support tool for adapting Romanian forests to climate change</i>	36
Radosław CICHOSZ, Michał JASIŃ, Stanisław MAŁEK: <i>Sphagnum moss response to elevated nutrient availability in hydroponic culture</i>	37
Maria CICȘA, Adrian INDREICA: <i>Assessing ecological recovery of check-dam-regulated torrential valleys using a protected species as an ecological reference: a case study of Tozzia alpina</i>	38
Mihnea-Ioan-Cezar CIOCÎRLAN, Elena CIOCÎRLAN, Alexandru Lucian CURTU: <i>Fruit production intensity drives earlier leaf senescence in European beech</i>	39
Aurel CIORIÎA, Gheorghe Marian TUDORAN: <i>Structural diversity of natural forests in the Ciucas Mountains</i>	40
Iulian-Constantin DĂNILĂ, Daniel AVĂCĂRIȚEI, Gabriel DUDUMAN, Mihai-Leonard DUDUMAN, Vlăduț-Maricel HAZI: <i>Comparative stem form and height growth of hybrid poplar clones AF8 and Pannonia in short-rotation woody crops: a case study from the Suceava Plateau (NE Romania)</i>	41
Dumitru-Mircea DUȘCU, Geta RÎȘNOVEANU: <i>Mapping the cultural ecosystem services provided by urban forests using public participation. Case study Băneasa Forest, Romania</i>	42
Cristian Mihai ENESCU: <i>Survival of Siberian elm (Ulmus pumila L.) and green ash (Fraxinus pennsylvanica Marshall) after two growing seasons in an agroforestry system established in southern Romania</i>	43
Evripidis FARMAKIS, Konstantinos FARMAKIS, Vasileios C. DROSOS: <i>Forest operating in semi mountainous Greek (Mediterranean) conditions and environment</i>	44
Paula GARBACEA, Emanuel STOICA, Alin-Madalin ALEXANDRU, Georgeta MIHAI, Katri HIMANEN, Heino KONRAD: <i>Advancement in seed collection timing for three European tree species: Abies alba, Larix decidua and Tilia cordata</i>	45
Giulia P.S. GRAHAM, Edson BOLIGE, Alice DOWNES, Lorenzo TAGLIAFERRI, Domenico RIZZO, Tiziana PANZAVOLTA, Matteo BRACALINI: <i>Rapid molecular identification of Tomicus destruens: A new tool</i>	46



for forest biosecurity

Vladislav GRATI, Cătălin-Constantin ROIBU, Mihail CÎRLIG, Ion COVRIGHIN: <i>Forest growth patterns in Orhei National Park</i>	47
Adrian Stefan IRIMIN, Avram CICSĂ, Gheorghe Marian TUDORAN: <i>Structural optimization of recreational forests in the Postăvarul Massif by integrating social perspectives</i>	48
Laura ȚĂNIȚĂ, Ion Catalin PETRITAN, Ieva JAUNSLAVIETE, Elferts DIDZIS: <i>Height-diameter relationship in old-growth spruce forest in Romania</i>	49
Constantin-Cosmin LOGHIN, Bogdan-Ionut PLEȘCA, Nicolae Ovidiu BADEA: <i>Structural variability of mature Quercus pedunculiflora stands in the Romanian forest-steppe</i>	50
Valentin LUPȘAN, Maria Magdalena VASILESCU: <i>Productivity aspects of forest ecosystems in the Bârgău Mountains according to habitat types within the established forest sampling network</i>	51
Mirabela MARIN, Nicu Constantin TUDOSE, Mihai-Ionut HAPA, Cezar UNGUREAN, Alin Lucian MIHALACHE: <i>Interactive activity for managing the risk of falling trees in the Brasov urban area</i>	52
Mirabela MARIN, Nicu Constantin TUDOSE, Mihai-Ionut HAPA, Cezar UNGUREAN, Alin Lucian MIHALACHE, Danut CHIRA, Andy POPA, Radu NAN, Tibor SERBAN, Boglarka OPRA, Alexandru ZAHARIA: <i>Urban tree inventory for risk assessment in an urban area</i>	53
Mirabela MARIN, Nicu Constantin TUDOSE, Ionut Mihai HAPA, Cezar UNGUREAN, Florentina NANU, Ciprian NANU: <i>Can citizen science enable transformative change in forests? A case study on active participation in environmental compliance in forestry</i>	54
Any-Mary PETRITAN, Raul Gheorghe RADU, Ștefan PETREA, Gabriel LAZAR, Dănuț CHIRA, Marius PARASCHIV, Mirabela MARIN, Constantin DUMITRU-DOBRE, Gruică IENĂȘOIU: <i>BIOFORMA – Adaptive management of mountain Norway spruce forests under climate change</i>	55
Bogdan-Ionut PLEȘCA, Irina IRIMIA, Constantin Cosmin LOGHIN, Ioana-Maria PLEȘCA: <i>The transition vegetation zones from the Curvature Subcarpathians – The vegetation study from Odobești Hill</i>	56
Dragoș TOMA, Ștefania TÖTÖS, Iuliana VASIAN, Flavius BĂLĂCENOIU: <i>Optimizing monitoring strategies for Lamprodila festiva L. (Buprestidae, Coleoptera): Insights from a two-year field study</i>	57
Mila TOST, Markus MÜLLER, Ourania GRIGORIADOU-ZORMPA, Selina WILHELMI, Mehdi BEN TARGEM, Henning WILDHAGEN, Alexandru Lucian CURTU, Timothy BEISSINGER, Oliver GAILING: <i>A genome-wide association analysis in natural European beech populations reveals genomic regions potentially involved in climate adaptation</i>	58
Marian TRISCIUC, Constantin BUDESCU, Elena CIOCÎRLAN: <i>Diversity of Ericaceae in the Northern Eastern Carpathian, from forest bioindicators to glacial relicts</i>	59
Diana VASILE, Gabriel Ervin LAZĂR, Alexandra Mihaela ȘTEFAN, Virgil SCĂRLĂȚESCU, Constantin DUMITRU-DOBRE, Gruică IENĂȘOIU, Any-Mary PETRITAN: <i>Comparison of plant species diversity from herbaceous layer in four virgin and four managed spruce and mixed beech forests from Romania</i>	60

Wildlife management

Poster presentations

Katarzyna CICHOSZ, Piotr DZIEKAN, Anna GIERA, Radosław CICHOSZ, Marek WAJDZIK: <i>Biometric characterization of the stone marten (Martes foina) in selected areas of the lesser Poland Voivodeship, Southern Poland</i>	62
Călin CORLECIUC, Gabriel DUDUMAN: <i>Preliminary results on the analysis of the ecological and social impact of the reintroduction of bison (Bison bonasus Linnaeus, 1758) into the Vânători-Neamț Natural Park</i>	63

Carlos Daniel NIEVES PRADO, Genaro OLMOS OROPEZA, Juan Antonio ENCINA DOMÍNGUEZ, Jorge PALACIO NÚÑEZ, Saúl Ugalde LEZAMA, Jorge Luis CASTRELLÓN MONTELONGO, Luis Antonio TARANGO ARÁMBULA: <i>Carrying capacity of white-tailed deer and cattle with regenerative grazing in Mexico</i>	64
---	----

Forest engineering

Oral presentations

Samet BILA, Zennure UÇAR, Ebru BILICI, İnanç TAŞ, Halit BÜYÜKSAKALLI: <i>Assessment of optimal road spacing for fire prevention in forested areas</i>	66
Mirella ELIAS, Stelian Alexandru BORZ: <i>Wood measurement at the factory gate: A comparison study to evaluate the accuracy of a state-of-the-art digital truckload measurement system</i>	67
Evripidis FARMAKIS, Konstantinos FARMAKIS, Vasileios K. DROSOS: <i>Application of UAV photogrammetry for the surveying and sustainable redevelopment of a peri-urban forest</i>	68
Gabriel Osei FORKUO, Rodolfo PICCHIO, Andrea Rosario PROTO, Stelian Alexandru BORZ: <i>Applications of artificial intelligence in forest operations engineering research: A systematic review</i>	69
Muhittin İNAN, Mehmet Altuğ KÜÇÜKOSMANOĞLU: <i>A GIS-based spatiotemporal analysis of wildfire dynamics: The Mediterranean region in Turkey</i>	70
Victor Bogdan MITITELU, Andrea Rosario PROTO, Stelian Alexandru BORZ: <i>Economics of poplar forest establishment operations: Exploring the effects of plot geometry, planting scheme and machine type to optimize the management practices</i>	71
Victor Bogdan MITITELU, Lucian Mircea SASU, Gabriel Osei FORKUO, Andrea Rosario PROTO, Stelian Alexandru BORZ: <i>Performance of shallow and deep learning models in classifying mechanized pit drilling events based on GNSS input data</i>	72
Jenny Magaly MOROCHO TOAZA, Gianni PICCHI, Carla NATI, Stelian Alexandru BORZ: <i>Accuracy and time efficiency of a new app developed to source and map single tree data: A comparison to state-of-art lidar data collectors in terms of basal area estimates</i>	74
Tolga OZTURK: <i>An overview of the efficiency of machinery used in extraction operations in Türkiye</i>	75
Ana Alexandra REYES ROBALINO, Stelian Alexandru BORZ: <i>Dynamics of cognitive load, mental demand, and adaptation to repeated exposure in a virtual reality forest simulator</i>	76
Ioannis SISMANIDIS, Evripidis FARMAKIS, Konstantinos FARMAKIS, Vasileios C. DROSOS: <i>Application of Kroth method in the field of environmentally sustainable planning and development of the forest opening-up in Greece</i>	77
Lukas STOPFER: <i>Digital identity: DPPs from single log to sawmill</i>	78

Poster presentations

Dimitra ALEXIOU, Evripidis FARMAKIS, Konstantinos FARMAKIS, Vasileios K. DROSOS: <i>Site planning and design of a forest recreation area with outdoor recreation facilities and landscape improvements</i>	80
Aurora BONAUDO, Francesco LATTERINI, Rodolfo PICCHIO, Rachele VENANZI, Luca COZZOLINO, Stelian Alexandru BORZ, Eugenia PAUSELLI, Angela LO MONACO: <i>Integrating forest operations into landscape-level planning: A GIS-AHP approach</i>	81
Stelian Alexandru BORZ, Gabriel Osei FORKUO, Tomi KAAKKURIVAARA, Nopparat KAAKKURIVAARA: <i>Estimating the conversion factors for solid wood based on smartphone LiDAR in Thailand: A case study of high-value teak log piles in Thailand</i>	82
Mihai CIOCIRLAN, Vasile Razvan CAMPU: <i>Timber losses associated with felling notch formation in a spruce stand affected by windthrow</i>	83



Rudolf Alexandru DERCZENI, Gheorghe IGNEA, Marina Viorela MARCU, Eugen IORDACHE, Cezar SCRIBA, Stelian Alexandru BORZ: <i>Design of a modular wooden bridge to support sustainable forest operations</i>	84
Vasileios K. DROSOS, Evangelia POURNARA, Vasileios GIANNOULAS, Evripidis FARMAKIS, Konstantinos FARMAKIS: <i>Three-dimensional (3D) surveying of a forest trail using modern methods</i>	85
Diana Elena DUMITRU, Elena Camelia MUŞAT: <i>The influence of forest roads on tree development – A short review</i>	86
Gabriel Osei FORKUO, Stelian Alexandru BORZ, Tomi KAAKKURIVAARA, Nopparat KAAKKURIVAARA: <i>Postural classification by image embedding and transfer learning</i>	87
Gabriel Osei FORKUO, Marina Viorela MARCU, Nopparat KAAKKURIVAARA, Tomi KAAKKURIVAARA, Stelian Alexandru BORZ: <i>Human and machine reliability in postural assessment of forest operations by OWAS method: Level of agreement and time resources</i>	88
Alin Lucian MIHALACHE, Nicu Constantin TUDOSE, Mirabela MARIN, Cezar UNGUREAN, Valentina AGA, Raul RADU, Maria Ilinca CHEVERESAN, Mihai STANCU, Nicoleta POPESCU: <i>Hydrodynamic modelling of flow wave propagation through energy dissipation systems</i>	89
Victor Bogdan MITITELU, Ilie Silvestru NUŢĂ, Marina Viorela MARCU, Eugen IORDACHE, Stelian Alexandru BORZ: <i>Documenting the harvesting conditions in Romanian hybrid poplar forests: A study to characterize key input variables for economic, social and environmental assessment</i>	90
Ioan-Aurelian MITROFAN, Beata BORS, Elena-Camelia MUSAT: <i>Bark – The shield of pine trees against forest fires</i>	91
George MUŞAT, Emilia-Adela MANEA SALCA: <i>Dimensional characteristics of 1-year-old willow rods from short-rotation coppices</i>	92
Tolga OZTURK, Muhittin INAN: <i>Evaluation of forest road standards for long-log transportation: The case of the Istanbul University-Cerrahpaşa Research Forest</i>	93
Madalina Florina PRESECAN, Gabriel Osei FORKUO, Stelian Alexandru BORZ: <i>Soil compaction in final harvest operations using medium-sized cable skidders: results of an experimental study with controlled payloads</i>	94
Madalina Florina PRESECAN, Gabriel Osei FORKUO, Stelian Alexandru BORZ: <i>Soil compaction induced by three timber extraction options: A controlled experiment on penetration resistance on silty-loamy soils</i>	95
Ionuţ-Cătălin ROTARU, Elena Camelia MUŞAT: <i>Distance to forest roads and the amount of forest residues – A case study</i>	96
Alexandra Florina STAIKU, Maria Magdalena VASILESCU: <i>Can the Arboreal Tree app minimize timber volume errors and improve SUMAL accuracy?</i>	97
George Iulian STĂNCIULESCU, Elena Camelia MUŞAT: <i>The impact of mechanized timber extraction on soil – A short review</i>	98
Nicu Constantin TUDOSE, Mirabela MARIN, Cezar UNGUREAN, Alin Lucian MIHALACHE: <i>Life Cycle Assessment of hydrotechnical structures: an evaluation based on cumulative energy demand and global warming potential</i>	99
Cezar UNGUREAN, Mirabela MARIN, Nicu Constantin TUDOSE, Alin Lucian MIHALACHE: <i>Geomatics for riverbed morphometry: Efficiency in data collection and interpretation</i>	100

Forest economics, policy and regulation

Oral presentations

Laura BOURIAUD, Liviu NICHIFOREL, Dorin PĂLIE, Ionut BALABAŞCIUC: <i>Assessment of the perception and acceptability of local level stakeholders on rewilding options in five European case studies</i>	102
--	-----



Konstantinos FARMAKIS, Evripidis FARMAKIS, Nikolaos KARAGIORAS, Vasileios C. DROSOS: <i>Local development programs for viable and sustainable development of mountainous area</i>	103
Mihai-Ionut HAPA, Mirabela MARIN, Nicu Constantin TUDOSE, Cezar UNGUREAN, Bogdan POPA: <i>Beyond ownership restoration: The evolution of non-state forest owner agency in Romania</i>	104
Mihai-Ionut HAPA, Mirabela MARIN, Nicu Constantin TUDOSE, Cezar UNGUREAN, Bogdan POPA: <i>Understanding climate adaptation through qualitative interaction analysis: Evidence from Romanian forest practitioner</i>	105
Emelyne Ineza KAYISIRE, Aureliu Florin HĂLĂLIȘAN: <i>Forest certification for sustainable forest management and rural livelihoods: Evidence from Rwanda</i>	106
Julija KONSTANTINAVICIENE, Aidas PIVORIUNAS, Benas ŠILINSKAS: <i>Forest Stewardship Council Forest Certification Impacts – The case of Lithuania</i>	107
Liviu NICHIFOREL, Ionuț BARNOAIEA, Ciprian PALAGHIANU, Vasile-Cosmin COȘOFREȚ, Emilian STOICA, Bogdan POPA: <i>Forest restoration decision support system for Republic of Moldova</i>	108
Liviu NICHIFOREL, Valeriu-Norocel NICOLESCU, Bogdan POPA: <i>From EU forest strategy to national law: a comparative analysis of key concept integration in European forest acts</i>	109
Erick O. OSEWE, Ibrahim OSEWE, Bogdan POPA, Ioan Vasile ABRUDAN: <i>Navigating prospects of harmonising forestry laws and policies in the East African region</i>	110
Ibrahim OSEWE, Bogdan POPA: <i>Coping mechanisms of rural households to shocks: The role of socio-economic determinants and strategies in Kakamega Forest, Kenya</i>	111
Alexandra POPA: <i>Assessing and mitigating systemic risks: Personal protective equipment deficits and fatal accidents in Romanian forests</i>	112
Lewis RAWLE: <i>Is a forest-based bioeconomy a viable option for Guyana?</i>	113
Nicolae TALPĂ, Liviu NICHIFOREL, Aureliu-Florin HĂLĂLIȘAN, Bogdan POPA: <i>Translating the EU forest strategy for 2030 into National forest policy: A strategic analysis of implementation opportunities and challenges in Romania</i>	114

Poster presentations

Andrei APĂFĂIAN, Vlad CRIȘAN, Diana VASILE, Constantin Dumitru DOBRE: <i>Trends in harvesting certificate cancellations in Romania in the context of the upcoming EUDR</i>	116
Mihai-Ionut HAPA, Mirabela MARIN, Nicu Constantin TUDOSE, Cezar UNGUREAN, Bogdan POPA: <i>Institutional readiness for climate-oriented forest policy implementation: Evidence from Romanian forestry experts</i>	117
Alexandra POPA: <i>Assessing systemic risks and PPE deficits in Romanian forestry</i>	118

Forest geomatics and artificial intelligence

Oral presentations

Samira ALHASSAN, Dhananjana RAJAKARUNA, Adrian INDREICA, Petru Tudor STĂNCIOIU, Mihai Daniel NIȚĂ: <i>Quantifying forest structural dynamics through Integration of remote sensing and field-based methods</i>	120
Ionut BARNOAIEA, Cosmin COSOFREȚ, Gabriel DUDUMAN, Liviu NICHIFOREL: <i>Combining terrestrial inventory and remote-sensing to assess forest dynamics in set aside areas – Vanatori Neamt Natural Park</i>	121
Mihnea CĂȚEANU: <i>Mapping forest structure at regional scales with open access, multi-sensor data, machine learning algorithms and convolutional neural networks</i>	122



Iulia COROIAN, Diana FICIOR, Luisa ANDRONIE, Rodica SOBOLU: <i>Comparative assessment of drought effects on broadleaved and coniferous forests using Sentinel-2 and ERA5-Land data in Cluj County, Romania</i>	123
Iuliana Adriana CUIBAC PICU, Iuliana Maria PÂRVU, Adrian PÂRVU, Nicoleta PÂRVULESCU, Ioana CORNEANU: <i>Digital twin of Săcele – An interactive tool to assess the risks in case of extreme events</i>	124
Jorge DIAZ-SUAREZ, Victor Dan PĂCURAR, Mihai Daniel NIȚĂ: <i>Linking rainfall structure and atmospheric conditions to rainfall erosivity: An event-based framework for forest hydrology in tropical regions</i>	125
Sergiu FLOREA, Mihai Daniel NIȚĂ: <i>Using ALS pointcloud for deriving different canopy characteristics</i>	126
Mohamed Islam KESKES, Mihai Daniel NIȚĂ: <i>Fine-grained tree species recognition using taxonomy-aware embedding separation</i>	127
Mohamed Islam KESKES, Mihai Daniel NIȚĂ: <i>Romania's first national high-resolution map of forest tree species via deep learning</i>	128
Aya Hamed MOHAMED, Petru Tudor STĂNCIOIU, Mihai Daniel NIȚĂ: <i>Evaluating LAI estimation accuracy across forest development stages in mountainous forests using hemispherical photography, satellite data, and deep learning</i>	129
Dhananjana RAJAKARUNA, Samira ALHASSAN, Valentin BALAN, Raluca ENESCU, Petru Tudor STĂNCIOIU, Mihai Daniel NIȚĂ: <i>Site-specific calibration of TMS-4 soil moisture sensors in contrasting forest stands of the Postăvaru Mountain, Romania</i>	130
Alice-Elena TEȘILEANU, Mihnea CĂȚEANU, Larisa-Ștefania BURTEA: <i>Establishing the real-time kinematic positioning accuracy of the Global Navigation Satellite System under forest canopy</i>	131
Poster presentations	
Lucian MIZGACIU, Petru Tudor STĂNCIOIU, Victor Adrian INDREICA, Marius PARASCHIV, Mihai Daniel NIȚĂ: <i>Building Romanian forest pathways for iLand</i>	133
Cornel Cristian TEREȘNEU, Cristian Samuel TEREȘNEU: <i>Creating a 3D model of a forested area by combining field measurements with data from topographic maps</i>	135



Plenary session

Precision forestry for sustainable development: Connecting digital innovation with forest stewardship

Maurizio ACUNA, Australia

¹ Forest Research Institute, University of the Sunshine Coast, Australia.

E-mail address: macuna@usc.edu.au

Abstract: Forests face increasing pressure to provide renewable materials, conserve biodiversity and support livelihoods while adapting to climate change. Precision forestry offers opportunities to reconcile these demands by improving how we observe forests, plan interventions and evaluate their consequences. Its contribution to sustainable development depends on connecting digital innovation with management objectives and measurable outcomes.

This presentation examines how remote sensing, artificial intelligence, connected sensors and digital twins can support sustainable forest management across the forest value chain. Illustrative applications include forest inventory, selective thinning, harvesting and transport planning, alongside carbon monitoring and biodiversity assessment. These examples show how better information can support resource efficiency, reduce environmental impacts and strengthen resilience, while making trade-offs between production and ecosystem services more explicit.

The presentation also considers the conditions needed to translate technical capability into benefits. Data quality, interoperability, affordability and professional skills influence adoption, particularly among smaller forest owners and enterprises. Human judgement and collaboration remain central to responsible implementation.

Linking these opportunities to the United Nations Sustainable Development Goals, the presentation proposes an approach for selecting technologies around forestry needs, testing their value and learning from observed outcomes. The aim is better forest decisions that advance environmental, economic and social sustainability.



Co-creating the First Strategic Research and Innovation Agenda (SRIA): Research and funding gaps and the way forward

Alex GIURCĂ¹

¹ European Forest Institute (EFI).

E-mail address: Alex.Giurca@efi.int

Abstract: Building on the work of the European Forest Research and Innovation Ecosystem (EUFORE), this keynote presents the process and outcomes of developing the first Strategic Research and Innovation Agenda (SRIA) for the European forest-based sector. Drawing on a comprehensive mapping of forest-related research and innovation activities across Europe, the presentation highlights key thematic strengths, funding patterns, and persistent gaps in research and innovation support.

Particular attention will be given to underrepresented topics, emerging challenges, and opportunities for interdisciplinary collaboration to strengthen the sector's contribution to sustainability and competitiveness objectives. The talk also showcases the extensive co-creation process behind the SRIA, which brought together researchers, policy-makers, funding organizations, industry representatives, civil society actors, and European institutions to identify common priorities and future investment needs.

Finally, the presentation will discuss the next steps for implementation and explain how the SRIA is being taken forward through the Forest Partnership to guide future research programming, mobilize investments, and increase the impact of forest-based research and innovation across Europe.



Forest ecosystem management

- ORAL PRESENTATIONS -

The biological potential of edifying tree species from the Republic of Moldova green spaces in the context of environmental pressures and threats

Valeriu BRAȘOVEANU¹ Ala DONICA¹

¹ Institute of Ecology and Geography, Moldova State University, Academiei street 1, MD-2028, Republic of Moldova.

Corresponding author: Valeriu BRAȘOVEANU

E-mail address: valeriu.brasoveanu@sti.usm.md

Abstract: *Urban green spaces provide essential ecosystem services in cities, but trees are increasingly exposed to threats from climate extremes, air pollution, pests and diseases, as well as urban anthropogenic pressures, including through improper management. Assessing and managing these risks is vital for maintaining the benefits that urban forests offer to communities. In the context of increasing human pressures and climate change, this study conducted research on the ecological valences of edifying tree species from green spaces of six cities, located from the north to the south of the Republic of Moldova. The ecological sheet of the edifying species was completed and analysed according to several authors (Stănescu et al., 1997; Clinovschi, 2005; Bolea et al., 2008, European Atlas of Forest Tree Species, 2016). Through comparative analysis and data integration of the dominant species ecological valence with the physical-geographical particularities of each studied region, risks and vulnerable locations had identified, for the purpose of resilience, adaptability and sustainable management of urban forests in the face of current/future environmental challenges. In conclusion, we indicate that aridification and atmospheric pollution, in addition to other anthropogenic pressures, will have an impact on forest biodiversity, especially during the critical vegetation period of stands (June-August). Changes will occur in the sensitivity of forest species to water deficit, in synergy with atmospheric pollutants, competition with invasive species and the potential for adaptation to environmental changes. These challenges require complex and interdisciplinary studies to assess species-specific vulnerability and to support urban forest management based on the ecological valences of existing and proposed species, as foundations for green, healthy and resilient cities.*

Note: The study was carried out within the projects:

- 25.80012.7007.24SE "Fundamentals for green, healthy and resilient cities - Comprehensive assessment, protection and promotion of the urban green spaces' biodiversity sustainability of the biodiversity of urban green spaces in the context of environmental changes, including climate change" (2025-2026);
- 010801 "Increasing ecological security and resilience of geo-ecosystems to current environmental changes" (2024-2027), funded by the National Agency for Research and Development, Republic of Moldova.

Keywords: *edifying trees, urban forests, environmental pressure and threats, ecological valence, tolerance, sustainable management.*

Assessing climate change impacts on recreational ecosystem services: The case of Pătrăuți Forest District

Cosmin COȘOFREȚ¹ Laura BOURIAUD¹
Olivier BOURIAUD¹ Ionuț BARNOAIEA¹

¹ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania.

Corresponding author: Cosmin COȘOFREȚ

E-mail address: cosmin.cosofret@usm.ro

Abstract: *The impact of climate change on the recreational potential of forests in the Pătrăuți Forest District, can be assessed by the LandClim forest landscape-level dynamic model. The analysis covers a 100-year period (2020-2120) under three climate scenarios (RCP2.6, RCP4.5, RCP8.5) and two forest management types. The Recreation Index (RI) was calculated based on six indicators: species richness, diameter and height heterogeneity, stand and regeneration density, and the amount of deadwood. Results show optimal recreational potential at altitudes of 350-450 m asl due to the balance between species diversity and complex dimensional structure. Under the optimistic RCP2.6 scenario, recreational potential increases steadily, especially without management (NOM). The moderate RCP4.5 scenario maintains acceptable values until 2070, after which they decline sharply. The pessimistic RCP8.5 scenario leads to near-immediate collapse, with recreational potential dropping to nearly zero after 2090 due to massive tree dieback from extreme drought and rising temperatures. The study highlights the need to adapt forest management strategies, add coefficients to IR indicators based on local surveys, and include natural disturbances in future simulations to provide a realistic assessment of forest dynamics under climate change.*

Keywords: *climate change, recreational potential, species richness, structural diversity, deadwood, stand density, management, modelling.*

Narrow-leaved ash (*Fraxinus angustifolia* Vahl.) in the Danube region – The question of sustainable regeneration

Branislav CVJETKOVIĆ¹ Milan MATARUGA¹ Libor JANKOVSKÝ² Tomáš ŽID²

Petr MARTINEK² Jiří ROZSYPÁLEK² Vladan RIEDL² Katharina SCHWANDA³

Gregor BOŽIČ⁴ Saša BOGDAN⁵ Srđan STOJNIĆ⁶ Saša ORLOVIĆ⁶

¹ University of Banja Luka, Faculty of Forestry, Bulevar vojvode Petra Bojovića 1A, 78000 Banja Luka, Bosnia and Herzegovina;

² Mendel University in Brno, Faculty of Forestry and Wood Technology, Zemědělská 3, 613 00 Brno, Czech Republic;

³ Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW) Seckendorff-Gudent-Weg 8, 1131 Vienna, Austria;

⁴ Slovenian Forestry Institute, Večna pot 2, 1000 Ljubljana, Slovenia;

⁵ The Faculty of Forestry and Wood Technology, University of Zagreb, Svetošimunska cesta 23, 10000 Zagreb, Croatia;

⁶ University of Novi Sad, Institute of Lowland Forestry and Environment (ILFE), Antona Čehova 13 d. Novi Sad 21102, Serbia.

Corresponding author: Branislav CVJETKOVIĆ

E-mail address: branislav.cvjetkovic@sf.unibl.org

Abstract: *Narrow-leaved ash (*Fraxinus angustifolia* Vahl.) is a tree species of great importance throughout the Danube region. However, the combined effects of climate change, pathogens—most notably *Hymenoscyphus fraxineus*—root rot diseases, and anthropogenic pressures have resulted in severe decline and significant damage to ash populations.*

The regeneration of narrow-leaved ash forests requires appropriate measures aimed at preserving the species' biodiversity while ensuring the conservation and sustainable production of forest reproductive material. This study investigated the capacities for the production and utilization of narrow-leaved ash reproductive material, as well as the outcomes of artificial forest establishment, across six countries of the Danube region: the Czech Republic, Austria, Slovenia, Croatia, Bosnia and Herzegovina, and Serbia. Data on genetic variability studies, the type and number of seed sources, production of basic reproductive material, regeneration practices (natural versus artificial regeneration), field testing, and regeneration success were analysed. The information was collected through questionnaires completed by partner institutions participating in the INTERREG Danube project SCAN-DANUBE.

The results indicate substantial genetic variability within the species, which is currently being assessed in ex situ conservation plantations through provenance trials, progeny tests, and clonal tests.



Regarding seed production, records from the last ten years are available only for Serbia, while seed collection rates in Croatia ranged from 44% to 88% of planned production. In the remaining countries, such data are largely unavailable. Nursery production of planting stock has shown a sharp decline, and during the last five years both seedling production and afforested areas have become negligible. Furthermore, data on seedling survival in the field are generally lacking.

Narrow-leaved ash is a threatened species that is gradually disappearing from its natural habitats across Europe. Considering the challenges posed by climate change, pathogens, and other diseases, together with the reduced or absent production of forest reproductive material, the future of narrow-leaved ash in the Danube region remains uncertain.

Keywords: *narrow-leaved ash, forest reproductive material, planted forests.*

Urban semi-natural ecosystems – Integrative and sustainable approaches in the context of environmental changes

Ala DONICA¹ Valeriu BRAȘOVEANU¹ Corina CERTAN¹

¹ Institute of Ecology and Geography, Moldova State University, Academiei street 1, MD-2028, Republic of Moldova.

Corresponding author: Ala DONICA

E-mail address: aladonica1980@gmail.com

Abstract: *Semi-natural, anthropized ecosystems in cities (green spaces) play a crucial role in protecting local biodiversity, acting as essential habitats, refuges and ecological corridors for biodiversity. In the Republic of Moldova, against the backdrop of obvious urbanization (46.4% of the country's population lived in urban areas in 2024, compared to 39.4% in 2014), cities are faced with an insufficiency and uneven distribution of green space areas (in 2025, the urban green spaces area amounted to 6.7 thousand ha; with a low share from the South to the North of the country). This paper frames the complex scientific research - the Ecological Passport of Green Space - elaborated for three areas: North (Balti municipality) - "M. Volontir" Park; Centre (Chisinau municipality) - "Alunelul" Park and South (Stefan Voda city) - "M. Eminescu" Park, in order to substantiate the measures for the protection, conservation, monitoring and sustainable management of green spaces. During field research (2025-2026), the local natural heritage was inventoried; the current ecological state of green spaces and impact factors (pollution, climate change, invasive species, improper management, fragmentation, ecological instability etc.) were evaluated; the bioindicator and tolerant aspects of edifying tree species were interpreted; the socio-ecological value provided by green infrastructure was highlighted; the attributes necessary for the accessibility, functioning and quality of green space were identified; etc., with the recommendations development for conservation, sustainable use of natural resources and efficient management. The ecological passports were submitted for implementation to local public authorities and enterprises responsible for managing green space at the city level; the Ministry of Environment and its subdivisions, and other stakeholders.*

Note: The study was conducted within the projects: 25.80012.7007.24SE and 010801, funded by the National Agency for Research and Development, Republic of Moldova.

Keywords: *ecological assessment, pollution, climate change, invasive species, dominant species, ecological passport, sustainable management.*

Trap bias or forest type? Ethanol baiting matters more than forest management effects in a beech-silver fir forest in Romania

Ionuț-Marian DRAGOMIR¹ Gabriela ISAIA¹
Mihai-Leonard DUDUMAN² Ion Catalin PETRITAN¹

¹ Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Applied Ecology Laboratory, Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania.

Corresponding author: Ionuț-Marian DRAGOMIR

E-mail address: ionut.dragomir@unitbv.ro

Abstract: *Old-growth forests are widely regarded as biodiversity hotspots, yet comparisons with managed forests may be strongly influenced by how insects are sampled rather than by ecological differences alone. Semi-chemical attractants such as ethanol can alter beetle detectability and potentially reshape observed community patterns, raising a pressing question: are differences between forest types ecological signals or sampling artifacts?*

To break down these effects, saproxylic beetle assemblages were investigated in old-growth and managed beech–silver fir forests from the Southern Carpathians, Romania, using paired flight-interception traps with and without ethanol bait. Thirty plots were monitored during one sampling season, resulting in 60 standardized sampling units. Community responses were analysed through rarefaction and extrapolation, diversity metrics, negative binomial modelling, NMDS ordination, and PERMANOVA.

A total of 158 beetle species were recorded. Ethanol-baited traps captured substantially more individuals and species, increasing observed richness and diversity while reducing community evenness through stronger dominance patterns. Community composition differed significantly among treatments, but trap type explained considerably more variation than forest status. In comparison, old-growth and managed forests exhibited broad compositional overlap, with differences emerging mainly through shifts in dominance structure and assemblage heterogeneity rather than species turnover. Rarefaction analyses further suggested that unbaited traps retained a larger pool of undetected species despite lower observed richness.

The results indicate that methodological effects can outweigh forest-type effects in studies of saproxylic beetle diversity. Behavioural filtering associated with ethanol attractants may amplify or obscure ecological patterns, complicating the interpretation of biodiversity responses to forest management. These findings highlight the need to explicitly account for detection processes when assessing insect diversity and evaluating the conservation value of old-growth forests.

Keywords: *saproxylic beetles, flight-interception traps, detection bias, Carpathians, old-growth forest, species richness.*

Habitat gradients and the differentiation of saproxylic beetle communities in a Southern Carpathian beech–fir forest

Mihai-Leonard DUDUMAN¹ Gabriela ISAIA²

Ionuț Marian DRAGOMIR² Cătălin PETRIȚAN²

¹ Applied Ecology Laboratory, Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania;

² Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brașov, Romania.

Corresponding author: Mihai-Leonard DUDUMAN

E-mail address: mihai.duduman@usm.ro

Abstract: *Saproxylic beetles are among the most diverse and threatened components of the European forest fauna, yet how habitat gradients structure these communities in mixed mountain forests remains insufficiently understood. This study characterized the structure and diversity of saproxylic beetle communities in two adjacent beech-fir stands from the Southern Carpathians (Romania), one primary (unmanaged) and one managed for conservation purposes. Out of the 3,176 individuals and 158 species captured, 128 species (1,750 individuals) were saproxylic beetles; their analysis was conducted across six ecological categories. The effective diversity of saproxylic beetles was determined, at the sampling plot level, by two habitat gradients: the volume of fresh fir deadwood was positively associated with effective diversity, while elevation was negatively associated with it. Canonical correspondence analysis confirmed a significant, though weak, environmental structuring (adjusted $R^2=0.059$), with a dominant random component (88% unexplained variation). Asymptotic Hill numbers showed that the two stands harboured a similar species richness but differed in effective diversity; this differentiation was almost entirely due to species turnover from one stand to another, rather than an orderly loss of species, indicating that the two stands represent complementary compositional assemblages, each with its own conservation value. The results suggest that retaining fresh coniferous deadwood and maintaining a diversity of deadwood types and decay stages is likely more effective for conserving the regional pool of saproxylic species than simply maximizing the total volume of deadwood.*

Keywords: *Șinca Forest, saproxylic beetles, habitat gradients.*

Do hemiboreal Norway spruce old-growth forest stands show similar old-growth characteristics to Carpathian old-growth forests?

Laura ȚĂNIȚĂ¹ Ion Catalin PETRITAN²

Ieva JAUNSLAVIETE¹ Didzis ELFERTS¹

¹ Latvian State Forest Research Institute "Silava", Rigas street 111, Salaspils, LV—2169, Latvia;

² Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Laura ȚĂNIȚĂ

E-mail address: laura.kenina@silava.lv

Abstract: *Remaining old-growth forest patches provide vital ecosystem services, including biodiversity conservation, climate regulation, and, in some cases, long-term carbon storage, alongside significant socio-cultural benefits. The Carpathian region contains some of the best-preserved old-growth forests in Europe, providing valuable reference stands for evaluating old-growthness in other European forest ecosystems.*

*The study aims to improve the understanding of the old-growth forest characteristics by comparing hemiboreal old-growth Norway spruce (*Picea abies* (L.) Karst.) stands in Latvia with Postăvarul old-growth Norway spruce forest in the Romanian Carpathians, used as ecological reference. Forest structural attributes, including individual tree parameters, deadwood, and regeneration, were assessed in 73 circular sample plots (500 m²; radius 12.62 m) established in the Postăvarul mountains in 2025 and compared with corresponding data from 15 old-growth Norway spruce stands (92 sample plots) in Latvia. The Latvian stands were mixed Norway spruce forests (mean spruce dominance 75%), whereas the Postăvarul forest was almost entirely Norway spruce-dominated (99.6%). Mean stand volume was approximately 27% higher in the Postăvarul forest than in the Latvian old-growth stands. Compared with the Latvian old-growth stands, the deadwood volume was 1.4 times higher in the Postăvarul forest, while the deadwood ratio was similar. The observed similarities indicate that, despite regional differences, hemi boreal old-growth Norway spruce stands share important structural characteristics with Postăvarul forest, supporting the use of old-growth forest references for evaluating structural development across European forest biomes.*

Keywords: *Postăvarul mountain, old-growthness, structural dynamics, deadwood.*



Metapopulation-based design of *ex situ* conservation plantations for preserving evolutionary processes and genetic diversity: The case of Serbian spruce

Milan MATARUGA¹ Branislav CVJETKOVIĆ¹

¹ Faculty of Forestry, University of Banja Luka, Vojvode Petra Bojovića 1A, 78000 Banja Luka, Bosnia and Herzegovina.

Corresponding author: Milan MATARUGA

E-mail address: milan.mataruga@sf.unibl.org

Abstract: *Previous efforts aimed at the in-situ conservation of Serbian spruce (Picea omorika Panč/Purk.) populations have achieved only limited success, making the development of effective ex situ conservation measures one of the key priorities in the species' conservation strategy. To this end, three Serbian spruce conservation plantations were established in Bosnia and Herzegovina during 2024 at the localities of Srebrenica, Rogatica, and Višegrad.*

The design of these plantations was based on the metapopulation concept, taking into account existing knowledge of the species' genetic structure, the degree of fragmentation of natural populations, and patterns of gene flow throughout its natural range. The arrangement of populations and half-sib lines was developed to preserve not only the existing genetic diversity but also the evolutionary processes that shape natural Serbian spruce populations.

In addition to their conservation function, these plantations facilitate the preservation of genetic resources, the establishment of progeny tests, the production of high-quality reproductive material, and provide a foundation for future breeding programs. At the same time, the application of the metapopulation concept helps mitigate the adverse effects of local site limitations and climate change, thereby enhancing the long-term sustainability of ex situ collections.

The proposed planting schemes represent a practical framework for the long-term ex situ conservation of endangered tree species such as Serbian spruce. The metapopulation structure provides a solid basis for future research on adaptive potential, genetic stability, reproductive biology, and the development of effective management strategies for threatened populations of this species.

Keywords: *endangered, protected species, dynamic conservation, planting scheme, half-sib lines, ex situ plantation.*

Democratizing soil data: Scaling up regional soil health assessment through the ECHO citizen science network

Ciprian PALAGHIANU¹ Ionuț BARNOAIEA¹

Alexei SAVIN¹ Cosmin COSOFRET¹

¹ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania.

Corresponding author: Ciprian PALAGHIANU

E-mail address: cpalaghianu@usv.ro

Abstract: *Soil health is a cornerstone of ecosystem resilience, yet its comprehensive assessment remains hindered by high spatial variability, high analytical costs, and a historical scarcity of large-scale biological data. In the current European environmental framework, transitioning from the traditional utility-based concept of "soil quality" to a holistic understanding of "soil health" as a living system is paramount. This shift has gained critical regulatory urgency with the recent adoption of Directive (EU) 2025/2360 (the Soil Monitoring Law), which mandates EU Member States to establish harmonised national soil health monitoring systems by 2028. Addressing this challenge, the Horizon Europe-funded ECHO project offers a scalable framework that democratises soil data by integrating expert knowledge into a transnational citizen science network. This study presents the methodology and preliminary operational insights from the large-scale deployment of standardised, user-friendly soil sampling kits coupled with the dedicated EchoSoil mobile application. The scalability and robust spatial coverage of this approach are demonstrated by the successful collection of 1,200 soil samples across Romania—facilitated by an institutional partnership with the national forest administration (ROMSILVA)—alongside ongoing transboundary expansion into Hungary and Croatia. Beyond basic field parameters, the collected samples undergo advanced laboratory analyses that combine chemical nutrient and heavy-metal testing with DNA-based metagenomic screening to unlock critical insights into soil biodiversity. Ultimately, uploading these high-resolution datasets to the open-access ECHOREPO repository complements existing frameworks such as LUCAS Soil, bridging the gap between science and citizens while providing a validated foundation for future forestry, agricultural, and environmental policies.*

Keywords: *soil monitoring, citizen science, soil health, soil metagenomics, ECHOREPO.*

Influence of the production method of *Quercus robur*, *Fagus sylvatica*, *Pinus sylvestris* seedlings on the development of the root system of the seedlings after two years of growth in the crop as a potential in managing climate change

Karolina STASZEL-SZLACHTA¹ Mariusz KORMANEK¹

Jacek BANACH¹ Stanisław MAŁEK¹

¹ Department of Ecology and Silviculture, Faculty of Forestry, University of Agriculture, Aleja Mickiewicza street 21, 31-120 Krakow, Poland.

Corresponding author: Karolina STASZEL-SZLACHTA

E-mail address: karolina.staszelszlachta@urk.edu.pl

Abstract: *Container nursery production is a crucial element of modern forest management, enabling precise control of seedling growth conditions. The use of monitoring systems, such as humidity sensors and leachate monitoring, allows for the optimization of irrigation and fertilization, as well as more efficient water and nutrient management. This promotes the development of high-quality root systems and the production of uniform planting material, crucial for successful forest regeneration. The aim of this experiment was to analyse the development of root systems depending on the production method used and to assess its impact on the growth and survival of seedlings one and two years after planting in three locations.*

*The study included seedlings of European beech (*Fagus sylvatica* L.), English oak (*Quercus robur* L.), and Scots pine (*Pinus sylvestris* L.). Preparatory studies were conducted in facilities representing the main planting material production technologies currently used in Poland – ground nurseries and container nurseries. Analysis of qualitative indicators (SQ and S/R) demonstrated that the tested seedlings demonstrated adequate resistance to abiotic factors and appropriate shoot-to-root ratios. Root morphology was assessed after one and two growing seasons after planting in three contrasting locations. Measurements included root length, surface area, mean root diameter, and root volume. Additionally, multivariate statistical analysis was used to examine the relationship between root development and soil physical properties. The seedling production method was the main factor determining root system architecture in the early stages after planting. Container-grown seedlings developed longer and more extensive root systems than bare-root seedlings, particularly in terms of root length, surface area, and volume. The magnitude of these differences decreased over time, indicating a gradual decrease in the nursery effect after field planting. Species differed in their response to nursery production systems and soil conditions, with Scots pine showing the greatest plasticity, while European beech and English oak exhibited more stable growth patterns. These results indicate that although nursery production technology strongly determines initial root architecture, the persistence of this effect depends on subsequent site conditions.*

Keywords: *root morphology, stand, production technologies, soil physical parameters.*

Evaluating Douglas fir's provenances in Romania through multi-trait selection

Emanuel STOICA¹ Alin Madalin ALEXANDRU¹ Georgeta MIHAI¹
Virgil SCARLATESCU¹ Alexandru Lucian CURTU²

¹ Department of Forest Genetics and Tree Breeding, *Marin Dracea* National Institute for Research and Development in Forestry, 077190, Voluntari, Romania;

² Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Emanuel STOICA

E-mail address: emanuel.stoica@icas.ro

Abstract: *Douglas fir [Pseudotsuga menziesii (Mirb.) Franco] is a valuable timber species native to western North America that was introduced to Europe during the 19th century. This study aimed to identify the most productive and stable Douglas fir provenances in Romania by integrating two growth traits, diameter at breast height (DBH) and total height (TH), together with the quality trait pruned height (PH), using two recently adopted multi-trait selection approaches for forest tree species: the Multi-Trait Genotype–Ideotype Distance Index (MGIDI) and the Multi-Trait Stability Index (MTSI). The study was conducted in three common garden experiments established in Romania in 1977, including 61 provenances originating from the United States, Canada, Germany, France, and Romania. Significant genotype × environment interactions were observed, with the highest growth performance recorded at the Aleșd trial in western Romania. Both MGIDI and MTSI consistently identified superior provenances from diverse geographic origins, including the Pacific Northwest of North America, Canada, and Europe. Selection differentials ranged from 2.8% to 10.9% across individual traits, demonstrating considerable potential for genetic improvement. The selected provenances represent valuable genetic resources well adapted to the environmental conditions of western and south-western Romania, providing a strong basis for climate-resilient breeding programs and sustainable forest management strategies.*

Keywords: *Douglas fir, common garden experiments, multi-trait selection, genotype–environment interaction, non-native tree species.*

Phoretic mites associated with *Ips typographus* (Coleoptera: Scolytinae) in Romanian Norway spruce forests: Diversity and relationships with stand characteristics

Dragoş TOMA^{1,2} Gabriela ISAIA² Minodora MANU³

Carol Dieter SIMON² Ion Cătălin PETRIŢAN²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Şirul Beethoven 1, 500123 Brasov, Romania;

³ Department of Taxonomy, Ecology and Nature Conservation, Research Station Posada, Institute of Biology Bucharest of Romanian Academy, Splaiul Independenţei, no. 296, Bucharest, Romania.

Corresponding author: Dragoş TOMA

E-mail address: dragost93@gmail.com

Abstract: European spruce bark beetle (*Ips typographus*) is one of the most destructive pests of Norway spruce (*Picea abies*) forests across Europe. Besides its economic importance, it also contributes to forest biodiversity by creating habitats that support numerous associated organisms, including phoretic mites. Phoretic mites rely on bark beetles for dispersal to new habitats through a temporary commensal association known as phoresy. Although phoretic mite associated with *I. typographus* have been investigated previously, the influence of stand characteristics on these communities remains poorly understood.

The aim of this study was to characterize the diversity and abundance of phoretic mites associated with *I. typographus* in Romania and to evaluate the influence of stand-level characteristics on mite communities. Bark beetles were collected from 116 Norway spruce stands distributed throughout the Romanian Carpathians. For each sampling location, mite abundance, species richness, phoretic rate, and Shannon diversity index were calculated. The analysed stand characteristics included altitude, stand age, Norway spruce proportion, regeneration type, and mean stand diameter.

A total of 20,581 *I. typographus* beetles were examined, of which 47% carried at least one phoretic mite. In total, 32,559 mite individuals belonging to 14 species and 9 families were identified, including three species recorded for the first time in Romania. The most abundant and frequent species were *Dendrolaelaps quadrisetus*, followed by *Uroobovella ipidis* and *Trichouropoda polytricha*. Altitude was the main factor associated with phoretic mite communities, showing positive relationships with mite abundance, species richness, phoretic rate, and Shannon diversity. Regeneration type significantly influenced species richness and Shannon diversity, whereas stand age and Norway spruce proportion also had significant effects, although these relationships were relatively weak. These results provide new information on phoretic mites associated with *I. typographus* and improve our understanding of the environmental factors influencing their occurrence in Norway spruce forests.

Keywords: European spruce bark beetles, mites, phoresy, stand characteristics, Romania.

Structural characterization of even-aged beech stands as a basis for conversion to selection forest management

Adrian TUDORA^{1,2} Șerban CHIVULESCU¹ Ștefan LECA¹
Elena MIHĂILĂ¹ Mihăiță BÎTCĂ^{1,3} Ovidiu BADEA^{1,2}

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brașov, Romania;

³ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania.

Corresponding author: Adrian TUDORA

E-mail address: tudoraadrian19@yahoo.com

Abstract: *The conversion of even-aged European beech (*Fagus sylvatica* L.) stands into selection forest management is increasingly promoted as a silvicultural approach to enhance structural diversity, resilience, stability and long-term sustainability. The success of this process also depends on the initial structural conditions of the stands, which determine the planning and implementation of transformation cuttings. However, there is limited research describing these initial conditions for beech forests in Romania, in the context of transformation to selection system.*

This study aims to characterize the structural variability of beech stands selected for conversion to uneven-aged stands and to identify the main stand attributes that should be considered during the planning of transformation cuttings. The research was carried out in 14 representative stands dominated by European beech, with stand ages ranging from 85 to 100 years, except for one 60-year-old stand. In each stand, a permanent sample plot of 1 ha was established. All trees with diameter at breast height (DBH) greater than 8 cm were inventoried. Tree species, DBH, vitality status, quality class, and Kraft social class were recorded for every tree, while total height was measured on a representative sample.

The data obtained provide the baseline information required to evaluate stand structural characteristics, diameter distribution, social position, and timber quality before the first transformation cuttings and support science-based silvicultural decisions for the transition from even-aged to uneven-aged management in European beech forests.

Keywords: *European beech, even-aged stands, selection forest management, stand structure.*



Forest ecosystem management

- POSTER PRESENTATIONS -

Long-term assessment of forest health in the peri-urban forests of Bucharest, Romania

Alina ALEXANDRU¹ Mihnea CIOCÎRLAN¹ Flavius BĂLĂCENOIU¹

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Alina ALEXANDRU

E-mail address: alinaalexandruvalentina@gmail.com

Abstract: *Peri-urban forests provide essential ecosystem services by improving air quality, regulating the local microclimate, and offering opportunities for recreation and environmental education. Maintaining a good forest health status is therefore crucial for preserving both the ecological functions and the social benefits of these ecosystems. This study assessed the long-term occurrence of insect pests and forest diseases in the peri-urban forests surrounding Bucharest using historical records provided by the Romanian National Forest Administration (RNP–Romsilva) covering the period 1965–2020. The analyses focused on the occurrence, frequency, and impact of the main biotic damaging agents recorded during the study period. The results showed that the most significant defoliation events were caused by *Lymantria dispar*, *Tortrix viridana*, and several species belonging to the family Geometridae. Among forest pathogens, *Microsphaera alphitoides* was the most frequently recorded species. The findings highlight the recurrent nature of biotic disturbances affecting the peri-urban forests around Bucharest and emphasize the importance of continuous forest health monitoring to support adaptive forest management and maintain the ecosystem services provided by these forests.*

Keywords: *peri-urban forests, insect pests, forest health.*

A Geometridae outbreak in a peri-urban forest: Defoliation patterns and factors influencing tree vulnerability

Cosmin ROTARU¹ Dragoş TOMA¹ Alina ALEXANDRU¹
Mihnea CIOCÂRLAN¹ Flavius BĂLĂCENOIU¹

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Cosmin ROTARU

E-mail address: rotarucosmin10@gmail.com

Abstract: *Peri-urban forests represent an important component of the green infrastructure surrounding large cities, providing a wide range of ecological and social benefits. However, they are increasingly exposed to both abiotic and biotic stressors. In spring 2026, a severe outbreak of defoliating moths belonging to the family Geometridae occurred in Ștefănești Forest, located in the northeastern part of Bucharest, Romania. Field investigations identified five Geometridae species, with *Erannis defoliaria* being the dominant species. Other species recorded were *Operophtera brumata*, *Erannis aurantiaria*, *Phigalia pedaria*, and *Colotois pennaria*.*

The study aimed to assess the severity of defoliation and identify the factors influencing the vulnerability of both forest stands and individual trees. Defoliation was assessed between 18 and 26 May 2026, using randomly selected samples of 50 trees within each stand, with 17 deciduous species being analysed.

*Preliminary statistical analyses indicate that the most defoliated species were *Quercus robur* and *Ulmus minor*, with an average of 80%, followed by *Carpinus betulus* and *Acer campestre*, with average defoliations between 50 and 60%. At the opposite end are *Quercus cerris*, *Frasinus excelsior* and *Populus spp.*, with average defoliations below 20%. In *Robinia pseudoacacia*, although sporadic superficial defoliations were observed, it cannot be stated whether these were caused by Geometridae. Defoliation intensity is influenced by stand characteristics, including species composition, stand position relative to the forest edge and light exposure. In addition, tree susceptibility differs among forest tree species and is influenced by their social position within the stand, expressed by Kraft classes.*

The findings contribute to a better understanding of the factors driving Geometridae outbreaks in peri-urban forests and provide useful information for improving monitoring strategies and adaptive forest management under increasing forest decline.

Keywords: *forest health, insect pests, Geometridae outbreak, peri-urban forests.*



Growth and drought responses of four oak species in central Transylvania (Romania)

Florin-Alexandru BERAR¹ Any-Mary PETRIȚAN² Ion Catalin PETRIȚAN¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Florin-Alexandru BERAR

E-mail address: florin.berar@unitbv.ro

Abstract: *The effects of climate change are increasingly impacting forest ecosystems. To assess species responses to climatic variability, particularly recurrent droughts, four oak species (*Q. petraea*, *Q. robur*, *Q. cerris*, and *Q. rubra*) were analysed in the hilly region of Transylvania (Romania). This study quantifies their response to drought over a 30-year period and evaluates their adaptive capacity under current climatic conditions. A central component of this study is the analysis of decline processes in *Q. petraea*, integrating the relationships between competition, climate, and growth dynamics. The results show that juvenile stages are the most sensitive, exhibiting stronger responses to both annual and seasonal drought compared to mature or older trees. In addition, decline in *Q. petraea* was not driven by inter-individual competition, as Hegyi competition index values were similar between healthy and affected groups. Instead, a critical year was identified during early developmental stages, leading to population divergence and a reduced recovery capacity. Overall, the findings indicate that climatic sensitivity is higher in juvenile stages, while long-term responses are more strongly influenced by past climatic conditions than by competitive interactions.*

Keywords: *climate sensitivity, forest resilience, growth dynamics, forest decline, tree-ring analysis.*

Projected changes in the spatial distribution of European beech height growth potential in Romania

Emanuel BESLIU^{1,2} Marius BUDEANU¹ Alexandru Lucian CURTU²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Emanuel BESLIU

E-mail address: emanuel.besliu@icas.ro

Abstract: *Ongoing and projected climate changes are expected to reshape environmental suitability, leading to shifts in the natural distribution of forest tree species. Recent modelling approaches combine information from provenance trials with climate projections to estimate future growth potential and migration patterns, providing a scientific basis for adapting forest management to predicted future environmental conditions. To support climate-adaptive forest management, this study applied a Universal Response Function modelling approach to predict the future height growth of beech forests in Romania. The model was developed using data from four international beech provenance trials established in Romania between 1994 and 1998, and predictions were generated for the current climate and under the future climate scenarios. The URF model predicted pronounced height growth in the Carpathian region for the actual period, closely matching the current natural distribution of European beech. Predicted growth potential gradually declined toward the southern and southeastern regions of Romania, reflecting less favourable climatic conditions for beech. Under the RCP scenarios, the model predicts a substantial contraction and increasing fragmentation of the growth potential, particularly in the nearby areas of the Carpathian Mountains, suggesting a progressive restriction of favourable climatic conditions for European beech. These projections are consistent with previous studies reporting the negative effects of climate change on beech growth and species distribution. Therefore, beech populations growing close to the Carpathian mountain chain may become increasingly fragmented and experience a progressive decline, while the most favourable conditions for growth are expected to shift toward higher elevations in the Carpathian Mountains.*

Keywords: *European beech, provenance trials, universal response function, height growth potential.*

Preliminary results on the impact of climate change and water deficit on forest sites and forest vegetation status in the Ialomița River floodplain

Mihăiță BÎTCĂ^{1,2} Dorina DRĂGAN¹ Adrian TUDORA^{1,3}
Elena MIHĂILĂ¹ Gabriel DUDUMAN²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Forest Biometry Laboratory, Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania;

³ Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brașov, Romania.

Corresponding author: Mihăiță BÎTCĂ

E-mail address: bitcamihaita@gmail.com

Abstract: *In recent decades, the floodplains of the large inland rivers in southern Romania have become extremely vulnerable environments under the combined pressure of anthropogenic interventions and climate change. The study analyses the dynamics of the ecological complexes in the floodplain of the Ialomița River (plain and forest-steppe area) through an integrated approach, correlating a 30-year climate database with a focus on the evolution of evapotranspiration and water deficit with pedo-topographic and dendrometric parameters collected from the field. The research methodology included soil sampling up to the critical depth of 2 m, determining the level differences from the riverbed and inventorying the structural characteristics of the stands (diameters, heights), along with assessing their vegetation status. Preliminary results confirm the existence of important transformations at the soil and hydrological regime levels, highlighting the fact that the classic typology of the forest sites no longer reflects the current ecological reality. The statistical correlations established between long-term climate trends, deep soil moisture deficit and tree health degradation demonstrate the rigor of optimizing forest sites' mapping methods. The paper thus provides the necessary scientific foundation for re-evaluating forest site favourability, adapting regeneration compositions to the aridification phenomenon and preserving meadow ecosystems. Thus, the study has a major methodological relevance, which can be applicable by extrapolation to the entire Lower Danube river basin.*

Keywords: *forest sites' mapping, evapotranspiration, climate trends, Ialomiței Meadow, Water deficit, Forest typology.*

Strategies and challenges in the containment of *Tomicus destruens* in Mediterranean pine forests

Matteo BRACALINI¹ Lorenzo TAGLIAFERRI¹ Tiziana PANZAVOLTA¹

¹ Department of Agriculture, Food, Environment and Forestry (DAGRI), Plant Pathology and Entomology Section, University of Florence, Piazzale delle Cascine 18, 50144 Florence, Italy.

Corresponding author: Matteo BRACALINI

E-mail address: matteo.bracalini@unifi.it

Abstract: *Tomicus destruens* (Coleoptera: Curculionidae: Scolytinae) is one of the most destructive bark beetles threatening Mediterranean pine forests. Managing its infestations presents significant challenges due to the lack of effective pheromones for mass trapping and the high labour costs associated with bait logs. Thus, phytosanitary logging is considered the best practice for outbreak containment. However, in most of its distribution range, the detection window is extremely narrow, as symptomatic crown discoloration only becomes clearly visible in winter, requiring urgent action before the new generation emerges in spring.

In the Maremma Regional Park (Tuscany, Italy), a containment program conducted between 2019 and 2024 achieved an 84% reduction in newly infested trees compared to the first year of monitoring in 2019. This strategy successfully maintained an ecological equilibrium across the park's 600-hectare pine forests. Conversely, an unmanaged 7-hectare urban coastal pine forest located 35 km northwest, in similar meteorological conditions, showcased the devastating alternative: starting from just 2 infested trees in 2013, the outbreak surged showing a 30-fold increase to 60 newly infested trees by the fifth year of the infestation, before registering a slow, natural decline by the tenth year (2013–2022).

To streamline monitoring, camera-equipped drones were successfully deployed to detect even the smallest infestation hotspots. These aerial findings were then verified through ground-based assessments to evaluate each individual tree, accurately distinguishing between plants with rejected attacks and those fully compromised and marked for logging. Nevertheless, despite continuous guidance urging prompt clearance, some trees inevitably escape logging due to isolation or terrain inaccessibility. This, along with varying seasonal environmental factors affecting tree susceptibility, explains why infested pines fluctuate rather than stabilizing at low numbers.

Keywords: bark beetles, Mediterranean pine shoot beetle, phytosanitary logging, UAV monitoring, outbreak dynamics, pest management.

Dendrochronological evidence of gradual growth release in *Taxus baccata* L. following shelterwood (progressive) cuttings in a stand of management unit 2 Frumoasa, Tazlău Forest District (Eastern Carpathians, Romania)

Constantin BUDESCU¹ Marian TRISCIUC¹ Florin ISVORANU¹ Ionuț BALABASCIUC¹

¹ National Institute for Research and Development in Forestry Marin Dracea, Calea Bucovinei street 73bis, 725100 Câmpulung Moldovenesc Romania.

Corresponding author: Constantin BUDESCU

E-mail address: constantin.budescu@yahoo.com

Abstract: *Taxus baccata* L. is a relict species of high conservation value, listed in Annex II of the Habitats Directive (92/43/EEC) and on the IUCN Red List. This study quantifies the radial-growth response of English yew to progressive (shelterwood) cuttings using standardized dendrochronological methods. Three mature individuals (DBH $\approx$ 28–34 cm) were sampled in compartment 80A, Management Unit 2 Frumoasa, Tazlău Forest District, within a Natura 2000 site (SCI), in a fir–beech stand. Pressler cores ($\varnothing$ 5 mm, $\geq$ 2 radii per tree) were measured in Coorecorder v9.8.1 (0.001 mm resolution); cross-dating and chronology quality control were carried out in COFECHA v6.06 (LTRR, University of Arizona). The master chronology spans 1896–2025 (130 years), with a common overlap of 1953–2025 (73 years), an interseries correlation of 0.428 and a mean sensitivity of 0.224. Growth releases were identified following Nowacki & Abrams (1997): a $\geq$ 25% increase relative to the preceding 10-year mean, sustained for $\geq$ 10 years. The response is staggered among individuals, supporting the gradual character of the release. The highest-growth core (TI01, 1950–2025) shows the clearest post-treatment reaction: mean ring width rises from 2.85 mm (2008–2017) to 3.89 mm (2018–2025), a +37% increase, peaking at 5.90 mm in 2021. The thickest and oldest individual (TI02, DBH $\approx$ 33 cm, 1896–2025, 130 rings), which anchors the master chronology, displays an earlier release (mid-2010s; peak 5.74 mm in 2015), consistent with a stepwise opening of the canopy. The results provide the first quantitative evidence of yew growth responsiveness to a progressive-cutting regime in the Eastern Carpathians, with implications for conservation-oriented management of the species in Natura 2000 sites.

Keywords: dendrochronology, *Taxus baccata* L., shelterwood cutting, radial growth, COFECHA, Natura 2000, Eastern Carpathians.

Genotype-specific *in vitro* initiation of downy oak (*Quercus pubescens* Willd.) for climate-resilient forest restoration

Tatiana CĂLUGĂRU-SPĂȚARU¹ Svetlana SMEREA¹
Tatiana DELEAN¹ Alexandru DASCALIUC¹ Petru CUZA¹

¹ Institute of Genetics, Physiology and Plant Protection of Moldova State University, Pădurii 20, MD-2002 Chișinău, Republic of Moldova.

Corresponding author: Tatiana CĂLUGĂRU-SPĂȚARU

E-mail address: tatiana.calugaru.spataru@sti.usm.md

Abstract: Downy oak (*Quercus pubescens* Willd.) is a priority forest species for the restoration of drought-prone ecosystems in the Republic of Moldova. However, its natural regeneration is increasingly constrained by irregular acorn production, habitat degradation, recurrent drought, and high temperatures. This study aimed to evaluate the genotype-specific *in vitro* response of immature acorn explants and to identify culture conditions suitable for initiating clonal lines from locally adapted trees.

Immature acorns were collected from three selected donor trees: CP1 and CP2 from the Cărpineni population and B1 from the Băiuș population. Explants were cultured on variants of Murashige and Skoog medium and Woody Plant Medium differing in mineral salt concentration, sucrose content, plant growth regulator combination, and antioxidant supplementation.

The *in vitro* response was strongly influenced by genotype and medium composition. Genotype CP1 responded more favourably to MS medium containing full-strength mineral salts, 30 g L⁻¹ sucrose, 0.5 mg L⁻¹ BA, and 0.1 mg L⁻¹ IBA. In contrast, genotypes CP2 and B1 showed better development on half-strength WPM supplemented with 0.2 mg L⁻¹ BA and 0.05 mg L⁻¹ NAA. For these more sensitive genotypes, reducing the sucrose concentration from 30 to 20 g L⁻¹ promoted explant development and improved explant quality, suggesting lower osmotic stress. The addition of ascorbic acid and polyvinylpyrrolidone reduced phenolic browning and improved culture stability.

The results indicate that a single standard culture medium is not suitable for the *in vitro* initiation of all investigated *Q. pubescens* genotypes. Culture conditions should therefore be adjusted according to the physiological sensitivity and developmental response of each genotype. The proposed genotype-oriented approach may support the conservation of native forest genetic resources, the establishment of independent clonal lines, and the future production of planting material for ecological restoration and climate-resilient forest ecosystem management.

Keywords: Downy oak, forest genetic resources, genotypes, forest restoration, immature acorns, *in vitro* culture.

A decision support tool for adapting Romanian forests to climate change

Albert CICEU¹ Flavius BĂLĂCENOIU²

¹ Austrian Research Center for Forests (BFW), Vienna, Austria;

² National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Albert CICEU

E-mail address: albert.ciceu@bfw.gv.at

Abstract: *Forests are becoming increasingly maladapted to changing climatic conditions. The rapid pace of climate change limits the ability of the sessile, long-lived tree species, to adapt or migrate naturally to more suitable environments. Consequently, forest management must adopt a proactive approach by anticipating future climate–species relationships and promoting the establishment of forests that are better adapted to projected climatic conditions.*

Assisted migration has emerged as a promising strategy for enhancing forest resilience. However, its successful implementation requires robust assessments of species' climatic suitability to ensure that the right species are planted in the right locations. In this study, we developed a web-based decision support tool to facilitate assisted migration. The tool combines 69 species distribution models at 1 km spatial resolution with information from the scientific literature on species soil preferences to generate planting recommendations for each administrative territorial unit in Romania.

The application provides users with a list of tree species suitable for planting under two climate change scenarios. The framework presented here demonstrates how decision support tools can be developed and integrated into climate-smart forest management to support adaptive decision-making.

Keywords: *assisted migration climate change adaptation, decision support system, species distribution models, climate-smart forestry, tree species suitability.*

Sphagnum moss response to elevated nutrient availability in hydroponic culture

Radosław CICHOSZ¹ Michał JASIK¹ Stanisław MAŁEK¹

¹ Department of Ecology and Silviculture, Faculty of Forestry, University of Agriculture in Krakow, Poland.

Corresponding author: Radosław CICHOSZ

E-mail address: radoslawcichosz1@gmail.com

Abstract: *Nutrient availability is one of the main factors regulating the growth and physiological functioning of Sphagnum mosses. Understanding how increased nutrient supply affects biomass production and the internal distribution of elements is essential for both peatland ecology and the development of Sphagnum paludiculture. This study investigated the growth response and elemental allocation in Sphagnum fallax cultivated under controlled hydroponic conditions. Shoots were grown for 120 days using three nutrient treatments representing ambient (N100) and elevated nutrient availability (N300 and N500). Growth was assessed by comparing initial and final dry biomass, while elemental concentrations in the green (apical) and senescent (basal) stem sections were determined using ICP-OES and elemental analysis. Principal Component Analysis (PCA) was applied to evaluate patterns of elemental allocation within the moss stem. Increasing nutrient availability stimulated biomass production, with the highest nutrient treatment (N500) producing nearly twice the initial biomass and showing a markedly greater growth response than the lower nutrient variants. PCA revealed a clear pattern of elemental composition of green and senescing shoot sections across all treatments. Green apical tissues were characterized by higher concentrations of metabolically active elements, including N, P, K and S, whereas senescent stem sections accumulated Ca, Mg, Al, Fe, Mn and other trace metals. Elevated nutrient availability shifted the elemental composition of both tissue types, particularly by increasing phosphorus and nitrogen concentrations in the actively growing tissues, while the fundamental pattern of element partitioning between living and senescent stem sections remained unchanged. The results demonstrate that S. fallax maintains a highly organized internal nutrient allocation strategy despite substantial changes in external nutrient availability. Enhanced nutrient supply significantly increased biomass production but did not alter the preferential accumulation of mobile nutrients in the growing apex and less mobile cations in older stem tissues. These findings improve our understanding of nutrient retranslocation mechanisms in Sphagnum and provide practical insights for optimizing nutrient management in Sphagnum cultivation systems for paludiculture.*

Keywords: *Sphagnum biomass growth, nutrient allocation, paludiculture.*

Assessing ecological recovery of check-dam-regulated torrential valleys using a protected species as an ecological reference: A case study of *Tozzia alpina*

Maria CICȘA¹ Adrian INDREICA¹

¹ Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Maria CICȘA

E-mail address: maria_boroeanu@yahoo.com

Abstract: *Tozzia alpina subsp. carpathica* is a protected species associated with moist and nutrient-rich montane and subalpine habitats, considered sensitive to habitat modification. This study aimed to characterize its habitats in the Curvature Carpathians and assess their floristic and ecological similarity to vegetation in managed and natural sectors of check-dam regulated torrential valleys.

The study was conducted in five Romanian Carpathian massifs (Postăvaru, Piatra Mare, Grohotișu, Bucegi and Baiului). A total of 56 vegetation plots (1 m²) containing *T. alpina* were sampled along a 700–1700 m altitudinal gradient. Vegetation in check-dam regulated valleys was surveyed using 1-m² plots arranged along transects in managed and natural sectors. After excluding high-altitude *T. alpina* vegetation types without ecological analogues in the investigated valleys, 40 relevés were retained as references. Mean Bray–Curtis similarity to the *T. alpina* reference relevés was calculated for each plot in managed and natural sectors, allowing the identification of plots showing the highest floristic correspondence with the reference vegetation. These plots were subsequently examined for ecological similarity using Ellenberg indicator values.

The 56 relevés represented five alliances: *Petasition officinalis* (n = 27), *Filipendulion* (n = 10), *Adenostylion alliariae* (n = 9), *Rumicion alpini* (n = 7) and *Cardamino-Montion* (n = 3). Floristic similarity among *T. alpina* reference relevés ranged from 0.123 to 0.316 (mean = 0.240). Mean similarity of the managed plots to the *T. alpina* reference relevés ranged from 0.153 to 0.235 (mean = 0.185), compared with 0.110–0.242 (mean = 0.144) for the natural plots. Ellenberg moisture values differed among groups (Kruskal–Wallis, p = 0.004); natural plots differed from managed (Dunn, p = 0.002) and *T. alpina* reference plots (p = 0.010), whereas managed and *T. alpina* plots did not differ (p = 0.627). Nutrient values did not differ among groups (p = 0.102).

Some managed valleys may therefore develop floristic and ecological conditions resembling *T. alpina* habitats, suggesting their potential to provide suitable conditions for habitat-sensitive species.

Keywords: *Tozzia alpina*, habitat-sensitive species, torrential valleys, riparian vegetation, floristic similarity.

Fruit production intensity drives earlier leaf senescence in European beech

Mihnea-Ioan-Cezar CIOCÎRLAN^{1,2} Elena CIOCÎRLAN² Alexandru Lucian CURTU²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mihnea-Ioan-Cezar CIOCÎRLAN

E-mail address: ciokyx@yahoo.com

Abstract: *European beech (Fagus sylvatica L.) is an important forest tree species in Europe, with considerable ecological and economic significance. This species adjusts the length of its growing season in response to environmental conditions. Monitoring spring and autumn phenology, as well as fruiting abundance—both sensitive to climate variation—provides insight into beech responses. This study tested whether the abundance of fructification is associated with the onset of senescence or with individual heterozygosity. Spring and autumn leaf phenology, along with fructification, were monitored in natural populations during a masting year (2022). The study included 150 common beech trees distributed across five sites along a 900 m altitudinal gradient in the Southeastern Carpathian Mountains. The timing of bud burst and senescence, and the length of the growing season, varied with altitude. A 28-day difference in bud burst, a 20-day difference in the start of leaf senescence, and a 52-day difference in growing season length were observed between individuals at the extremes of the altitudinal gradient. The onset of senescence, indicated by leaf yellowing, was significantly associated with fructification abundance; individuals with abundant fructification exhibited premature senescence, a trend that followed the altitudinal gradient. No relationship was detected between fructification abundance and individual heterozygosity. These results indicate that abundant fructification reallocates most of the tree's energy and nutrients toward fruit development, accelerating leaf yellowing due to physiological stress. These findings, based on a one-year study, underscore the interconnected influence of climate, reproductive effort, and phenological timing in European beech across an altitudinal gradient, but to draw robust conclusions regarding adaptive strategies, further studies should be replicated and extended over longer periods.*

Keywords: *common beech, leaf phenology, masting year, individual heterozygosity, adaptive strategies.*



Structural diversity of natural forests in the Ciucaș Mountains

Aurel CIORIIA¹ Gheorghe Marian TUDORAN¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Aurel CIORIIA

E-mail address: aurel.cioriia@unitbv.ro

Abstract: *The natural forests of the Ciucaș Mountains (Romania) are concentrated within the Natura 2000 site ROSCI0038 Ciucaș, and this study analyses the strictly protected areas under public state ownership. The structure and yield of these forests were investigated in 1.0-hectare sample plots, while the biometric characteristics of the average trees were evaluated through surveys located in representative sections of the stands. The results reveal a composition dominated by European beech (55%), followed by Norway spruce (34%), larch, silver fir, and other broadleaved species. In terms of age, forests older than 150 years occupy more than 60% of the total strictly protected area, while those exceeding 180 years (12%) are represented by beech and larch stands. The greatest variability in three dimensions is recorded in stands older than 100 years (90%). Per hectare, the stands reach a basal area of 66 m² and a volume of up to 790 m³. The average trees exhibit diameters ranging between 8 and 70 cm, heights between 5 and 37 m, and slenderness coefficients between 40 and 80. The volume of deadwood averages approximately 50 m³/ha, distributed both as downed log and standing deadwood. The study confirms that age significantly influences structural diversity, with the highest Shannon index values (1.7) determined in old-growth stands. In conclusion, mixed old-growth stands exhibit the highest level of structural diversity.*

Keywords: *natural forest, strict protection, Shannon index, stand structure, forest composition, old-growth forest, Ciucaș Mountains.*

Comparative stem form and height growth of hybrid poplar clones AF8 and Pannonia in short-rotation woody crops: a case study from the Suceava Plateau (NE Romania)

Iulian-Constantin DĂNILĂ¹ Daniel AVĂCĂRIȚEI¹ Gabriel DUDUMAN¹
Mihai-Leonard DUDUMAN¹ Vlăduț-Maricel HAZI²

¹ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania;

² F.E. AGRAR SRL, 2 Austriei Street (Room 4), 725400, Rădăuți, Romania.

Corresponding author: Iulian-Constantin DĂNILĂ

E-mail address: juliandanila@usm.ro

Abstract: *Intensive hybrid poplar plantations represent a promising solution for sustainable woody biomass production, and understanding stem form and height growth dynamics is essential for optimising production cycles. This study comparatively analyses stem form and height growth of two hybrid poplar clones, AF8 (*Populus × generosa*) and Pannonia (*Populus × euramericana*), established in intensive short-rotation woody crops (SRWCs) on agricultural land in the Rădăuți Depression (NE Romania). A total of 184 individuals from six plantation plots with a density of 1,667 trees·ha⁻¹ were harvested and biometrically measured after 5, 6, and 7 growing seasons. Stem form indices (slenderness index I_z and taper coefficient q), relative taper equations Dr/Hr , and real volumes by timber assortments were determined. Analysis of the height growth index (ih) revealed that both clones reached maximum annual growth in 2018, a year with exceptional precipitation (762.4 mm), with mean ih values of 2.51–3.31 compared to a multi-annual mean of 1.36 m·m⁻¹. The correlation between annual cumulative precipitation and ih ($r = 0.44$; $p < 0.05$) confirms the determining role of moisture availability under local conditions. Clone AF8 showed a slenderer stem ($I_z = 91$ – 106), while Pannonia recorded higher volumes after 6 growing seasons. Linear taper equations ($Dr = a + b \cdot Hr$, $R^2 \geq 0.97$) accurately described the stem profile without significant differences between clones or production cycles. Results support the efficiency of intensive hybrid poplar cultivation in the study area and provide biometric parameters applicable to harvest planning.*

Keywords: *hybrid poplar, short rotation woody crops, relative taper, height growth rate, climatic factors.*

Mapping the cultural ecosystem services provided by urban forests using public participation. Case study Băneasa Forest, Romania

Dumitru-Mircea DUȘCU^{1,2} Geta RÎȘNOVEANU^{1,3}

¹ Doctoral School of Ecology, Faculty of Biology, University of Bucharest, 050095, Bucharest, Romania;

² National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

³ Department of Systems Ecology and Sustainability, Faculty of Biology, University of Bucharest, 050095, Bucharest, Romania.

Corresponding author: Dumitru-Mircea DUȘCU

E-mail address: dumitru.duscu@drd.unibuc.ro

Abstract: *Urban areas face significant pressures from urbanization and climate change that is why urban green infrastructure (urban forests, parks, street trees etc.) becomes increasingly relevant for landscape planning and management, due to their ability to provide ecosystem services. Our research aimed to assess and map the cultural ecosystem services provided by Băneasa Forest using Public Participation Geographic Information System (PPGIS) and emphasize its important contribution to the health and well-being of the population. The potential of the forest to provide cultural ecosystem services was assessed based on the citizens' stated preference. We applied the georeferenced survey method, using the online survey tool Maptionnaire. 816 respondents have marked 882 points on the Băneasa Forest map that they consider to be the most important for the provision of cultural ecosystem services. Based on the points, we created high-resolution maps with hot spots of cultural ecosystem services offered by the only urban forest in Bucharest, Băneasa Forest. This study underscores the complexity of interactions and relevance of the local context for cultural ecosystem services distribution and reaffirms the critical importance of urban forests in providing cultural ecosystem services and contributing to urban social resilience and environmental sustainability, in the context of rapid economic development, real estate pressures, and climate change. Our results support forest managers to adapt management according to public preferences, anticipate potential conflicts and set management priorities for the conservation of Băneasa Forest.*

Keywords: *Băneasa Forest, Cultural ecosystem services, PPGIS, Urban forests.*

Survival of Siberian elm (*Ulmus pumila* L.) and green ash (*Fraxinus pennsylvanica* Marshall) after two growing seasons in an agroforestry system established in southern Romania

Cristian Mihai ENESCU¹

¹ University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd, 1st District, 011464 Bucharest, Romania.

Corresponding author: Cristian Mihai ENESCU

E-mail address: mihai.enescu@agro-bucuresti.ro

Abstract: Agroforestry systems improve ecosystem resilience and agricultural sustainability, particularly in dry regions where trees enhance soil quality, biodiversity, and microclimatic conditions. This study evaluated the survival of container-grown Siberian elm (*Ulmus pumila* L.) and green ash (*Fraxinus pennsylvanica* Marshall) established in an experimental agroforestry system at HortiNova Nursery (southern Romania). In November 2023, 144 Siberian elm and 138 green ash seedlings were planted under identical conditions. Survival was assessed after the first growing season (2024) and re-evaluated at the end of 2025. During 2024, Siberian elm recorded an 81.5% survival rate (116 of 144 seedlings), while green ash achieved 87.0% survival (120 of 138 seedlings), despite low annual precipitation (238.8 mm) and temperatures ranging from 1.65 to 39.13°C. During the 2025 growing season (1 April–15 September), climatic conditions became slightly more severe, with temperatures ranging from 1.57 to 42.74°C (mean $22.02 \pm 7.84^\circ\text{C}$) compared with $21.89 \pm 7.23^\circ\text{C}$ in 2024, and relative humidity showing greater variability ($54.86 \pm 19.26\%$ versus $54.50 \pm 17.47\%$). These conditions likely increased physiological stress on seedlings. By the end of 2025, an additional seven Siberian elm and eleven green ash trees had died, reducing survival to 75.7% (109 of 144 seedlings) and 79.0% (109 of 138 seedlings), respectively. The results indicate that both species maintained satisfactory establishment under increasingly variable semi-arid conditions, supporting their suitability for agroforestry systems in southern Romania while emphasizing the importance of continued monitoring and appropriate soil nutrient management to improve long-term plantation performance.

Keywords: agroforestry, *Fraxinus pennsylvanica*, *Ulmus pumila*, survival rate.

Forest operating in semi mountainous Greek (Mediterranean) conditions and environment

Evripidis FARMAKIS¹ Konstantinos FARMAKIS¹ Vasileios C. DROSOS²

¹ Department of Computing, University of Derby, United Kingdom;

² Laboratory of Forest Engineering Sciences and Surveying, Department of Forestry and Management of Environment and Natural Resources, Scholl of Agricultural and Forestry Sciences, Democritus University of Thrace, Athen Pantazidou 193 Str. P.C. GR 68200 Orestiada, Greece.

Corresponding author: Vasileios C. DROSOS

E-mail address: vdrosos@fmenr.duth.gr

Abstract: *The semi mountain forests are usually forests of Oak, Pine and Chestnut in our country. The continuous reduction of forest workers of younger generation requires partial gradual mechanization of all operations in the future. Even if we assume that the European orientation of the country will carry over year to younger's similar requirements of quality life of forest worker (better pay at skilled tasks in conjunction with comfort at work, etc.), then the gradual introduction of technology of harvester is necessary. The aim of this paper is to answer the question: What method should be suitable for the Greek forest semi mountainous regions?*

Consider the forest operations for harvesting and skidding for:

A. Selective cutting of productive semi mountainous forests;

B. Clear-cutting logging in groups

Analysed the special requirements in terms of feasibility and protection of the environment and harvesting and skidding model for both cases is proposed. The means in connection with availability and ecological suitability (eco-friendliness), forestry species, restoring forest with revegetation or reforestation, slope of the ground, road density and road distance were examined.

Keywords: *clear-cutting, selective cutting, harvester, mechanized method, oak, pine, feasibility, protection.*



Advancement in seed collection timing for three European tree species:

Abies alba*, *Larix decidua* and *Tilia cordata

Paula GARBACEA¹ Emanuel STOICA¹ Alin-Madalin ALEXANDRU¹
Georgeta MIHAI¹ Katri HIMANEN² Heino KONRAD³

¹ Department of Forest Genetics and Tree Breeding, "Marin Dracea" National Institute for Research and Development in Forestry, 077190 Bucharest, Romania;

² Natural Resources Institute Finland (Luke), Latokartanonkaari 9, 00790 Helsinki, Finland;

³ Federal Research and Training Centre for Forests, Natural Hazards and Landscape, Seckendorff-Gudent-Weg 8, A-1131 Vienna, Austria.

Corresponding author: Paula GARBACEA

E-mail address: paula.garbacea@icas.ro

Abstract: Successful forest regeneration depends on the availability of high-quality seeds collected at the optimal stage of physiological maturity. Climate change is increasingly influencing reproductive phenology in forest tree species, with potential implications for seed collection practices and forest regeneration. This study aimed to evaluate seed maturation timing in three ecologically and economically important European species—silver fir (*Abies alba*), European larch (*Larix decidua*), and small-leaved lime (*Tilia cordata*)—using material collected from clonal seed orchards in Romania. Seed quality was assessed across successive collection dates to evaluate changes associated with seed maturation using tetrazolium viability tests for *Abies alba* and *Tilia cordata* and germination tests for *Larix decidua*. The results showed variation in seed quality among collection dates, suggesting that the optimal harvest period during the study years may have occurred earlier than the intervals traditionally recommended in the literature. These observations coincided with warmer conditions during the study years compared with the 10-year climatic averages, suggesting that recent warming trends may be associated with earlier seed maturation. The findings highlight the importance of re-evaluating seed collection schedules under changing climatic conditions. However, further multi-year studies are needed to confirm these patterns and refine seed collection recommendations for forest reproductive material.

Keywords: climate change, collection timing, forest regeneration, germination, seed maturity, seed viability.

Rapid molecular identification of *Tomicus destruens*: A new tool for forest biosecurity

Giulia P. S. GRAHAM¹ Edson BOLIGE² Alice DOWNES² Lorenzo TAGLIAFERRI¹
Domenico RIZZO² Tiziana PANZAVOLTA¹ Matteo BRACALINI¹

¹ Department of Agriculture, Food, Environment, and Forestry (DAGRI), Plant Pathology and Entomology Section, University of Florence, Piazzale delle Cascine 18, 50144 Florence, Italy;

² Laboratory of Phytopathological Diagnostics and Molecular Biology, Plant Protection Service of Tuscany, Via Ciliegiole 99, 51100 Pistoia, Italy.

Corresponding author: Giulia P.S. GRAHAM

E-mail address: giuliapatriciasofia.graham@unifi.it

Abstract: *The Mediterranean pine shoot beetle, Tomicus destruens, is a bark beetle widely distributed across Mediterranean pine forests, where it is frequently recorded as a major pest. Additionally, it is considered a species at risk of introduction in many areas outside its native range. Outbreaks are usually associated with abiotic and biotic stressors that increase tree susceptibility, while ongoing climate change is expected to exacerbate these conditions, further predisposing host trees to attacks. Given its impact, early detection is critical for effective forest management. However, rapid and reliable molecular diagnostic methods for the timely identification of this species are currently lacking. The purpose of this study was to develop a molecular tool for the identification of T. destruens, based on a TaqMan probe and primers targeting a 115 bp fragment of the mitochondrial COI gene. For specificity testing, real time PCR was performed on both target and non-target DNA, as well as on frass-like material collected from galleries. Non-target DNA was extracted from bark beetles belonging to 18 different bark beetle species closely resembling T. destruens morphologically or co-occurring in the same ecological niche; in addition, specificity against closely related taxa (e.g., T. piniperda) was verified in silico. Sensitivity is being assessed through serial dilutions to determine limit of detection (LoD) of target DNA. Preliminary results confirm species-specificity against the experimentally tested panel; although sensitivity is still under evaluation, the assay already demonstrates rapidity and promising specificity, thus supporting forest biosecurity and early pest monitoring strategies.*

Keywords: *Tomicus destruens, bark beetles, molecular diagnostics, TaqMan real-time PCR, COI, forest biosecurity, invasive species, Mediterranean pine forests.*

Forest growth patterns in Orhei National Park

Vladislav GRATI^{1,2} Cătălin-Constantin ROIBU¹ Mihail CÎRLIG¹ Ion COVRIGHIN^{2,3}

¹ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania;

² Parcul Național Orhei, Sciusev street 35, Chișinău, Republic of Moldova;

³ Universitatea de Stat din Moldova, Alexe Mateevici street 60, MD-2009 Chișinău, Republic of Moldova.

Corresponding author: Vladislav GRATI

E-mail address: grativlad@yahoo.com

Abstract: *The assimilation of the natural components of a forest stand contributes to achieving the productive potential of the species. Each species shows a unique response to site productivity potential and, consequently a distinct influence on its growth. To identify the structural elements of the forest stands within Orhei National Park, ten sample plots were established to determine the dendrometric and growth characteristics of the trees and stands. Comparative analyses were also conducted using forest management records for the specific management units where the sample plots are located. The results obtained are quantifiable, tracking changes in stand structure over a specific period. The collection of dendrometric data—including composition details from the same subplot—revealed species-specific characteristics, with a particular focus on the dominant species within the high-forest stands of Orhei National Park.*

Keywords: *site index, forest growth, structural elements.*

Structural optimization of recreational forests in the Postăvarul Massif by integrating social perspectives

Adrian Stefan IRIMIN¹ Avram CICSĂ¹ Gheorghe Marian TUDORAN¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Adrian Stefan IRIMIN

E-mail address: stefan.irimin@unitbv.ro

Abstract: *The forests of the Postăvarul Massif offer excellent natural conditions for recreation, but to become safe and accessible, they require appropriate structural organization and management. This research aimed to identify community preferences regarding the forest, with the purpose of integrating them into its spatial and ecological planning. To evaluate visitors' perspectives, a preliminary 30-question survey was administered, with preferences centralized and expressed as percentages. The demands of the Brasov community indicate that the public prefers a mixed forest with trees of various ages (62%) and dimensions (78%), structurally optimized to ensure good visibility near the trails (96%). Developments will adhere to an ecological design (57%), integrating natural paths (28%), gravel forest roads (28%), and discreet tourist signage (38%). Furthermore, motor vehicle access will be strictly limited to the edge of the forest (42%), protecting the interior of the massif from noise and chemical pollution. The success of this strategy lies in fusing public preferences with the forest management plan, the latter being the essential tool for the organization, administration, and long-term sustainability of forest ecosystems. To meet these requirements, the forest management plan will promote the selection system—optimal for diversifying stand structure and carrying out minimal interventions for conservation purposes—while silvicultural tending operations will be executed along the pathways to enhance the feeling of safety.*

Keywords: *forest recreation, stand structure, uneven-aged stands, forest management plan, social forestry.*

Height-diameter relationship in old-growth spruce forest in Romania

Laura ȚĂNIȚĂ¹ Ion Catalin PETRITAN² Ieva JAUNSLAVIETE¹ Eļferts DIDZIS¹

¹ Latvian State Forest Research Institute "Silava", Rigas street 111, Salaspils, LV—2169, Latvia;

² Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Laura ȚĂNIȚĂ

E-mail address: laura.kenina@silava.lv

Abstract: Tree height and diameter at breast height (DBH) are two of the most important variables commonly measured in forest inventories. However, tree height measurements require considerably more time and effort than DBH measurements and may have higher measurement errors. Therefore, height–diameter (H–D) models are widely used to predict individual tree heights, which are necessary for estimating tree volume, biomass and carbon stocks. Numerous local H–D models are available for managed Norway spruce (*Picea abies* (L.) Karst.) stands; however, such information in old-growth forests remains limited, as these forests differ from managed stands in terms of stand structure and competition. Therefore, developing H–D models for old-growth forests is essential to improve height prediction and provide reference information.

This study aimed to describe the height–diameter relationship of old-growth Norway spruce forests in the Romanian Carpathians and to provide a reference model for future ecological and forest inventory studies. Data were collected from 73 circular sample plots established in old-growth Norway spruce forest in the Postăvarul Mountains. DBH and tree height were measured for all living trees. Several commonly used nonlinear H–D functions were fitted and compared to identify the best-performing model.

The developed model may support tree height prediction in structurally complex old-growth Norway spruce forests and provide reference data for forest inventories and further studies of old-growth forests across Europe.

Keywords: Height growth curves, old-growth forest, modelling, *Picea abies*, Postăvarul Mountains.

Structural variability of mature *Quercus pedunculiflora* stands in the Romanian forest-steppe

Constantin-Cosmin LOGHIN^{1,2} Bogdan-Ionut PLEȘCA^{1,2} Nicolae Ovidiu BADEA^{1,3}

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brașov, Romania;

³ Romanian Academy, 125 Calea Victoriei, sector 1, RO-71102, Bucharest, Romania.

Corresponding author: Constantin-Cosmin LOGHIN

E-mail address: cosmin.loghin@yahoo.com

Abstract: *Understanding the structure of pure Quercus pedunculiflora stands is essential for interpreting forest dynamics in the forest-steppe zone and for supporting forest management under increasing aridity. Two relatively even-aged stands, Vărăști (VAR) and Braniștea Catârilor (BRC), located in the Romanian Plain forest-steppe, with de Martonne aridity indices (Ia) of 25.1 and 23.9, respectively, were investigated.*

The main stand structural statistics were determined and compared using complete inventories conducted within 1-ha square sample plots (100 × 100 m), revealing consistent differences between the two stands. The BRC stand exhibited higher mean and median values of diameter at breast height (DBH; 53.26 and 52.68 cm), tree height (25.68 and 26.60 m), and individual tree volume (3.363 and 3.058 m³) than the VAR stand (39.46 and 38.77 cm; 17.69 and 18.10 m; 1.220 and 1.106 m³, respectively). Diameter variability was comparable between stands (coefficient of variation, CV ≈ 24%), whereas tree height showed lower relative dispersion in BRC (20.17%) than in VAR (24.20%). Individual tree volume exhibited high variability in both stands (CV > 50%) and a positively skewed distribution, more pronounced in VAR (skewness = 1.32; kurtosis = 3.81) than in BRC (skewness = 0.67; kurtosis = -0.29), indicating a stronger influence of extreme values on the volume distribution in the former stand.

The results demonstrate that conventional stand structural variables can effectively characterize structural differences in pure Q. pedunculiflora stands and provide relevant information for adaptive forest management under forest-steppe conditions.

Keywords: *Quercus pedunculiflora, stand structure, diameter distribution, stand variability, forest-steppe, adaptive silviculture.*

Productivity aspects of forest ecosystems in the Bârgău Mountains according to habitat types within the established forest sampling network

Valentin LUPȘAN¹ Maria Magdalena VASILESCU¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Valentin LUPȘAN

E-mail address: llvalylupsan@yahoo.com

Abstract: *Forest ecosystem productivity is a key indicator of ecosystem functioning, reflecting the influence of environmental conditions, stand structure, and site characteristics. In the Bârgău Mountains (Romania), the diversity of forest habitats provides an opportunity to evaluate productivity patterns across different Natura 2000 habitat types.*

*This study aims to assess and compare the productivity of forest ecosystems corresponding to habitat types 91V0 (Dacian beech forests Symphyto-Fagion), 9130 (Asperulo-Fagetum beech forests), and 9140 (medio-European montane beech forests with *Abies alba* and, locally, *Picea abies*). The analysis is based on data collected from a network of permanent sampling plots established within these habitats. Stand productivity was evaluated using dendrometric and site-related variables, including stand composition, tree diameter, tree height, growing stock, increment, and site productivity indices.*

Comparative analyses were performed to identify differences in productivity among habitat types and to examine the influence of ecological and site conditions on stand development. The results highlight habitat-specific productivity patterns and emphasize the importance of environmental variability in shaping forest growth dynamics.

The findings contribute to a better understanding of the productive potential of Natura 2000 forest habitats in the Bârgău Mountains and provide scientific support for sustainable forest management, biodiversity conservation, and adaptive management strategies under changing environmental conditions.

Keywords: *forest productivity, forest ecosystems, sustainable forest management, Bârgău Mountains, stand structure, permanent sample.*

Interactive activity for managing the risk of falling trees in the Brasov urban area

Mirabela MARIN¹ Nicu Constantin TUDOSE¹ Mihai-Ionut HAPA^{1,2}
Cezar UNGUREAN¹ Alin Lucian MIHALACHE¹

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mirabela MARIN

E-mail address: mirabela.marin@icas.ro

Abstract: *Urban areas play a critical role in climate regulation and enhancing urban resilience. As extreme weather events increase in frequency and intensity, adapting urban forests to climate change is imperative to mitigate risks, such as tree failure, which can compromise urban infrastructure and public safety. This study presents a participatory tool for qualitative data collection, interpretation and co-creation in the form of an interactive tabletop simulation exercise focused on an engagement and learning activity, developed under the TREESURE project, designed to model natural disaster scenarios and incident management within the Brasov urban area. Conducted in May 2026, the two-session event convened 20 local stakeholders, experts, and project partners to evaluate challenges in urban tree risk management and assess innovative approaches to disaster preparedness. Participants engaged in a 'role reversal' exercise, navigating diverse responsibilities—from institutional decision-makers to citizens—while coordinating interventions, allocating resources, and prioritizing incidents generated by a simulated disaster. The exercise demonstrated the impact of situational pressure on decision-making, highlighted information-flow dynamics, and underscored the necessity of robust communication and collaboration for effective emergency management. Participants actively contributed to discussions on local challenges and strategies for enhancing multi-stakeholder cooperation. The simulation proved to be an effective tool for fostering collaborative problem-solving and proactive planning, especially when facing uncertainty and cumulative extreme events. Moving forward, the TREESURE project will implement an advanced Decision Support System to monitor tree health, anticipate failure risks, and facilitate timely interventions before disasters occur.*

Keywords: *climate change adaptation, urban forestry, emergency preparedness, risk management, Decision Support System.*



Urban tree inventory for risk assessment in an urban area

Mirabela MARIN¹ Nicu Constantin TUDOSE¹ Mihai-Ionut HAPA^{1,2}
Cezar UNGUREAN¹ Alin Lucian MIHALACHE¹ Danut CHIRA¹
Andy POPA¹ Radu NAN¹ Tibor SERBAN¹
Boglarka OPRA^{1,2} Alexandru ZAHARIA¹

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mirabela MARIN

E-mail address: mirabela.marin@icas.ro

Abstract: *Urban forests provide essential ecosystem services, yet mature trees in highly populated areas pose structural failure risks exacerbated by climate and anthropogenic pressures. Urban green spaces management aligns with European frameworks (Nature Restoration Regulation, Urban Nature Plans) and national legislation (Law No. 24/2007). In Romania, this law mandates a Local Register of Green Spaces using tree-by-tree inventories of public areas to provide essential data on tree condition, dimensions, health status, and other relevant metrics and establishes the foundation to prioritize, fund, and utilize that inventory effectively in an urban forestry program.*

In 2021, an urban tree inventory across Brasov Municipality's public domain mapped approximately 88,000 trees, recording their localization, dendrometric characteristics, and overall condition and management parameters.

Building on this, the TREASURE project re-inventoried approximately 2,300 of these trees, aiming to develop an early-warning application for urban tree-fall risks under climate and social challenges. This work updated the 2021 records and introduced new structural parameters, including crown form, tree tilt, crown shading, and rooting environment, across distinct urban micro-environments, including residential areas, active or passive recreation zones, and traffic corridors.

The monitored population revealed highly diverse species, spanning 39 dendrological genera with highly varied and occasionally exceptional dimensions, including diameters exceeding 160 cm. Correlating these biometric observations with specific environmental stressors enables the development of a predictive framework for proactive urban tree risk assessment, supporting a digitized decision-making tool for municipal authorities to mitigate public hazards while preserving urban canopy biodiversity.

Keywords: *urban forestry, tree risk assessment, tree inventory, emergency preparedness, Decision Support System.*

Can citizen science enable transformative change in forests? A case study on active participation in environmental compliance in forestry

Mirabela MARIN¹ Nicu Constantin TUDOSE¹ Ionut Mihai HAPA¹
Cezar UNGUREAN¹ Florentina NANU² Ciprian NANU²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Business Development Group SRL, 80 Plantelor street, 023976 Bucharest, Romania.

Corresponding author: Mirabela MARIN

E-mail address: mirabela.marin@icas.ro

Abstract: *Forests are vital for biodiversity, ecosystem services, and climate mitigation. Within the EU, they offset 7% of annual greenhouse gas emissions, highlighting the importance of climate-smart management. In Romania, forests cover 29.3% of the land and include UNESCO World Heritage Sites, yet deforestation remains a persistent concern. To address this, the Brasov case study of the ENFORCE project explores how citizen science can enhance sustainable forestry and timber monitoring. We aim to enhance forest resilience by developing an independent, user-friendly mobile application that simplifies data collection through three guiding questions and photo uploads. Collected data will be transmitted to local forest managers for field verification to determine if incidents stem from natural processes, legal operations, or illegal interventions. Additionally, an illustrated glossary of key definitions will enhance public environmental literacy. Preliminary findings from a case study in Brasov underscore the need for local accountability, legal enforcement, stakeholder communication, and support for forest owners. Ultimately, active citizen participation in forest compliance fosters informed, transformative change toward sustainability.*

Keywords: *citizen science, sustainable forestry, citizen empowerment, wood tracking tool, Brasov case study.*

BIOFORMA: Adaptive management of mountain Norway spruce forests under climate change

Any Mary PETRITAN¹ Raul Gheorghe RADU¹ Ștefan PETREA¹ Gabriel LAZAR¹ Dănuț CHIRA¹
Marius PARASCHIV¹ Mirabela MARIN¹ Constantin DUMITRU-DOBRE¹ Gruică IENĂȘOIU

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Any Mary PETRITAN

E-mail address: apetritan@gmail.com

Abstract: Mountain Norway spruce forests are among the most climate-sensitive forest ecosystems in Europe, while providing essential ecological, economic, and social benefits. Climate change is expected to alter forest structure, biodiversity, and ecosystem functioning, highlighting the need for adaptive management strategies that enhance forest resilience. BIOFORMA (2025–2029) is an international research project coordinated by the Swiss Federal Institute for Forest, Snow and Landscape Research in collaboration with research institutions from Bulgaria, Croatia and Romania. The project aims to evaluate the effects of different forest management strategies on biodiversity and ecosystem functions under current and future climate scenarios and to provide science-based recommendations for sustainable forest ecosystem management.

The project investigates mountain spruce forests across four representative case study areas spanning the Alps, the Carpathians, and southeastern Europe. Field surveys conducted in 500 plots distributed across 100 forest stands quantify forest structural characteristics and biodiversity, including soil microorganisms, vascular plants, bryophytes, fungi, insects, and birds. These data are integrated with forest growth models to simulate long-term forest development under contrasting climate and management scenarios. Remote sensing is used to upscale biodiversity assessments from stand to landscape level, supporting the identification of resilient management practices. The project also evaluates trade-offs between timber production, structural complexity, and biodiversity conservation while promoting knowledge transfer through stakeholder engagement and international collaboration.

BIOFORMA will provide scientific evidence to support adaptive management of mountain Norway spruce forests, helping maintain biodiversity, ecosystem functions, and forest resilience under climate change while contributing to sustainable forest policy and practice across Europe.

Keywords: climate change, mountain Norway spruce forests, forest ecosystem management, biodiversity, forest resilience, adaptive management.

Acknowledgement : This research is carried out and financed within the framework of the second Swiss Contribution Multilateral Academic Projects (MAPS) (SNSF project code: IZ11Z0_230148 and UEFISCDI project code: F-RO-CH-2024-0280).

The transition vegetation zones from the Curvature Subcarpathians – The vegetation study from Odobești Hill

Bogdan-Ionuț PLEȘCA^{1,2} Irina IRIMIA³ Constantin Cosmin LOGHIN^{1,2} Ioana-Maria PLEȘCA¹

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190 Ilfov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

³ Faculty of Biology, Alexandru Ioan Cuza University of Iasi, 11 Carol I Blvd, 700506 Iași, Romania.

Corresponding author: Ioana-Maria PLEȘCA

E-mail address: ioana.plesca@icas.ro

Abstract: *Vegetation occurring at the limits of forest massifs exhibits distinct structural, compositional, and site-related characteristics, giving rise to transition zones. These zones may occur either as natural ecotonal interfaces between different plant communities or as a consequence of land-use change, driven by the expansion of areas designated for non-forest purposes.*

The present study focuses on the Odobești Hill, a representative remnant of transition zones that were formerly more extensive. Located on the southern slope, on the left side of the Milcov Valley (looking downstream), as an extension of the massif surrounding Măgura Odobești Peak (Vrancea Subcarpathians), the study area displays a distinct vegetation gradient, with transition vegetation on slopes of up to 30° and thermophilous vegetation on steeper slopes.

*The phytocoenological relevés conducted within the study area confirmed the transitional nature of the vegetation, reflected in the gradual replacement of sessile oak (*Quercus petraea*) stands on lower slopes terrain by stands with thermophilous oaks on steeper slopes. Variation in site conditions is reflected in changes in floristic composition and phytocoenotic structure, highlighting the role of ecological factors in shaping plant community differentiation. Two distinct vegetation types were identified: one dominated by *Quercus petraea*, associated with thermophilous and xerophilous species such as *Fraxinus ornus*, *Tilia tomentosa*, and *Vincetoxicum hirundinaria*; and another dominated by *Quercus pubescens*, accompanied by species characteristic of thermophilous communities, including *Cotinus coggygria*, *Fraxinus ornus*, *Tanacetum corymbosum*, and *Quercus virgiliana*.*

Although the study area is not currently included within the ROSPA0075 Măgura Odobești Special Protection Area for birds (SPA), it supports high levels of biodiversity, conferring considerable conservation value. From a conservation perspective, the area is of particular importance both for avifauna protection, meeting the criteria for designation as a habitat conservation, thereby warranting an assessment of its potential inclusion in the Natura 2000 network as a Site of Community Importance (SCI).

Keywords: *plant communities, transition zones, phytocoenotic structure, thermophilous vegetation.*

Optimizing monitoring strategies for *Lamprodila festiva* L. (Buprestidae, Coleoptera): Insights from a two-year field study

Dragoş TOMA^{1,2} Ştefania TÖTÖS³ Iuliana VASIAN³ Flavius BĂLĂCENOIU²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Şirul Beethoven 1, 500123 Brasov, Romania;

³ Pheromone Production Center, “Raluca Ripan” Institute for Research in Chemistry, “Babes-Bolyai” University, 30 Fantanele Street, 400294 Cluj-Napoca, Romania.

Corresponding author: Dragoş TOMA

E-mail address: dragost93@gmail.com

Abstract: Recent studies have shown that the cypress jewel beetle, *Lamprodila festiva* L. (Buprestidae, Coleoptera), a species native to the Mediterranean region, has significantly expanded its range and become a major pest of ornamental Cupressaceae species in many urban areas and nurseries. Often, new outbreaks of this pest are identified based on damage caused by the larvae on host plants. However, this type of identification can be lethal for the host species, which often dries up partially or completely. Therefore, the development of effective detection and monitoring methods, as well as a better understanding of adult flight dynamics, is essential for pest management.

To monitor this pest of Cupressaceae species, a two-year field experiment was conducted in a nursery located near Bucharest, Romania, using sticky traps (coated on both sides with adhesive) in green and yellow colours, together with dispensers containing host volatile compounds. The trapping schemes were as follows: green unbaited, green baited, yellow unbaited and yellow baited.

A total of 2,231 *L. festiva* specimens were captured, revealing differences in trap performance among treatments. Females represented a very small proportion of the total catch (approximately 3%) in both study years. Green traps were the most effective in capturing adults, while the use of host volatile-based lures did not affect the mean number of individuals captured per trap.

Both sexes showed clear responses to trap colour, with males being more strongly attracted to green traps, while females exhibited a preference for yellow traps.

Under the climatic conditions of the study area, adult flight activity began at the end of May and lasted until the first decade of August. The main flight activity occurred in June in both years, while from late July onwards a marked decline in the mean number of adults captured per day was observed. The results contribute to a better understanding of *L. festiva* flight dynamics and support the use of green sticky traps as a practical monitoring tool in ornamental nurseries and urban plantings of Cupressaceae.

Keywords: *Lamprodila festiva*, visual cues, olfactory cues, host volatiles, sticky traps.

A genome-wide association analysis in natural European beech populations reveals genomic regions potentially involved in climate adaptation

Mila TOST^{1,2} Markus MÜLLER¹ Ourania GRIGORIADOU-ZORMPA¹
Selina WILHELM¹ Mehdi BEN TARGEM³ Henning WILDHAGEN⁴
Alexandru Lucian CURTU⁵ Timothy BEISSINGER⁶ Oliver GAILING¹

¹ Forest Genetics and Forest Tree Breeding, University of Göttingen, Buisenweg 2, 37077 Göttingen Germany;

² Center for Quantitative Genetics and Genomics, Aarhus University, C.F. Møllers Allé 3, 8000 Aarhus C, Denmark;

³ Thünen Institute of Forest Genetics, Sieker Landstraße 2, Grosshansdorf 22927, Germany;

⁴ Faculty of Resource Management, HAWK, Buisenweg 1a, 37077 Göttingen, Germany;

⁵ Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Şirul Beethoven 1, 500123 Brasov, Romania;

⁶ Heritable Agriculture, Mountain View, California, USA, 94040, USA.

Corresponding author: Mila TOST

E-mail address: mila.tost@qgg.au.dk

Abstract: *European beech is affected by climate change and a decrease in its growth is predicted for large parts of its distribution range. Therefore, knowledge about the genetic basis of environmental adaptation is of particular importance in this species. This study combined genome-wide association studies (GWAS) and landscape genomics to investigate beech populations in the South-Eastern Romanian Carpathians, spanning an altitudinal gradient characterized by varying temperature and precipitation regimes. Genotypic and phenotypic data were collected from approximately 100 adult beech trees per stand across five distinct locations. Several single nucleotide polymorphisms (SNPs) were significantly associated with environmental variables as well as with drought stress-related traits such as stomatal density or $\delta^{13}C$ as measure of intrinsic water use efficiency. Correlations between minor allele frequencies of SNPs and temperature-based variables were observed. This study highlights genomic regions potentially associated with drought resilience and climate adaptation in European beech.*

Keywords: *Fagus sylvatica*, drought, GWAS, genome.

Diversity of Ericaceae in the Northern Eastern Carpathian, from forest bioindicators to glacial relicts

Marian TRISCIUC¹ Constantin BUDESCU¹ Elena CIOCÎRLAN²

¹ National Institute for Research and Development in Forestry Marin Dracea, Calea Bucovinei street 73bis, 725100 Câmpulung Moldovenesc, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Marian TRISCIUC

E-mail address: mtrisciuc@yhaoo.com

Abstract: *The Ericaceae family represents a key structural component of montane and subalpine ecosystems in the northern Eastern Carpathians, where its species serve as indicators of habitat integrity, hydrological conditions, and the persistence of postglacial ecosystems. This study investigates the diversity, distribution, and ecological significance of Ericaceae species based on floristic surveys conducted between 2019 and 2024. Field surveys were conducted at ten representative localities distributed across nine orographic units, encompassing volcanic plateaus (Igniș, Gutâi, and Călimani) and crystalline massifs (Giumalău, Suhard, Rodnei, Maramureș, Obcina Mestecănișului, and Obcina Mare). Particular attention was given to the peatlands within these areas, including Tăul lui Dumitru and Tinovul Mic, recognized as important refugia for hygrophilous and boreal flora. A total of ten Ericaceae taxa were identified and mapped across six Natura 2000 habitat types (4030, 4060, 4070*, 7110*, 91D0*, and 9410). The recorded species were classified into three ecological groups: forest bioindicators (*Vaccinium myrtillus*, *V. vitis-idaea*, *Calluna vulgaris*, and *Monotropa hypopitys*), peatland-associated glacial relicts (*Andromeda polifolia* and *Vaccinium oxycoccos*), and species with extreme alpine adaptations (*Rhododendron myrtifolium*, *Kalmia procumbens*, *Empetrum nigrum*, and *V. uliginosum*). A notable outcome of this study is the reconfirmation of the circum-boreal glacial relict *Scheuchzeria palustris* L. in the Tăul lui Dumitru peatland (Igniș Mountains). The persistence of this nationally Red-listed species highlights the outstanding biogeographical significance and exceptional conservation value of the investigated peatland ecosystems, emphasizing their role as refugia for boreal flora and as priority habitats for biodiversity conservation in the Eastern Carpathians.*

Keywords: *Ericaceae, Eastern Carpathians, glacial relicts, Natura 2000 habitats, Scheuchzeria palustris, chorology, sozology, active bogs.*

Comparison of plant species diversity from herbaceous layer in four virgin and four managed spruce and mixed beech forests from Romania

Diana VASILE¹ Gabriel Ervin LAZĂR¹ Alexandra Mihaela ȘTEFAN¹ Virgil SCĂRLĂTESCU¹
Constantin DUMITRU-DOBRE¹ Gruică IENĂȘOIU¹ Any-Mary PETRIȚAN¹

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Diana VASILE

E-mail address: diana_vasile@ymail.com

Abstract: *An indication of the ecosystem well-being is considered to be the diversity. The greater the diversity of species of plants, birds, animals, the greater the biodiversity of an ecosystem.*

The studies has been conducted in four virgin and managed forest, respectively in a virgin mixed beech and silver fir forest and a managed forest of 90-100 years from Șinca; in a virgin mixed beech forest Slătioara and a nearby managed forest; in a spruce virgin forest from secular forest Giumalău and a managed forest Demăcușa; in a virgin mixed beech and sessile oak forest from the Natural Reserve Runcu-Groși and a nearby managed forest from UP I Conop.

The diversity of plant species was determined by calculating some phytocenotic indices: specific richness and coverage, average abundance-dominance values, Shannon diversity indices and inverse Simpson index (1/D), as well as the constancy of species for each forest category.

The phytogeographical structure of the species in the herbaceous layer was described with the help of geoelements, and the functional diversity of the studied forests was described with the help of bioforms.

The results highlight that managed forests generally present a higher specific richness and a more pronounced floristic heterogeneity, favoured by the reduction of canopy consistency and the increase in light availability at ground level. In contrast, virgin forests are characterized by a more stable floristic structure, a higher proportion of forest species, endemic or characteristic of natural habitats, and a higher ecological variability. Plant communities in virgin forests are more homogeneous and less influenced by anthropogenic disturbances, which is reflected by the presence of specific indicator species and a higher degree of naturalness.

Keywords: *diversity, phytocenotic indices, plant species, managed forest, virgin forest.*



Wildlife management

- POSTER PRESENTATIONS -

Biometric characterization of the stone marten (*Martes foina*) in selected areas of the lesser Poland Voivodeship, Southern Poland

Katarzyna CICHOSZ¹ Piotr DZIEKAN¹ Anna GIERA¹
Radosław CICHOSZ¹ Marek WAJDZIK¹

¹ University of Agriculture in Krakow, Aleja Mickiewicza 21, 31-120 Kraków, Poland.

Corresponding author: Katarzyna CICHOSZ

E-mail address: katarzyna.cichosz@protonmail.com

Abstract: *The stone marten (*Martes foina*) is a widely distributed carnivorous mammal species exhibiting considerable morphological variation influenced by factors such as sex, age, and environmental conditions. The aim of this study was to characterize the biometric traits of individuals collected in selected areas of the Lesser Poland Voivodeship, southern Poland, and to assess variation in selected morphometric and craniometric parameters between sexes and age classes.*

The study material consisted of stone martens collected by hunters as part of wildlife management practices. Biometric measurements were recorded for each individual and included body mass, body length, tail length, hind foot length, ear length, and chest circumference. Subsequently, skulls were prepared and subjected to craniometric measurements, including total skull length, condylobasal length, as well as braincase width and height.

The collected data were analysed using descriptive statistics, correlation analysis, and linear discriminant analysis. Comparisons were conducted defined age classes.

The results revealed significant differences between sexes, particularly with respect to body mass. Furthermore, younger individuals exhibited greater variability in the analysed traits compared to those belonging to older age class. The analyses demonstrated that age is an important factor influencing both biometric and craniometric characteristics of the studied individuals. These findings highlight the importance of incorporating population age structure into morphometric studies of the stone marten, as it may substantially affect the interpretation of observed inter-individual variation.

Keywords: *stone marten, biometric measurements, craniometric measurements.*

**Preliminary results on the analysis of the ecological and social impact of the reintroduction of bison
(*Bison bonasus* Linnaeus, 1758) into the Vânători-Neamț Natural Park**

Călin CORLECIUC¹ Gabriel DUDUMAN¹

¹ Faculty of Forestry, Ștefan cel Mare University of Suceava, 13 Universității Street, 720229 Suceava, Romania.

Corresponding author: Călin CORLECIUC

E-mail address: calincorleciuc10@gmail.com

Abstract: *Reintroduction of the European bison (*Bison bonasus* Linnaeus, 1758) is an important initiative to restore biodiversity and restore the functionality of forest ecosystems in Europe. In Romania, the expansion of free-ranging bison populations, especially in the Eastern Carpathians, requires a substantiated assessment of the interactions between this species and the forest environment. The lack of precise information on the influence of the bison on natural regeneration processes and the health of forest stands makes it difficult to harmonize the objectives of protecting the species with active forestry practices. This research aims to reduce these information gaps and scientifically substantiate the management of forests populated by bison. The research is carried out in the Vânători-Neamț Natural Park, i.e. the area with the longest experience in reintroducing free-ranging bison in Romania. The main objectives are to assess the current spatial distribution and population dynamics of bison in the study area and to quantify the impact of the species' presence on natural regeneration processes and on the structure of stands. The study adopts a mixed approach, correlating critical analysis of the literature with field investigations and data processing in geographic information systems (GIS). The dynamics and use of the habitat are analysed by capitalizing on GPS monitoring data, essential for identifying behavioural patterns, complemented by direct observations. A specific methodology was proposed to quantify the ecological effects, based on comparative research areas. Preliminary results have allowed the identification of correlations between the presence of bison and the dynamics of forest ecosystems, providing a quantitative estimate of the effects on forest regeneration and health. Through this research, we aim to highlight both the ecological benefits of the rewilding process and potential points of conflict with forest management activities.*

Keywords: *Bison bonasus, reintroducing free-ranging bison, biodiversity conservation, forest ecosystems, natural regeneration, Vânători-Neamț Natural Park.*

Carrying capacity of white-tailed deer and cattle with regenerative grazing in Mexico

Carlos Daniel NIEVES PRADO¹ Genaro OLMOS OROPEZA¹ Juan Antonio ENCINA DOMÍNGUEZ¹
Jorge PALACIO NÚÑEZ¹ Saúl Ugalde LEZAMA¹ Jorge Luis CASTRELLÓN MONTELONGO¹
Luis Antonio TARANGO ARÁMBULA¹

¹ Colegio de Postgraduados, Carretera Federal México-Texcoco Km. 36.5, Montecillo, 56264 Texcoco de Mora, Estado de México, Mexico.

Corresponding author: Carlos Daniel NIEVES PRADO

E-mail address: carlosnievesprado@gmail.com

Abstract: *Altitudinal strata influence vegetation composition and productivity, affecting the carrying capacity of ecosystems with wild and domestic ruminants. The objective was to evaluate the influence of the altitudinal gradient and two grazing systems (regenerative and rotational) on plant diversity, biomass production, and dietary overlap between cattle (*Bos taurus*) and white-tailed deer (*Odocoileus virginianus mexicanus*), as well as to determine the carrying capacity for both species.*

*The research was conducted at the “El Dorado” Demonstration Center Ranch in Tolimán, Querétaro. Stratified sampling was carried out at three altitudinal levels (lowland, slope, and plateau) to estimate tree, shrub, grass, and herbaceous biomass, in addition to species diversity and abundance. A micro histological catalogue was developed to analyse the botanical composition of the diet using fecal samples. A total of 177 plant species belonging to 35 families were recorded, with *Hechtia lepidophylla* and *Calliandra conferta* being the most abundant. The greatest diversity was found on the plateau, while herbaceous productivity was lower on the slope. Cattle under regenerative grazing consumed 63 species, those under rotational grazing 49, and white-tailed deer 63 species. The deer's diet showed greater diversity (Shannon-Wiener Index = 3.21) than that of cattle. Dietary overlap between cattle grazing systems was 70.86%, but less than the 22% overlap between cattle and deer, indicating differences in feeding habits. Carrying capacity was lower on the slope than in the other strata. However, overuse of the plateau could compromise deer forage resources. The adjustment of carrying capacity should consider the altitudinal stratum, the availability of forage and the botanical composition of the diet, promoting strategies that favour coexistence between livestock and wildlife.*

Keywords: *altitudinal strata, botanical composition, microhistological, diversity, animal unit.*



Forest engineering

- ORAL PRESENTATIONS -

Assessment of optimal road spacing for fire prevention in forested areas

Samet BILA¹ Zennure UÇAR² Ebru BILICI³
İnanç TAŞ⁴ Halit BÜYÜKSAKALLI⁵

¹ Faculty of Science, Eskisehir Technical University, Turkey;

² Faculty of Forestry, Izmir Katip Celebi University, Turkey;

³ Dereli Vocational School, Forestry Program, Giresun University, Turkey;

⁴ Faculty of Forestry, Bursa Technical University, Turkey;

⁵ Köyceğiz Vocational School, Forestry Program, Muğla Sıtkı Koçman University, Turkey.

Corresponding author: Zennure UÇAR

E-mail address: sametbila@eskisehir.edu.tr

Abstract: *Forest roads are vital infrastructure for sustainable forest management, with density typically determined by timber extraction needs. However, in fire-prone regions like Türkiye, where climate change is increasing wildfire frequency, roads are also critical for fire truck access and initial suppression efforts. This study aims to compare optimal forest road spacing and density for fire protection and timber production and to evaluate the effectiveness of the current network. The research will be conducted in the highly fire-sensitive Bodrum Forest District, Muğla. For timber production, optimal road spacing is calculated based on terrain slope and extraction methods, and for fire protection, optimal spacing is determined by the maximum hose reach of firefighting trucks positioned at the roadside, factoring in downhill, uphill, and flat terrain conditions to define the "fire-access-zone." Ultimately, the calculated road spacing and density values for timber production and fire protection will be compared against the study area's existing network. This comparison will show whether production-based road densities are sufficient for fire control. If gaps are identified, specific recommendations will be made to increase road density, enhance the reach of first-response crews, and ensure they can arrive within critical initial response windows to maximize fire containment success.*

Keywords: *forest roads, optimal road spacing, road density, forest fire protection structures.*

Wood measurement at the factory gate: A comparison study to evaluate the accuracy of a state-of-the-art digital truckload measurement system

Mirella ELIAS¹ Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mirella ELIAS

E-mail address: mirella.elias@unitbv.ro

Abstract: *Precise wood measurement and traceability are important for increasing supply chain efficiency and guaranteeing legal compliance in the forest industry. Digitalization has emerged as a transformative trend globally, offering significant potential to address current challenges associated with wood transportation. This study investigates the accuracy of the CIND's Timspec[®] system in measuring the roundwood solid volume at the factory gate. It compares the system's performance using data from a number of 1,300 truckloads, of which 1,292 were retained after outlier removal, and were compared to data sourced by manual measurements performed in the forest and Microtec[®] measurements carried out in the sawmill yard. The study followed a comprehensive methodological framework from outlier removal using the DBSCAN (Density-Based Spatial Clustering of Applications with Noise) algorithm to statistical analysis and heteroskedasticity tests to assess the reliability of the system. The results indicate a high degree of agreement among the used measurement systems. However, it highlights the differences in volume estimations produced by these systems, revealing that while the Timspec system tends to overestimate wood volumes by approximately 0.5 m³ overall, which is likely attributed to operational factors such as truckload gaps and moving speed, Microtec system underestimates by about 0.8 m³ overall, primarily due to observable factors such as bark loss during mechanical handling in the sawmill yard. Based on the findings, Timspec[®] system can be used to effectively check the conformity regarding the quantity of wood delivered to the processing industry by those in charge with tactical and strategic decision making, mainly due to speed, effectiveness, and coverage of measurements. Following improvements, this digital system may stand as an effective tool for the wood supply chain, allowing for fast and accurate estimates of the truckload-based wood deliveries, as well as automation of the measurement processes at the factory gate.*

Keywords: *transportation, supply chain, estimates, agreement, digital systems, traceability, decision making.*



Application of UAV photogrammetry for the surveying and sustainable redevelopment of a peri-urban forest

Evripidis FARMAKIS¹ Konstantinos FARMAKIS¹ Vasileios K. DROSOS²

¹ Department of Computing, University of Derby, United Kingdom;

² Laboratory of Forest Engineering Sciences and Surveying, Department of Forestry and Management of Environment and Natural Resources, School of Agricultural and Forestry Sciences, Democritus University of Thrace, Athen Pantazidou 193 Str. P.C. GR 68200 Orestiada, Greece.

Corresponding author: Konstantinos FARMAKIS

E-mail address: kf20060418@gmail.com

Abstract: *The use of Unmanned Aerial Vehicles (UAVs) for the acquisition and surveying of the Earth's surface, as well as for the mapping of vegetation, water resources, and other natural features, has become one of the most advanced and efficient technologies in modern surveying and geomatics. When combined with photogrammetric techniques, UAV-based surveying provides a highly accurate, cost-effective, and flexible approach for capturing detailed spatial information over extensive and difficult-to-access areas, overcoming many of the limitations associated with conventional surveying methods.*

The study area is the peri-urban forest in Northern Greece. The forest covers an area of approximately 832,000 m² and is predominantly composed of Pinus brutia, forming one of the area's most important natural ecosystems and recreational landscapes.

The aerial survey was conducted using the Trinity F9 unmanned aerial vehicle. Flight planning and data acquisition were performed using the QBase 3D for Trinity Drones applications, while the acquired imagery was processed in Pix4D to generate high-resolution photogrammetric products, including orthomosaics, digital surface models, and three-dimensional representations of the study area.

Based on the survey data produced and the resulting spatial models, a redevelopment proposal was developed for the peri-urban forest. The proposal focuses on the improvement of recreational facilities and outdoor activity areas while preserving the natural environment. The planning and design of the proposed interventions were carried out using AutoCAD software, providing a comprehensive framework for the sustainable enhancement of the forest's infrastructure and accessibility.

Keywords: AutoCAD software, Pix4D, Ground Control Points (GCPs), recreational facilities, three-dimensional survey model.

Applications of artificial intelligence in forest operations engineering research: A systematic review

Gabriel Osei FORKUO¹ Rodolfo PICCHIO²
Andrea Rosario PROTO³ Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Agricultural and Forest Sciences, Tuscia University, Via S. C. de Lellis, Viterbo, 01100, Italy;

³ Department of AGRARIA, Mediterranean University of Reggio Calabria, Feo di Vito snc, Reggio Calabria, 89122, Italy.

Corresponding author: Gabriel Osei FORKUO

E-mail address: gabriel.forkuo@unitbv.ro

Abstract: *This systematic review aims to map the current landscape of Artificial Intelligence (AI) applications within forest operations engineering research. It seeks to identify dominant AI techniques, common data sources, key problem domains, demonstrated strengths, persistent challenges, and future research trajectories by analysing a curated dataset of 173 scholarly papers, providing a comprehensive overview of AI's transformative role in this specific scientific topic.*

Current research demonstrates a significant surge in AI adoption in forest operations engineering, particularly since 2017. Machine learning (ML), especially deep learning methods like Convolutional Neural Networks (CNNs), frequently combined with remote sensing data from satellites, drones, and LiDAR, is pivotal. These tools are applied to optimize wood supply chains, assess ergonomic risks, and manage forest infrastructure by accurately extracting and updating road and skid trail networks. Furthermore, tasks such as tree species classification and 3D forest reconstruction are increasingly utilized in operational contexts, specifically to plan extraction trails in single-tree selection harvesting and to feed Decision Support Systems (DSS) for optimal harvesting system selection.

AI enables more accurate and efficient solutions to complex forest engineering challenges. However, practical implementation remains constrained by the "black box" nature of AI, poor model generalizability across diverse ecosystems, and heavy computational demands and large datasets required—which are often incompatible with a typical forest manager's workflows and budget. Future advancements must focus on explainable AI, external validation, benchmarking, and user-friendly, edge-computing systems to transition AI from theoretical research to practical, operational forestry tools. These will further enhance sustainable forest management and engineering practices, guiding impactful future research and application.

Keywords: *machine learning, deep learning, wood harvesting, forest operations, tree species classification, forest management, convolutional neural networks, road extraction.*

A GIS-based spatiotemporal analysis of wildfire dynamics: The Mediterranean region in Turkey

Muhittin İNAN¹ Mehmet Altuğ KÜÇÜKOSMANOĞLU²

¹ Faculty of Forestry, Istanbul University-Cerrahpaşa, 34473 Sarıyer, Istanbul, Turkey;

² Vocational School of Technical Sciences, Civil Defense and Firefighting Program, Istanbul University-Cerrahpaşa, 34500 Büyükçekmece, Istanbul, Turkey.

Corresponding author: Muhittin İNAN

E-mail address: inan@iuc.edu.tr

Abstract: Türkiye's Mediterranean Region is among the areas most frequently affected by wildfires due to high temperatures, pronounced precipitation seasonality, prolonged summer drought, and intense human activity. This study aims to identify the spatiotemporal patterns of concentration, persistence, and change in wildfire occurrences across the region using a Geographic Information Systems-based approach. Wildfire records for the 2020–2025 period were modelled using a Space–Time Cube constructed with 10 km spatial cells and three-month temporal intervals. Incremental Spatial Autocorrelation analysis was conducted to determine the spatial dependence of wildfire occurrences and identify an appropriate analysis distance, followed by Emerging Hot Spot Analysis based on the Getis–Ord G_i^* statistic. The results were evaluated according to the new, consecutive, persistent, intensifying, sporadic, and diminishing hot spot categories. WorldClim bioclimatic variables were used to investigate the relationships between the identified hot spot categories and long-term climatic conditions. Multicollinearity among the variables was assessed using correlation analysis and variance inflation factors. Differences among the hot spot categories with respect to the selected bioclimatic variables were evaluated using nonparametric statistical tests and effect-size measures. The findings showed that wildfire occurrences were concentrated along the coastal zone and within wildland–urban interface areas. While hot spots exhibited persistent patterns in some subregions, new or intermittent clusters emerged in others. The study examines not only where wildfires are concentrated but also the bioclimatic conditions associated with these spatial concentrations. Compared with conventional density maps, this integrated approach is expected to provide a more comprehensive understanding of the persistence, trajectories, and climatic context of wildfire dynamics. The findings are intended to contribute to the spatial prioritisation of wildfire prevention measures, the development of early warning systems, and the formulation of regional wildfire management plans.

Keywords: GIS, space–time cube, forest fire, wildland–urban interface.

Economics of poplar forest establishment operations: Exploring the effects of plot geometry, planting scheme and machine type to optimize the management practices

Victor Bogdan MITITELU¹ Andrea Rosario PROTO² Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of AGRARIA, Mediterranean University of Reggio Calabria, Feo di Vito snc, Reggio Calabria 89122, Italy.

Corresponding author: Stelian Alexandru BORZ

E-mail address: stelian.borz@unitbv.ro

Abstract: *Poplar plantations are intensive industrial systems requiring precise operational management to ensure a timely wood supply. Unlike conventional forestry, these plantations resemble agricultural systems where plot geometry is a driver of operational efficiency. This study explores the economic performance of mechanized pit-drilling, a critical step in poplar establishment, by analysing the interactions between machine size, plot geometry, and planting scheme. Operational data were collected in Romania using two tractor types (John Deere and Landini) equipped with Selvatici augers. Using GNSS tracking and video analysis, the study extracted operational parameters, which were then integrated into a plot-parameterization model covering 83,760 scenarios. Results indicate that cost efficiency is driven by an inverse power-law relationship with plot length and a discontinuous linear increase with plot width. Smaller, wider plots significantly increase unit costs due to a higher frequency of turning manoeuvres at headlands. The findings demonstrate clear economies of scale, as unit costs stabilize once plot sizes exceed 5–7 hectares, with marginal gains beyond 10 hectares. The John Deere unit consistently outperformed the Landini unit due to lower hourly operating costs and faster operation. Optimal economic and environmental performance is achieved in rectangular plots exceeding 10 hectares with narrow widths. By quantifying how spatial layouts and machine selection influence the environmental footprint and cost-efficiency, this study provides practical guidance for optimizing poplar establishment.*

Keywords: *poplar, machine-rate, plot geometry, economy of scale, cost efficiency.*

Performance of shallow and deep learning models in classifying mechanized pit drilling events based on GNSS input data

Victor Bogdan MITITELU¹ Lucian Mircea SASU² Gabriel Osei FORKUO¹
Andrea Rosario PROTO³ Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Mathematics and Computer Science, Faculty of Mathematics and Computer Science, Transilvania University of Brasov, 50 Iuliu Maniu street, 500091 Brașov, Romania;

³ Department of AGRARIA, Mediterranean University of Reggio Calabria, Feo di Vito snc, Reggio Calabria, 89122, Italy.

Corresponding author: Victor Bogdan MITITELU

E-mail address: victor.mititelu@unitbv.ro

Abstract: *Decision-making on spatial and temporal machine allocation is typically supported by dedicated time-and- motion studies, and long-term monitoring of forest operations is a promising way to improve our understanding of the performance of the machines used. Nevertheless, the level of resources and expertise required to conduct long-term studies often prevents such efforts aimed at collecting, processing and making use of the data. Most of the currently used machines come equipped with Global Navigation Satellite System (GNSS) dataloggers, which provide georeferenced, time-stamped position records, enabling digital data transfer and processing. Coupling deep learning with event-based labelled GNSS datasets may be a suitable tool for gathering information and automating the prediction effort on very large datasets, thereby offering access to long-term data for operational planning and machine allocation. To the best of our knowledge, this work pioneers the use of sequential deep learning on GNSS data for six-class event recognition in mechanized pit drilling operations. Our primary original contributions include: formulating a novel operational problem, curating one of the largest annotated GNSS datasets for this task, and providing a rigorous performance comparison of Temporal Convolutional Network (TCN), Long Short-Term Memory Network (LSTM), and Gated Recurrent Unit network (GRU) models using comparable hyperparameter-tuning and data-splitting protocols. The goal of this study was to evaluate the performance of sequential deep learning architectures in predicting operational events by considering six event classes that are relevant for mechanized pit-drilling operations using as a benchmark the performance of five classical shallow models. The study was based on a large annotated GNSS dataset containing >127,000 observations collected from two machines at a rate of 1 Hz. The eight models were each evaluated using a randomized hyperparameter search across 100 trials. The optimization process considered lookback windows ranging from 10 to 50 time steps and batch sizes of 16, 32, and 64 for the sequential deep learning architectures. Among all models, Random Forest achieved the highest test macro-averaged F1 score (0.7355), outperforming all three sequential deep*



learning architectures. Among the deep learning models, GRU yielded the highest test macro-averaged F1 (0.6976), followed by LSTM (macro-F1 = 0.6918) and TCN (macro- F1 = 0.6254). These findings indicate that, within the operational context of this study, well-tuned shallow classifiers - particularly tree-based models - match or exceed sequential deep learning architectures for automated activity recognition in pit drilling operations using GNSS-derived data.

Keywords: *activity recognition, operational events, poplar planting, forest operations, sequential deep learning, shallow models, classification, feature importance.*

Accuracy and time efficiency of a new app developed to source and map single tree data: A comparison to state-of-art lidar data collectors in terms of basal area estimates

Jenny Magaly MOROCHO TOAZA¹ Gianni PICCHI² Carla NATI² Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Institute of Bioeconomy, National Research Council, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Italy.

Corresponding author: Jenny Magaly MOROCHO TOAZA

E-mail address: jenny.morocho@unitbv.ro

Abstract: *The growing demand for effectiveness in forestry and the wood supply chain calls for the development of industry-specific digital tools. This study analysed the accuracy of plot-level basal area estimates and the time efficiency of a new mobile application - Tree Scanner (hereafter referred to as Platform 1), using measurements sourced from a FDJ Trion P1 Scanner PLS (personal laser scanner, hereafter referred to as Platform 2) as a reference, by considering 50 plots of 300 m² each characterized by a wide diversity in tree biometrics, age, species, and density. The results indicate that the accuracy levels achieved by the mobile application are comparable to those derived from professional Light Detection and Ranging (LiDAR) scanners (BIAS = 1.950 m²/ha, MAE = 2.292 m²/ha, and RMSE = 3.085 m²/ha). Furthermore, the average measurement time was significantly shorter with Platform 1 (11 s/tree) compared to Platform 2 (51 s/tree), not accounting for the additional processing time required to produce results with Platform 2. This research concludes that Platform 1 represents a promising tool for enhancing the efficiency of data sourcing for forest inventories, offering an alternative that can significantly improve the speed of acquiring crucial information for decision-making.*

Keywords: *smart technology, tree scanner, effectiveness, tree biometrics, agreement, polyfunctionality, LiDAR, big data.*



An overview of the efficiency of machinery used in extraction operations in Türkiye

Tolga OZTURK¹

¹ Department of Forest Engineering, Faculty of Forestry, Istanbul University-Cerrahpasa, 34473 Sarıyer, İstanbul, Türkiye.

Corresponding author: Tolga OZTURK

E-mail address: tozturk@iuc.edu.tr

Abstract: *Türkiye maintains a substantial forest coverage of 21.5 million hectares, representing 26.6% of its total territory. A significant portion - approximately 75% - of these forested areas is situated on challenging terrain with gradients exceeding 40%. Timber production in Türkiye has increased significantly in recent years. However, the amount of forest area burned in forest fires has also been quite high in recent years. The extraction the product from the burned forest areas also requires a considerable amount of labour. In Turkish forestry operations, extraction operation is accomplished through three primary methods: manual labour, animal-based transport, and mechanical systems. In timber production, prioritizing mechanization increases efficiency and speed of work. The mechanical systems are skidders, farm tractors, feller-bunchers and skylines. Farm tractors are widely used throughout the country in timber production operations. In addition, skylines are used in the mountainous regions of the country, such as the eastern Black Sea region. These skylines in used to Türkiye are Koller K300, URUS MIII, Gantner and Tajfun MOZ 500GR skylines. The machines used as skidder are MB Trac 900 and Tigercat machines. This research synthesizes findings from multiple studies conducted by researchers across Türkiye. Our assessment examines the productivity metrics, cost-benefit analysis, and practical implementation approaches of machines utilized in forest management operations. Furthermore, each study provided detailed operational parameters including transportation distances, product specifications, quantity metrics, terrain gradients, and volumetric data.*

Keywords: *productivity, skylines, feller-buncher, farm tractor, skidder.*

Dynamics of cognitive load, mental demand, and adaptation to repeated exposure in a virtual reality forest simulator

Ana Alexandra REYES ROBALINO¹ Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Ana Alexandra REYES ROBALINO

E-mail address: ana.reyes@unitbv.ro

Abstract: *With advances in technology, the use of virtual reality has increased significantly, especially in high-risk sectors, where it is a widely used tool for training and learning. In the forestry sector, simulations are used primarily to train operators in the operation of machinery, thereby avoiding the risks and costs associated with real-world practice. This article analyses the dynamics of cognitive load, mental demand, and user tolerance during repeated exposure to a virtual reality (VR) simulator. The study involved 10 trainees (8 men and 2 women) across 6 scenarios, 4 for harvester (basic and advanced gripping, felling), and 2 forwarder (loading and unloading). The evaluation methodology consisted of six questionnaires, 3 multiple-choice and 3 Likert scales. Various indicators were taken into account, including perceptions of mental effort, participant performance, quality of experience, tolerance, and pre- and post-training knowledge. Additionally, factors that may affect the user experience were considered, such as task complexity, duration of the scenario, exposure time, level of immersion, and interaction with elements of the virtual scenario. Finally, the article highlights the importance of understanding cognitive adaptation processes in virtual reality environments, as these directly influence the effectiveness of training programs and performance. The results provide evidence that can be useful for optimizing the design of immersive virtual environments, enhancing user experiences, and reducing cognitive load during the early stages of interaction, thereby contributing to improved learning and performance in simulated scenarios.*

Keywords: *virtual reality, cognitive load, human factors, mental demands.*

Application of Kroth method in the field of environmentally sustainable planning and development of the forest opening-up in Greece

Ioannis SISMANIDIS¹ Evripidis FARMAKIS²
Konstantinos FARMAKIS² Vasileios C. DROSOS¹

¹ Laboratory of Forest Engineering Sciences and Surveying, Department of Forestry and Management of Environment and Natural Resources, School of Agricultural and Forestry Sciences, Democritus University of Thrace, Athen Pantazidou 193 Str. P.C. GR 68200 Orestiada, Greece;

² Department of Computing, University of Derby, United Kingdom.

Corresponding author: Ioannis SISMANIDIS

E-mail address: sisman21@gmail.com

Abstract: *Forest exploitation and wood utilization represent a very important function within the framework of forest operations. The forest as a natural resource and depending on the given socio-economic conditions of a specific area can be subject to the following alternative uses:*

1. *To be conserved, in such a way that at some time in the future it can be utilized to produce tangible or intangible goods.*
2. *To be exploited to achieve a single purpose, e.g., wood production or improving the water balance in the area or as tourist attraction, etc.*
3. *To be utilized to achieve multiple goals.*

The more one moves from alternative 1 to alternative 3, the practice of forestry becomes more intensive. But in all three alternatives, of course, it is necessary to have a good and functional forest opening-up plan (e.g., road network), which either makes the forest accessible or allows the harvest of its products or serves both. The road density is or should be different for each of the above alternatives because the factors that influence it are different every time and affect it in a different way. A common requirement of all three cases is to achieve their goals at the minimum cost.

Aim of this paper is to investigate an optimum forest opening-up system for the Greek conditions regarding efficiency, effectiveness, ergonomics, employment, environmental protection with adaptation to European standards by applying the Kroth method.

Minimal environmental damage and minimal loggings costs are not necessarily incompatible objectives. In many cases both can be achieved with the same design. Road costs and environmental damage can be minimized by timber harvest designs that call for reduced road and landing density, and minimal earthwork. Lower skidding costs can be achieved by using mechanically efficient systems that have minimal impact on the environment.

Keywords: *road density, forest exploitation, improvement, forest operations, skidding, transportation.*

Digital identity: DPPs from single log to sawmill

Lukas STOPFER¹

¹ University of Freiburg, Friedrichstraße 39, 79098 Freiburg im Breisgau, Germany.

Corresponding author: Lukas STOPFER

E-mail address: lukas.stopfer@foresteng.uni-freiburg.de

Abstract: *Digitalizing forestry value chains is a prerequisite for efficiency, transparency, and traceability, yet this transition is hampered in practice by missing system integration between harvesting machinery, forwarding, transport logistics, and the wood-processing industry. This paper presents an integrated approach that establishes a unique, manipulation-resistant digital identity for each individual log across the entire process chain. The solution builds on the international StanForD harvesting-data standard, which structures single-stem parameters (diameter, length, volume, species) together with GPS and time stamps in a machine-independent format. During harvesting, a Logscam colour-spraying module mounted on the harvester head/forwarder automatically applies an alphanumeric identification code to the log's end-grain surface, physically anchoring the digital record to the material and linking single-stem, pile, and transport data. At the sawmill, camera-based systems automatically capture these markings and reconcile them with the corresponding digital records, enabling automated documentation of material flows, production batches, and quality data. Optional blockchain notarization of selected records strengthens data integrity and verifiability of the process history.*

The core innovation lies not in any single component, as harvesting data standards, physical marking, optical re-identification, and blockchain notarization already exist and are partly established in operational practice, but in combining these previously separate technologies into one interoperable end-to-end data chain. The system eliminates media discontinuities, creates the technical basis for Digital Product Passport (DPP)-ready wood products, supports standards-based data spaces, and addresses regulatory requirements such as the EUDR while enabling data-driven business models (e.g., carbon markets). For research and practice, the approach offers a field-tested, extensible process model that integrates into existing infrastructures and provides impetus for data-space-ready architectures, digital twins, and future piloting and standardization projects.

Keywords: *Digital Product Passport (DPP); traceability; StanForD; single-log; blockchain.*



Forest engineering

- POSTER PRESENTATIONS -

Site planning and design of a forest recreation area with outdoor recreation facilities and landscape improvements

Dimitra ALEXIOU¹ Evripidis FARMAKIS² Konstantinos FARMAKIS² Vasileios K. DROSOS¹

¹ Laboratory of Forest Engineering Sciences and Surveying, Department of Forestry and Management of Environment and Natural Resources, School of Agricultural and Forestry Sciences, Democritus University of Thrace, Athen Pantazidou 193 Str. P.C. GR 68200 Orestiada, Greece;

² Department of Computing, University of Derby, United Kingdom.

Corresponding author: Dimitra ALEXIOU

E-mail address: dimitraalexiou@plandevl.auth.gr

Abstract: *Recreation and tourism constitute important economic activities that contribute significantly to regional development and local economies. However, beyond their economic impact, they also influence the natural environment and the overall character of an area. In many countries, the rapid development of tourism, recreation, and forestry projects during recent decades has often resulted in environmental degradation, sometimes to such an extent that the long-term ecological costs outweigh the short-term economic benefits, regardless of their magnitude.*

An important form of sustainable economic use of natural landscapes is outdoor recreation, which refers to leisure activities carried out in relatively non-urban environments with natural characteristics and aims primarily at entertainment, relaxation, and the improvement of physical and mental well-being.

This paper examines the location of the proposed project and analyses the environmental conditions in which it will be implemented. It also addresses social, spatial planning, and management issues while proposing suitable infrastructure interventions that support both environmental protection and visitor accessibility.

From a scientific perspective, the study explores the rationale, benefits, and overall usefulness of the project. From a practical standpoint, it demonstrates how the proposed technical works can serve the local community while acting as an attraction for hikers, mountaineers, and visitors passing through the area. Finally, the thesis includes a detailed budget covering the construction process, estimated costs, and the materials required for the successful implementation of the project, providing a comprehensive framework for its development and future operation.

Keywords: *leisure activities, non-urban environments, sustainable economic use, table with benches, kiosk.*

Integrating forest operations into landscape-level planning: A GIS-AHP approach

Aurora BONAUDO¹ Francesco LATTERINI² Rodolfo PICCHIO¹ Rachele VENANZI¹

Luca COZZOLINO¹ Stelian Alexandru BORZ³ Eugenia PAUSELLI¹ Angela LO MONACO¹

¹ Department of Agricultural and Forest Sciences, University of Tuscia, DAFNE, Via San Camillo de Lellis, 01100 Viterbo, Italy;

² Institute of Dendrology, Polish Academy of Sciences, Parkowa 5, 62-035 Kórnik, Poland;

³ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Aurora BONAUDO

E-mail address: aurora.bonaudo@unitus.it

Abstract: *In Italy, decisions concerning logging systems are typically addressed only within executive-level harvesting plans, drawn up for individual cutting units immediately before harvesting takes place. Broader, landscape-scale forest management plans instead define silvicultural and management guidelines without engaging directly with operational aspects, leaving a gap between strategic and operational planning. This may limit the assessment of operational constraints at a wider spatial scale, especially in the Italian forests where production, environmental protection and social expectations must be balanced. This study proposes to bridge that gap by extending a Geographic Information System–Analytic Hierarchy Process (GIS-AHP) framework, previously applied at parcel level, to a wide-area, landscape scale, upstream of executive-level planning. The approach is applied to the Castelli Romani area, central Italy, where sweet chestnut coppice is the dominant management type. Six environmental and operational criteria are being considered: slope, terrain roughness, extraction distance, forest-road density, soil bearing capacity and extractable timber amount. These criteria are spatially processed and weighted to compare three extraction alternatives: forwarder, skidder equipped with winch and cable yarder. Data processing are currently ongoing, and results will be presented at the conference for the first time. The study aims to demonstrate the potential of GIS-AHP as a tool for integrating forest operations into landscape-level planning, upstream of and complementary to executive-level plans.*

Keywords: *landscape-level planning, timber extraction systems, GIS-AHP, Castanea sativa.*



Estimating the conversion factors for solid wood based on smartphone LiDAR in Thailand: A case study of high-value teak log piles in Thailand

Stelian Alexandru BORZ¹ Gabriel Osei FORKUO¹

Tomi KAAKKURIVAARA² Nopparat KAAKKURIVAARA²

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Forest Engineering, Faculty of Forestry, Kasetsart University, 50 Ngamwongwan Rd., Lat Yao, Chatuchak, Bangkok 10900, Thailand.

Corresponding author: Stelian Alexandru BORZ

E-mail address: stelian.borz@unitbv.ro

Abstract: *Accurate estimation of timber volume is critical for managing high value teak (*Tectona grandis*) supply chains, yet traditional manual measurements remain laborious and prone to human error. This study evaluated the use of a low-cost smartphone integrated LiDAR sensor combined with freeware point cloud processing to derive conversion factors between gross pile volume and solid wood content for teak roundwood in western Thailand. Forty heterogeneous log piles were scanned using an iPhone-based LiDAR system, and gross volumes were computed through 2.5D modelling in CloudCompare across progressively finer grid steps. Conversion factors were calculated using solid volumes provided by the Forest Industry Organization. Mean absolute error analysis showed that conversion factor estimates stabilized at the finest grid step (0.001 m), demonstrating the reliability of the LiDAR based workflow. Multiple linear regression revealed that log diameter, number of logs, and log length significantly influenced conversion factor variability (adjusted $R^2 = 0.54$, $p < 0.001$), with diameter exerting the strongest effect. Average conversion factors ranged from 0.593 to 0.825, reflecting substantial variation in pile structure and log geometry. The findings highlight the feasibility of using low-cost LiDAR technology to provide objective, repeatable, and efficient volume estimates for teak log piles, offering a practical alternative to conventional measurement methods widely used in timber auctions. Further refinement incorporating detailed geometric attributes and broader validation across species and stacking conditions could enhance predictive accuracy and support the development of fully digitized roundwood inventory systems.*

Keywords: *2.5D algorithm, grid step, LiDAR application, manual measurement, mean absolute error, smartphone-based LiDAR, log stack, volume.*



Timber losses associated with felling notch formation in a spruce stand affected by windthrow

Mihai CIOCIRLAN¹ Vasile Razvan CAMPU¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mihai CIOCIRLAN

E-mail address: mihai.ciocirlan@unitbv.ro

Abstract: *Windthrow events have been extensively studied in the scientific literature, particularly with regard to their ecological, social, and economic impacts (Brüchert & Gardiner, 2006; Ulanova, 2000), including effects on forest carbon balance. Timber losses is a less studied aspect related to windthrow. Within this context, the present study aims to quantify timber losses associated with felling notch formation. Field data were collected in a Norway spruce (*Picea abies* L.) stand affected by windthrow. Two independent methods were used to quantify wood losses from felling notches: the xylometric method and the 3D scanning method. The total felling notch losses were very similar in both methods: 0.13146 m³ (xylometry) and 0.12982 m³ (scanning).*

Keywords: *timber losses, windthrow, Picea abies.*



Design of a modular wooden bridge to support sustainable forest operations

Rudolf Alexandru DERCZENI¹ Gheorghe IGNEA¹ Marina Viorela MARCU¹
Eugen IORDACHE¹ Cezar SCRIBA¹ Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Rudolf Alexandru DERCZENI

E-mail address: derczeni@unitbv.ro

Abstract: *Finding ecological solutions for timber harvesting operations, particularly wood extraction, is essential to sustaining the multi-functional capacity of forest ecosystems. This study synthesizes the design and deployment frameworks of a modular wooden bridge engineered for crossing small watercourses within active logging sites. The bridge structure is specifically developed to meet the operational demands of articulated forestry skidders, which currently represent the predominant wood extraction option in Romania. Three standardized span lengths were investigated, for which timber decks reinforced with steel components were engineered based on structural strength assessments and the adoption of dimensional parameters that optimize practical manufacturing and assembly. The decks are designed against worst-case loading scenarios relative to the clearance and gross weight dimensions of fully laden forestry machinery. These solutions simultaneously optimize manufacturing, transport, installation, and dismantling efficiency. Consequently, this study provides a comprehensive technical blueprint, including relevant engineering specifications, component and assembly designs, installation, and operational guidelines, structured systematically.*

Keywords: *modular wooden bridge, skidding operations, stream crossing, structural engineering, sustainable timber harvesting, eco-efficient harvesting.*

Three-dimensional (3D) surveying of a forest trail using modern methods

Vasileios K. DROSOS¹ Evangelia POURNARA² Vasileios GIANNOULAS²
Evripidis FARMAKIS³ Konstantinos FARMAKIS³

¹ Laboratory of Forest Engineering Sciences and Surveying, Department of Forestry and Management of Environment and Natural Resources, Scholl of Agricultural and Forestry Sciences, Democritus University of Thrace, Athen Pantazidou 193 Str. P.C. GR 68200 Orestiada, Greece;

² School of Forestry and Natural Environment, Aristotle University of Thessaloniki, 54125, Thessaloniki, Greece;

³ Department of Computing, University of Derby, United Kingdom.

Corresponding author: Vasileios K. DROSOS

E-mail address: vdrosos@fmenr.duth.gr

Abstract: *Forest trails are an integral part of the forest, but also a means of transition to the forest environment, where it is not possible to go by any means of transport. We would say that their value is very important for the maintenance of man's relationship with nature. The surveying of forest trails, with the aim of inventorying the entire network and recording their coordinates in detail, is an important tool at the disposal of any researcher who is called upon to deal with the forest environment. Three-dimensional (3D) surveying is, if nothing else, the trend that has now become necessary in many areas of our lives. The 3D visualization of the surrounding space is the clearest way of visualizing the space even for a person who has no concept of the shape of the space. In particular, the results of the 3D visualization create the observer the feeling that he has visited space and the combination of the ability to measure the real dimensions of the space, which the topographical 3D surveying gives, is an excellent tool for a multitude of sciences. In this paper, a comparison will be made of forest trail surveying with two different means of three-dimensional topographical surveying, namely a fixed laser scanner and a portable (handheld) laser scanner, which allows 3D surveying on the move. The data obtained from the two surveys will be compared in terms of the individual factors of interest for forestry, while at the same time the advantages and disadvantages of using each survey instrument will be analysed, with a simultaneous evaluation of the suitability of each instrument given the recording time, but also in combination with the quality of the output.*

Keywords: *handheld laser scanner, fixed laser scanner, 3D visualization, topographical surveying.*

The influence of forest roads on tree development – A short review

Diana Elena DUMITRU¹ Elena Camelia MUȘAT¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Diana Elena DUMITRU

E-mail address: elena.dumitru@unitbv.ro

Abstract: *Forest roads represent an essential component of forest infrastructure, playing a significant role in providing access for silvicultural operations, timber harvesting, forest stand health monitoring, and necessary interventions for forest protection. In addition to their operational and economic benefits, their presence alters environmental conditions in their vicinity by influencing light regimes, temperature, moisture, air circulation, and soil physical properties. These modifications can impact the growth and development processes of trees situated near forest roads, leading to variations in key dendrometric parameters and the structural characteristics of forest stands.*

The objective of this paper was to conduct a short-review regarding the influence of forest roads on the development of trees located in their proximity. Accordingly, the preparation of this article was based on a literature review, specifically examining scientific articles from the Web of Science, Scopus, and Google Scholar databases, utilizing a series of keywords and their combinations, such as: "influence", "forest roads", "dendrometric characteristics", "base diameter", "height", "crown radius", "crown volume", "light", and "moisture".

Following the literature search in the databases, a series of articles were retrieved and subsequently screened based on title and abstract relevance, with those not presenting information of interest being excluded. Furthermore, the remaining articles were reviewed in full and grouped into categories according to the primary research directions addressed in each study. Based on these, the article was drafted, highlighting the most significant insights from the literature regarding the influence of forest roads on tree development.

Keywords: *forest roads, tree growth, dendrometric parameters, edge trees, impact.*



Postural classification by image embedding and transfer learning

Gabriel Osei FORKUO¹ Stelian Alexandru BORZ¹

Tomi KAAKKURIVAARA² Nopparat KAAKKURIVAARA²

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Forest Engineering, Faculty of Forestry, Kasetsart University, 50 Ngamwongwan Rd., Lat Yao, Chatuchak, Bangkok 10900, Thailand.

Corresponding author: Gabriel Osei FORKUO

E-mail address: gabriel.forkuo@unitbv.ro

Abstract: Forest operations often expose workers to physical risks, including posture-related disorders such as low back pain. The Ovako Working Posture Assessment System (OWAS) is widely used to assess postures in forest operations, but it requires expertise and significant resources. In this study, the use of image embedding and transfer learning was explored to automate OWAS classification. Over 5000 images from motor–manual cross-cutting operations were analysed using two models: Google’s Inception V3 and SqueezeNet, both of which were integrated with neural networks via the Orange Visual Programming platform. The image vectors were fed into a locally run neural network (a multilayer perceptron with backpropagation) that was optimized for architecture and hyperparameters. The models were trained and tested using 20-fold cross-validation on the Posture and Action datasets, achieving accuracies of 84% and 89%, respectively, with Inception V3 outperforming SqueezeNet on both datasets. Predictions on unseen images yielded lower accuracies (50%–60%), highlighting the challenge of domain differences. These results demonstrate the potential of embedding-based transfer learning to automate postural classification with high accuracy, thereby reducing the need for expertise and resources. However, further research is needed to improve performance on unseen data and to explore alternative classifiers and embedding methods for better representation.

Keywords: forest harvesting, ergonomics, posture, chainsaw, crosscutting, deep learning, neural network, accuracy.

Human and machine reliability in postural assessment of forest operations by OWAS method: Level of agreement and time resources

Gabriel Osei FORKUO¹ Marina Viorela MARCU¹ Nopparat KAAKKURIVAARA²

Tomi KAAKKURIVAARA² Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Forest Engineering, Faculty of Forestry, Kasetsart University, 50 Ngamwongwan Rd., Lad Yao, Chatuchak, Bangkok 10900, Thailand.

Corresponding author: Gabriel Osei FORKUO

E-mail address: gabriel.forkuo@unitbv.ro

Abstract: *In forest operations, traditional ergonomic studies have been carried out by assessing body posture manually, but such assessments may suffer in terms of efficiency and reliability. Advancements in machine learning provided the opportunity to overcome many of the limitations of the manual approach. This study evaluated the intra- and inter-reliability of postural assessments in manual and motor-manual forest operations using the Ovako Working Posture Analysing System (OWAS)—which is one of the most used methods in forest operations ergonomics—by considering the predictions of a deep learning model as reference data and the rating inputs of three raters done in two replicates, over 100 images. The results indicated moderate to almost perfect intra-rater agreement (Cohen’s kappa = 0.48–1.00) and slight to substantial agreement (Cohen’s kappa = 0.02–0.64) among human raters. Inter-rater agreement between pairwise human-model datasets ranged from poor to fair (Cohen’s kappa = –0.03–0.34) and from fair to moderate when integrating all the human ratings with those of the model (Fleiss’ kappa = 0.28–0.49). The deep learning (DL) model highly outperformed human raters in assessment speed, requiring just one second per image, which, on average, was 19 to 53 times faster compared to human ratings. These findings highlight the efficiency and potential of integrating DL algorithms into OWAS assessments, offering a rapid and resource-efficient alternative while maintaining comparable reliability. However, challenges remain regarding subjective interpretations of complex postures. Future research should focus on refining algorithm parameters, enhancing human rater training, and expanding annotated datasets to improve alignment between model outputs and human assessments, advancing postural assessments in forest operations.*

Keywords: wood harvesting, ergonomics, reliability, comparison, variability, human rater, machine learning, consistency.

Hydrodynamic modelling of flow wave propagation through energy dissipation systems

Alin Lucian MIHALACHE¹ Nicu Constantin TUDOSE¹ Mirabela MARIN¹
Cezar UNGUREAN¹ Valentina AGA^{1,2} Raul RADU¹ Maria Ilinca CHEVERESAN³
Mihai STANCU⁴ Nicoleta POPESCU⁴

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

³ Technical University of Civil Engineering Bucharest, 124 Lacul Tei Blvd, 020396, Bucharest, Romania;

⁴ DHI-SW Project S.R.L., 22 Nicolae G. Caramfil street, floor 1, ap. 104, 014143, 1st sector, Bucharest, Romania.

Corresponding author: Alin Lucian MIHALACHE

E-mail address: mihalache.alin.93@gmail.com

Abstract: *Besides their main components, torrent control structures are equipped with auxiliary components s designed to protect the downstream reach and guide flow along a controlled trajectory. Among these, the apron serves as the main downstream component for reducing channel erosion and dissipating hydraulic energy. The absence of this protective structure could trigger severe scour processes, which threaten the stability and functionality of hydraulic works. Consequently, energy dissipation systems, including baffle-block stilling basins and water cushions (stilling basins), are critical elements for ensuring the safety and efficiency of torrent control facilities.*

This study investigates the hydraulic performance of selected energy dissipation systems through the hydrodynamic modelling of flood wave propagation using the MIKE hydraulic modelling framework. A hypothetical transverse hydraulic structure equipped with a downstream apron was considered, and four distinct scenarios were analysed. The first two scenarios simulated the discharge of flood flow from a drop height of 2.0 m onto an apron fitted either with a baffle-block energy dissipator or a water cushion. The remaining scenarios examined the same dissipation systems under a higher drop height of 4.0 m.

A comparative analysis of the simulation results was conducted to assess the effectiveness of the investigated configurations in reducing flow velocities and dissipating hydraulic energy. These findings provide valuable insights into the hydraulic behaviour of alternative energy dissipation solutions and contribute to the optimization of the design and operation of torrent control structures under flood conditions. The results guide the selection of efficient protective measures to enhance structural stability and minimize erosion risks in downstream reaches.

Keywords: *torrent control structures, hydraulic performance, baffle-block energy dissipater, water cushion, flow velocities.*

Documenting the harvesting conditions in Romanian hybrid poplar forests: A study to characterize key input variables for economic, social and environmental assessment

Victor Bogdan MITITELU¹ Ilie Silvestru NUȚĂ² Marina Viorela MARCU¹
Eugen IORDACHE¹ Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Agricultural and Forestry Technologies, Faculty of Agronomy, University of Craiova, 13 Alexandru Ioan Cuza Street, 200585, Craiova, Romania.

Corresponding author: Marina Viorela MARCU

E-mail address: viorela.marcu@unitbv.ro

Abstract: *Poplar plantations are globally recognized for their potential to provide a wide range of ecosystem services. Strategic-level studies often shape the implemented practices and require key information to design better management approaches. Unfortunately, such data is often missing, it is based on written rules and regulations, or it is derived from coarse assessments. The goal of this study was to document such key information for hybrid poplar plantations in Romania. Based on features such as area, age, tree size, and extraction distance, documented from 100 representative pre-harvest inventories for thinning and clear-felling operations, we developed an augmented dataset using bootstrapping to characterize these figures, aiming to ensure their certainty and stability. Except for the extraction distance, which was similar across the two types of operations, the parameters differed significantly between them. Nevertheless, the mean values stabilized by the approach we used, and confidence intervals were established to inform future studies. Accordingly, a thinning operation was characterized by the following mean values: area – 3.12 ha, age – 14.62 years, number of extracted trees per hectare – 71, and average tree volume – 0.33 m³. Clear felling differed significantly in all these parameters (area – 1.76 ha, age – 32.35 years, number of trees per hectare – 306, and average tree volume – 2.55 m³). These findings are critical for developing future studies aimed at strategically assessing the economic, environmental, and social performance of poplar forests. Additionally, they serve as a benchmark for comparison with other international practices.*

Keywords: *poplar, descriptive factors, thinning, clear cutting, plantation life cycle.*

Bark – The shield of pine trees against forest fires

Ioan-Aurelian MITROFAN¹ Beata BORS¹ Elena-Camelia MUSAT¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Ioan-Aurelian MITROFAN

E-mail address: ioan.mitrofan@unitbv.ro

Abstract: *Forests are affected in most cases by the occurrence of biotic and abiotic factors. Forest fires are among these factors, being generated by a wide range of causes. This represents one of the most important imbalances that negatively influence forest ecosystems, generating substantial ecological and economic losses. Unlike deciduous trees, coniferous species have a high content of volatile substances and oils, which makes their wood more flammable. Although conifers are more prone to fires, there are species such as pine that have thicker bark, playing the role of a natural shield against high temperatures, insulating the cambium and vital tissues from the destructive effects of fire. The chemical composition, moisture content, structure and thickness of the bark determine the resistance and survival of trees in the face of a fire. Thus, the damage caused to stands by fires varies significantly, sometimes being fatal for the affected specimens. On the other hand, specimens that exceed the critical phase will have a development conditioned by the traumas suffered. Therefore, the intensity of the burn regulates their regeneration capacity, vulnerability and immunity to future environmental aggressions. Considering the above, the purpose of the work was also established, namely the evaluation of pine trees in terms of wood quality following a forest fire. The research was conducted during the second half of the spring of the current year in the compartment 104E, Recheș Forest Block, Production Unit II Vâlcele, Tălișoara Forest District, Covasna Forestry Directorate, in a 110-year-old pine stand affected by a surface fire in the summer of 2024. The methodology involved visual assessments, investigations using the Rinntech Arbotom sonic tomograph, and point measurements with the IML F-500 Resi resistograph. Visual analysis revealed that some trees were drying out, while the stumps were completely dry. The most severely affected trees were those located along the fire's path of spread. Results obtained via sonic tomography showed a wide range of wave velocities, directly correlating with the trees' health status. Interpretation of the data indicated that healthy trees predominated over those showing signs of degradation.*

Keywords: *burned wood, pine trees, tomogram, quality evaluation, forest fires, bark.*

Dimensional characteristics of 1-year-old willow rods from short-rotation coppices

George MUŞAT¹ Emilia-Adela MANEA SALCA¹

¹ Faculty of Furniture Design and Wood Engineering, Transilvania University of Brasov, University street 1, 500068, Brasov, Romania.

Corresponding author: George MUŞAT

E-mail address: george.musat@unitbv.ro

Abstract: *Short-rotation coppices have become highly important for ensuring an increased percentage of biomass, especially in the current context of continuously rising energy demands and a growing requirement for wood volume, whether for high-quality industrial processing assortments or lower economic value assortments. From this perspective, short-rotation willow crops can provide significant biomass volumes to meet domestic or institutional energy needs. Thus, the purpose of this paper is outlined, namely to evaluate the dimensional characteristics of willow rods in a one-year-old short-rotation coppice. Field data collection took place in Covasna County, where rectangular sample plots were established within the crop. In these plots, the rod diameter at the stool insertion point and the rod length were measured, and the number of rods per stool was recorded. Following field data processing, it was found that the number of rods varies within a fairly narrow interval, whereas the diameters present a wider range of variation.*

Keywords: *Salix, short rotation coppices, shoots, dimensions, biomass.*

Evaluation of forest road standards for long-log transportation: The case of the Istanbul University-Cerrahpaşa Research Forest

Tolga OZTURK¹ Muhittin INAN¹

¹ Faculty of Forestry, Istanbul University-Cerrahpaşa, 34473 Sarıyer, İstanbul, Turkey.

Corresponding author: Tolga OZTURK

E-mail address: tozturk@iuc.edu.tr

Abstract: *Forest roads are essential infrastructure for timber production, silvicultural operations, forest protection, and wildfire suppression. Planned forest road construction in Türkiye began in the 1930s and accelerated after the 1950s with the mechanization of timber production. Much of the existing forest road network was constructed according to the harvesting methods, transport vehicles, and timber dimensions of that period, generally with relatively low geometric standards, and remains in use today. These roads were shaped largely by the transport of short-length logs. However, long-log transportation by multi-axle logging trucks requires wider road platforms, larger horizontal curve radii, suitable turning and manoeuvring areas, pavement structures with adequate bearing capacity, and functional drainage facilities. Therefore, forest roads originally designed for short-log transportation should be reassessed for long-log transport. This study aims to examine existing forest roads in the Istanbul University-Cerrahpaşa Research Forest and evaluate their suitability for long-log transportation using multi-axle vehicles. Based on a literature review and case-study assessment, the study will compare the forest road standards applied in Türkiye with road conditions in the research area. Road width, longitudinal gradient, horizontal curve radius, turning and manoeuvring areas, pavement condition, and drainage structures will constitute the evaluation criteria. Forest structure, timber production volume, product dimensions, and vehicle requirements will be considered. Road sections will be classified as adequate, requiring limited improvement, or requiring geometric or structural upgrading. Recommendations will focus on widening roads, increasing curve radii, establishing manoeuvring areas, strengthening pavement structures, and improving drainage systems.*

Keywords: *forest road, timber production, truck, road standard, transportation.*

Soil compaction in final harvest operations using medium-sized cable skidders: results of an experimental study with controlled payloads

Madalina Florina PRESECAN¹ Gabriel Osei FORKUO¹ Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Madalina Florina PRESECAN

E-mail address: madalina_presecan@yahoo.com

Abstract: *Ground-based timber extraction is one of the most important harvesting methods used around the world, but it also causes negative effects on forest soils, to a degree that depends on machine mass, soil condition, and operational decisions. Skidding, in particular, may cause compaction in the deeper soil layers and soil mixing at the surface due to the way timber is extracted. Although several studies have examined soil compaction following timber extraction, few have been conducted under controlled measurement and comparison conditions; in addition, the heterogeneity of soil conditions makes it unlikely that existing results can be applied to the wide variety of conditions encountered in regular forest operations. In this study, a controlled experiment was set up to evaluate the effect of successive machine passes on soil compaction, measured as resistance to penetration, specifically accounting for loads typical to selective, final harvests. Measurements of resistance to penetration were taken at 10 control points and then at 10 points located on the wheel footprints after the first, third, fifth, and tenth loaded machine passes, while the machine payload remained constant and there was no ground slope. Variation in resistance to penetration from 0 to 80 cm depth was visually assessed, and the data were partitioned for comparison into 5 cm soil layers from the surface downward. While the first three passes caused significant but small changes in the upper soil layer, more important changes were found after the fifth and tenth machine passes. Five passes caused an increase in resistance to penetration of about 1.0 MPa, particularly in the first 15 cm of soil. After 10 machine passes, resistance to penetration increased further, particularly in the soil layer between 5 and 15 cm depth, although not statistically significant, increases in mean resistance to penetration were also found below the first 15–20 cm of soil. Under the specific conditions of this study (flat terrain, luvisol, full payload, autumn soil moisture), three loaded machine passes did not appear to cause persistent severe soil compaction. This finding should not be generalized without accounting for differences in soil moisture, terrain slope, and machine type. The results of this study are useful for planning, since the number of passes over the same skid trail may be controlled through a well-developed trail network and careful operational planning so as to avoid irreversible soil compaction.*

Keywords: *forest operations, payload control, penetration resistance, planning decisions, skidding, soil compaction, soil disturbance.*

Soil compaction induced by three timber extraction options: A controlled experiment on penetration resistance on silty-loamy soils

Madalina Florina PRESECAN¹ Gabriel Osei FORKUO¹ Stelian Alexandru BORZ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Madalina Florina PRESECAN

E-mail address: madalina_presecan@yahoo.com

Abstract: *Local effects of ground-based timber harvesting, such as soil compaction, are often important for forest management and resilience of forests. One way to evaluate the compaction of the forest soils is by the penetration resistance. Most often, however, the control over the weight of the means used to extract the wood is difficult to maintain, influencing therefore the outcomes of the comparison studies. In this study, a controlled experiment was set up to see how the penetration resistance is affected by the number of passes of three wood extraction methods. A first objective of the study was to characterize the undisturbed soils by the mean values of penetration resistance along the profile. The second objective of the study was to compare the changes in penetration resistance induced by the number of passes along the soil profile. The extraction means were selected based on their typical use in flat-land operations, namely horse logging, skidding and forwarding, and the weight of their loads was determined before the experiment; then, each one was tested in a different area by operating in a closed loop on flat land, with 15 passes over the respective testing area. Penetration resistance was sampled up to 80 cm in depth in 10 control points, as well as in 10 sampling points over the wheels' footprints. Ten samples were taken on the latter after the first, second, third, fourth, fifth, tenth and fifteenth passes, and comparisons were set up based on natural changing points in penetration resistance found in the control areas. The comparisons found significant differences by an increase in penetration resistance for all three extraction means, and there was a difference by an order of magnitude and depth; horse logging affected it the least and forwarding the most in magnitude, while skidding seemed to produce more significant changes in depth. However, the magnitude and depth of these changes may have depended on the characteristics of the soils from the test areas, and it cannot be concluded that the found levels of penetration resistance will affect the trees located nearby the experimental trails. The problem of soil compaction should be further examined by dedicated studies, given the variability in soil characteristics and diversity in means used to extract timber.*

Keywords: *soil layers, effects, controlled weight, horse logging, skidding, forwarding.*

Distance to forest roads and the amount of forest residues – A case study

Ionuț-Cătălin ROTARU¹ Elena Camelia MUȘAT¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Elena Camelia MUȘAT

E-mail address: elena.musat@unitbv.ro

Abstract: *The forest is recognized as one of the most important terrestrial ecosystems, playing an ecological, economic, as well as a social role. At the same time, the forest constitutes an important resource of raw materials, especially wood, which is used in multiple fields.*

Forest biomass is gaining increasing importance as a source of renewable energy. It includes harvested wood as well as forest residues left in the woods following silvicultural operations, such as branches, leaves, treetops, and other organic matter.

An important aspect of biomass management is its accessibility, which is directly influenced by the forest road network. The distance to forest roads plays a crucial role in the feasibility of collecting and utilizing combustible materials, affecting both logging costs and the actual recoverable quantities. Consequently, the distribution of materials within the forest is uneven, being determined by a series of factors such as stand structure, stand age, and the silvicultural interventions applied. Changes in the quantity and type of forest residues may occur near forest roads due to the higher intensity of anthropogenic activities.

In this context, the present study aims to analyse the relationship between the distance to forest roads and the number of combustible materials in the forest. The objective is to highlight their potential for energy recovery and to contribute to the optimization of logging activities and the sustainable management of forest resources. The research was conducted within the Olt Forestry Directorate, Vulturești Forest District, Production Unit (U.P.) IV Cungea, in forest stands located near the FE012 Valea Cerbu–Dienci forest road. The research methodology involved establishing sample plots at various distances from the forest road, followed by the collection, differentiation, and evaluation of the vegetal combustible materials present within these plots.

The results obtained highlighted variations in the quantities of combustible materials in relation to the characteristics of the analysed stands. The study emphasizes the importance of forest accessibility in the process of collecting and recovering energy from the biomass resulting from the forest.

Keywords: *biomass, forest residues, harvesting residues, forest fires, forest roads.*

Can the Arboreal Tree app minimize timber volume errors and improve SUMAL accuracy?

Alexandra Florina STAIKU¹ Maria Magdalena VASILESCU¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Alexandra Florina STAIKU

E-mail address: alexandra.staicu@unitbv.ro

Abstract: *Accurately determining the volume of standing timber prior to harvesting is essential for sustainable and transparent forest management. The present study addresses a critical structural vulnerability in Romanian forestry practice, namely the generation of the Timber Valuation Report (APV). The research focuses on the discrepancies between volumes estimated using traditional methods in APV preparation and those determined through individual digital tree measurements. The objective of the present study is to provide an answer to the following question: To what extent can digital measurements taken with the Arboreal Tree app reduce errors in timber volume estimation and increase the accuracy of the SUMAL system? The research hypothesis is that comprehensive measurement of trees' biometric parameters (diameter and height) using digital technologies yields more accurate volume values than traditional methods. The present experimental study was conducted using data from the Brasov Forest District for the Bucegi Management Unit, compartment 55. The compartment under discussion covers an area of 0.90 hectares, and the applied treatment was clear cutting, with an inventory date of 4 October 2024. The analysed stand included a total of 230 trees, with an initial gross volume recorded in the Forest Management Plan of 330.12 m³. The comparative study focused exclusively on coniferous species, primarily spruce (*Picea abies*) and fir (*Abies alba*), of all the trees inventoried in the APV. The objective of the analysis was to compare values obtained using traditional inventory methods with those resulting from individual digital measurements taken using the Arboreal Tree app, which is based on LiDAR technology. For the analysed lot, the total volume recorded in the APV was 330.12 m³. Following a thorough inspection of the timber by the Brasov Forest District, the volume was determined to be 343.53 m³. Consequently, a request was submitted to the Forest Guard for approval of the additional 13.41 m³. The Arboreal Tree application has been utilised for the analysis of coniferous trees, and it has been demonstrated that the digital measurement of specific dendrometric parameters can facilitate the identification of differences that result in substantial deviations in total volume at the lot level. This study on coniferous trees in the analysed stand demonstrates the necessity to enhance current methodologies for determining timber volume by integrating digital technologies. The use of the Arboreal Tree application for the measurement of biometric parameters in coniferous trees offers a contemporary approach to enhance the precision of forest inventories, marking a prospective trajectory for the advancement of the SUMAL system.*

Keywords: *timber volume estimation, digital forestry, LiDAR, dendrometric measurements, Arboreal Tree, SUMAL, forest inventory.*



The impact of mechanized timber extraction on soil: A short review

George Iulian STĂNCIULESCU¹ Elena Camelia MUȘAT¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: George Iulian STĂNCIULESCU

E-mail address: george.stanciulescu@unitbv.ro

Abstract: *Timber extraction is an important stage in the technological process through which timber is concentrated and transported, in most cases, to a permanent transportation route, such as forest roads. This timber transportation is carried out mechanically by using skidders, forwarders, or agricultural tractors adapted for forestry use. However, the use of mechanized equipment produces a series of impacts on forest soils and on the soils of logging trails, affecting certain physical soil characteristics, such as density, moisture, and the degree of compaction. Consequently, the aim of this paper was to prepare a short review regarding the influence of mechanized timber extraction on soil characteristics. Thus, the preparation of the paper was based on the review of the scientific literature, more specifically on scientific articles indexed in the Web of Science, Scopus, and Google Scholar databases, using a series of keywords and combinations thereof, namely: "impact", "forest roads", "logging trails", "physical soil characteristics", "skidders", "forwarders", "compaction", "timber extraction", "density", and "soil".*

Following the literature search in these databases, a series of articles were obtained, which were subsequently selected according to their relevance based on the title and abstract, while those that did not present information of interest were excluded. The remaining articles have been fully read and grouped into categories according to the main topics addressed. Based on these studies, the present paper was prepared, highlighting the most important aspects reported in the scientific literature regarding the influence of mechanized timber extraction on the physical properties of soils in harvesting sites and on logging trails.

Keywords: *timber extraction, skidder, soil impact, moisture, soil compaction.*

Life Cycle Assessment of hydrotechnical structures: An evaluation based on cumulative energy demand and global warming potential

Nicu Constantin TUDOSE¹ Mirabela MARIN¹

Cezar UNGUREAN¹ Alin Lucian MIHALACHE¹

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Nicu Constantin TUDOSE

E-mail address: tudose@icas.ro

Abstract: *Climate change significantly increases the frequency and intensity of extreme weather events—such as floods, droughts, and landslides—and has driven overall dynamics to rise by over 60% in recent decades. Furthermore, climate projections for the 2050–2100 period indicate that major flood frequency and magnitude will increase by 10% and 18%, respectively. In this context, hydraulic structures play a vital role in mitigating torrential floods, controlling soil erosion, and minimizing socio-economic damages. Aligned with modern sustainable development frameworks, the hydraulic construction sector must quantify its ecological footprint using Life Cycle Assessment (LCA). This study evaluates the cradle-to-grave environmental impacts of two structural alternatives implemented in the Valea Popii river basin (Prahova County, Romania): a conventional concrete dam (P1) and a stone masonry dam constructed with cement mortar (P2). Adhering to ISO 14040/14044 principles, the Cumulative Energy Demand (CED) and Global Warming Potential GWP100 indicators were modelled using openLCA (v2.6.1) and the Ecoinvent 3.12 database (allocation cutoff system). The results demonstrate that the environmental performance of torrent control structures depends heavily on material composition, industrial processing, and logistics. Overall, P1 yielded lower environmental impacts, whereas P2 exhibited a 7.2% higher GWP100 and a 35.0% higher CED. However, sensitivity analysis reveals that the optimal choice shifts based on transport parameters: for GWP100, stone masonry becomes more favourable than conventional concrete if rock hauling distances are reduced by at least 25%, whereas for CED, maximum transport reduction is mandatory. These findings serve as a decision-support tool for technical decisions based on environmental criteria.*

Keywords: *Life Cycle Assessment, torrent control structures, global warming potential, cumulative energy demand, environmental impacts*

Geomatics for riverbed morphometry: Efficiency in data collection and interpretation

Cezar UNGUREAN¹ Mirabela MARIN¹
Nicu Constantin TUDOSE¹ Alin Lucian MIHALACHE¹

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Cezar UNGUREAN

E-mail address: cezaru.ungurean@icas.ro

Abstract: *Design of hydrotechnical structures require accurate local data sets on runoff dynamics (flows, hydrographs), channel morphometry, but also regarding the physical properties of the riverbed (roughness, stability and permeability of the banks and the thalweg). This study aims to quantify and compare the performance of two riverbed morphometry data collection methods: traditional topographic measurement using a TOPCON ES100 total station and mobile laser scanning using a GeoSLAM ZEB-REVO LiDAR. The measurements and scans were performed on riverbeds from a mountainous, predominantly forested watershed from central Romania. Based on the measurements/scans, georeferenced situation plans were produced, incorporating elevations and structural details of the riverbed areas (such as roads, torrential control works, bridges), alongside longitudinal profiles and cross-sections at characteristic points. Processing the recorded data generated Digital Elevation Models (DEMs), which were subsequently georeferenced using features identified on satellite imagery. Finally, the performance of the two data collection methods was quantified through a comparative analysis of point elevations and cross-sectional areas. Our findings suggest that while total station surveys deliver high precision, they require extensive fieldwork and are highly dependent on operator experience. Conversely, LiDAR scanning significantly reduces field time but demands expensive equipment and high-performance computing for data processing. For engineering design works that require localized, high-precision data, traditional topographic surveying via total station (such as closed-loop traversing) remains the recommended method for capturing riverbed morphometry.*

Keywords: *riverbed morphometry, data collection, torrential control works, forested watershed, LiDAR scanning, TOPCON measurements.*



Forest economics, policy and regulation

- ORAL PRESENTATIONS -

Assessment of the perception and acceptability of local level stakeholders on rewilding options in five European case studies

Laura BOURIAUD¹ Liviu NICHIFOREL¹ Dorin PĂLIE¹ Ionut BALABAȘCIUC¹

¹ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania.

Corresponding author: Laura BOURIAUD

E-mail address: bouriaud@usv.ro

Abstract: *Over the past decade, rewilding has become a mainstream approach in nature conservation and is increasingly gaining traction in policy at the national and international level (Carver et al., 2025). The study aims to assess public perceptions on two specific rewilding strategies, as defined in the WILDCARD project: proforestation, defined as the cessation of forest management to allow spontaneous forest development, and natural afforestation of abandoned land, defined as the recovery of shrubs and/or trees on cleared lands through spontaneous regrowth following the cessation of previous disturbance or land use.*

Local-level stakeholder perceptions were assessed through semi-structured interviews with 52 stakeholders across five case studies with different rewilding approaches: Belgium (Brabantse Wouden), Bulgaria (Rhodopes), Czechia (Šumava Mountains), Italy (Friuli-Venezia-Giulia) and Romania (Natural Park Vânători Neamț).

The results demonstrated that perceptions of rewilding are highly context-dependent. Acceptability is strongly shaped by local social, economic, and historical conditions rather than by universal attitudes. Stakeholders' views reflect deep-seated concerns about direct impacts on livelihoods and cultural identity. Proforestation generally high received high level of support for this strategy, primarily driven by perceived ecological benefits, particularly biodiversity enhancement. However, this support was conditional; stakeholders expressed strong opposition to uncontrolled expansion of forests beyond established protected areas. Key concerns included wildfire risk, bark beetle infestations (notably in the Czech Republic and Romania), and the loss of income from commercial forestry. Natural afforestation of abandoned agricultural land elicited greater scepticism and more localized concerns. Negative perceptions were most commonly linked to fire and security risks, loss of agricultural income and subsidies, and adverse impacts on local aesthetics associated with traditional cultural landscapes and perception of rural decline. Acceptability was higher in regions where land abandonment is already well established or where rewilding could be clearly linked to benefits such as tourism development or enhanced nature conservation.

The findings reveal substantial differences in perceptions and acceptability of rewilding strategies — particularly natural afforestation and proforestation — across European citizens and stakeholder groups. These divergences indicate that successful rewilding implementation requires a multi-level and context-sensitive approach.

Keywords: *rewilding, proforestation, biodiversity, conflicts, landscape, cultural heritage, wildfire, wildlife, afforestation.*

Local development programs for viable and sustainable development of mountainous area

Konstantinos FARMAKIS¹ Evripidis FARMAKIS¹

Nikolaos KARAGIORAS² Vasileios C. DROSOS²

¹ Department of Computing, University of Derby, United Kingdom;

² Laboratory of Forest Engineering Sciences and Surveying, Department of Forestry and Management of Environment and Natural Resources, Scholl of Agricultural and Forestry Sciences, Democritus University of Thrace, Athen Pantazidou 193 Str. P.C. GR 68200 Orestiada, Greece.

Corresponding author: Konstantinos FARMAKIS

E-mail address: kf20060418@gmail.com

Abstract: *The abandonment and depopulation of mountainous areas in favour of coastal and urban areas are additional effects of urbanisation and the dominance of tertiary sector activities in Greece.*

The objective of this paper is to achieve the integrated development of a mountainous region with the help of strategic directions and comprehensive measures in relation to spatial planning policies. Also, the submission of proposals concerning individualized production activities, according to a correct typology, which characterizes the differentiation of regional problems, needs and prospects.

Certain land policy measures for the integrated development of mountainous areas are proposed, the aims of which are to maximise the potential of these areas in agriculture, stockbreeding and forestry. This can be achieved with the help of the proper technology, but in dialectic harmony with the sensitive and invaluable natural and cultural environment of Greece.

The study finally sets some strategic directions for the integrated development of mountainous areas through specific spatial planning; the attraction of new investment, suited to the natural and cultural environment; the financial promotion of the public infrastructure, strengthening the polycentric structure within the country and achieving a better connectivity between the regions through an interregional road network; the promotion of cultural heritage and of the protected natural environment; and the establishment of new management bodies for mountainous areas.

The sustainable development of the mountainous areas of Greece targets regional and social cohesion in the framework of the following strategic targets:

- *Integrated development of mountains and mountainous areas;*
- *Adjustment of the economy of mountainous areas in line with European and international trends;*
- *Strengthening of the transportation system in mountainous areas by improving access to the basic infrastructure system;*
- *Protection and upgrading of the natural ecosystems.*

Keywords: *zoning, sustainable development, exploitation, mountainous areas.*

Beyond ownership restoration: The evolution of non-state forest owner agency in Romania

Mihai-Ionut HAPA^{1,2} Mirabela MARIN¹ Nicu Constantin TUDOSE¹

Cezar UNGUREAN¹ Bogdan POPA²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mihai-Ionut HAPA

E-mail address: ionutmihaihapa@gmail.com

Abstract: *Forest restitution in post-socialist countries restores property rights, but ownership does not necessarily translate into greater agency. This study examines how the agency of non-state forest owners evolved in Romania from 1881 to 2025, using the country's forest restitution process as a longitudinal case of institutional and governance change.*

The research combines historical analysis, documentary analysis of forest legislation and institutional arrangements, and an expert survey to examine the relationship between ownership restoration, owner agency, and participation opportunities across six governance eras. Rather than treating these dimensions as parallel outcomes of institutional reform, the study analyses their distinct trajectories and the ways in which they interact over time.

The findings show that ownership, agency, and participation evolved asynchronously. Although post-1991 restitution successfully restored private and community ownership, owners' capacity to influence forest management and governance remains constrained by regulatory requirements, administrative procedures, and institutional arrangements. Participation opportunities have expanded through the development of representative organisations and consultative mechanisms, but this has not been accompanied by a comparable increase in owner agency. Experts and stakeholders still perceive their decision-making autonomy as highly limited and identify the current institutional framework as a constraint on the effective exercise of ownership rights.

The study argues that owner agency is a distinct dimension of forest governance rather than an automatic consequence of property rights. By distinguishing ownership, agency, and participation, it offers a conceptual framework for understanding governance change.

Keywords: *owner agency, forest governance, non-state forest owners, forest restitution, property rights,; participation.*

Understanding climate adaptation through qualitative interaction analysis: Evidence from Romanian forest practitioner

Mihai-Ionut HAPA^{1,2} Mirabela MARIN¹ Nicu Constantin TUDOSE¹
Cezar UNGUREAN¹ Bogdan POPA²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mihai-Ionut HAPA

E-mail address: ionutmihaihapa@gmail.com

Abstract: *Growing climate change pressure on forest ecosystems highlights the need for governance frameworks that support adaptive and resilient forest management. Although European and national forest policies increasingly promote climate-smart forestry, their implementation ultimately depends on how forest practitioners understand climate-related challenges, evaluate management responses and perceive institutional support. Examining these perspectives is essential for developing policy instruments that are operationally feasible and responsive to local forest conditions.*

As part of the OptFor-EU project, this study investigated Romanian forest practitioners' perspectives on climate change, forest ecosystem services and adaptive forest management through fourteen semi-structured interviews conducted within the Romanian Case Study Area. Using an iterative qualitative approach in MAXQDA, interview transcripts were analysed to identify relationships among ecological, socio-economic and governance themes, resulting in over 1,100 validated coded segments covering governance, policy implementation, institutional effectiveness, socio-economic factors, climate impacts and forest ecosystem services.

The analysis shows that climate adaptation is perceived as an interconnected process linking ecological change, forest management decisions and governance mechanisms. Strong relationships emerged between drought stress, rising temperatures and regulating ecosystem services, particularly through their effects on wood production, biodiversity and natural resources. Regeneration practices, adaptive silvicultural interventions and soil conservation were identified as key adaptation measures, while legislative complexity, institutional capacity, financial support and inter-institutional cooperation remained major implementation barriers. Overall, the study demonstrates how qualitative interview analysis can reveal interactions between climate risks, management responses and institutional factors, providing evidence to support more effective climate-oriented forest policies and strengthen the long-term resilience of Romanian forest.

Keywords: *forest governance, climate adaptation, qualitative analysis, MAXQDA, forest policy, Romania.*

Forest certification for sustainable forest management and rural livelihoods: Evidence from Rwanda

Emelyne Ineza KAYISIRE¹ Aureliu Florin HĂLĂLIȘAN¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Emelyne Ineza KAYISIRE

E-mail address: inezakayisire@gmail.com

Abstract: *Forest certification is an important tool for promoting sustainable forest management (SFM) by improving environmental, social, and economic performance. In Rwanda, it has the potential to strengthen forest governance while supporting rural livelihoods. This study evaluated the contribution of forest certification to sustainable forest management and rural livelihoods using data collected from the Rwanda Forestry Authority (RFA), an FSC-certified forest company, and local communities. A mixed-methods approach was applied, combining structured questionnaires with a review of scientific literature and policy documents. The results showed that forest certification contributes to improved biodiversity conservation, forest monitoring, legal compliance, and responsible forest management. It also enhances institutional credibility and governance. However, its socioeconomic benefits remain limited due to low community awareness, unequal benefit-sharing, high certification costs, and weak market incentives. The study concludes that forest certification can effectively support sustainable forest management in Rwanda when integrated with community participation, supportive policies, and equitable benefit-sharing mechanisms. These findings provide practical recommendations for policymakers, forest managers, and certification bodies seeking to improve sustainable forest management and rural livelihoods.*

Keywords: *forest certification, sustainable forest management, rural livelihoods, forest governance, Rwanda.*



Forest Stewardship Council Forest Certification Impacts: The case of Lithuania

Julija KONSTANTINAVICIENE¹ Aidas PIVORIUNAS¹ Benas ŠILINSKAS¹

¹ Lithuanian Research Centre for Agriculture and Forestry, Institute of Forestry, FSC Lithuania.

Corresponding author: Julija KONSTANTINAVICIENE

E-mail address: julija.konstantinaviciene@lammc.lt

Abstract: *The new Forestry Strategy and Green Deal rely on sustainable forest management. Forest certification helps advance this objective. This study aimed to assess the social, ecological, and economic impacts of forest certification on forest management. The study presents an assessment methodology for the impact of the Forest Stewardship Council (FSC) standard's application, and, based on it, a case study on forest management practices in Lithuania. This study helps clarify what constitutes impact in the context of forest certification and how it can be operationalised using indicators. The findings show that the major difficulties encountered were related to social factors regarding the FSC standard: the level of knowledge of employees and contractors of forest management organisations about the requirements of the forest stewardship standard, and community relations were not in all cases sufficient. The economic impact of the standard is positive, encouraging the use of local forest-related services and indicating that the price of FSC-certified wood is higher than that of non-certified wood. The study contributes to the scientific literature by proposing an indicator-based framework for assessing FSC implementation and by situating the Lithuanian case within the broader European context of forest certification governance.*

Keywords: *assessment, certification, forest, impact, indicators, stewardship.*



Forest restoration decision support system for Republic of Moldova

Liviu NICHIFOREL¹ Ionuț BARNOAIEA¹ Ciprian PALAGHIANU¹

Vasile-Cosmin COȘOFREȚ¹ Emilian STOICA¹ Bogdan POPA²

¹ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania;

² Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Bogdan POPA

E-mail address: popa.bogdan@unitbv.ro

Abstract: *The main objective of the Forest Restoration Decision Support System is to identify, map and prioritize the areas where restoration — particularly through the natural expansion of forests — generates the greatest ecological and socio-economic benefits in the Republic of Moldova. This analysis supports the National Forest Extension and Rehabilitation Programme of Moldova 2023–2032, contributes to meeting national and EU biodiversity targets, and aligns with international frameworks, including the EU Biodiversity Strategy for 2030. The Forest Restoration Decision Support System (SSDR) is designed as a spatial multi-criteria analysis applied to a uniform grid of approximately 2,219 cells covering the territory of the Republic of Moldova. The analytical foundation is the processing of an extensive volume of geospatial data, obtained predominantly through remote sensing and processed on open-source platforms (Google Earth Engine and QGIS): multi-temporal and multi-source satellite imagery (Landsat, Sentinel-1 and Sentinel-2) for the analysis of the evolution and current distribution of forest cover, digital elevation models for the geomorphological parameters, as well as climatic, hydrographic and soil datasets. On this basis, the SSDR analysis criteria were derived, grouped into three dimensions: biophysical favourability (the potential for spontaneous vegetation expansion and on marginal soils), the ecological dimension (overlap with the protected-area network, connectivity and the reduction of habitat fragmentation, soil degradation and erosion, and the attainment of the minimum forest-cover threshold), and the socio-economic dimension, which also defines the feasibility of restoration projects (population and road-infrastructure density, firewood demand and the agricultural opportunity cost). Each criterion was computed at cell level, normalized and classified against editable thresholds, then combined through a non-compensatory rule — which prevents a high score on one dimension from offsetting deficiencies on another, ensuring that the prioritized areas are simultaneously robust across all axes. The integrated result is a parameterized, transparent and reproducible system that translates restoration objectives into prioritization maps and into a catalogue of priority areas, automatically recalculated when the thresholds or the input data are modified. On this basis, 586 priority restoration sites were identified, along with a robust core of 48 cells that are convergently prioritized across all three dimensions — the target with the greatest net benefit and the recommended starting point for prioritizing financial resources.*

Keywords: *decision support system, forest restoration, science-policy interface, Republic of Moldova.*

From EU forest strategy to national law: a comparative analysis of key concept integration in European forest acts

Liviu NICHIFOREL¹ Valeriu-Norocel NICOLESCU² Bogdan POPA²

¹ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Liviu NICHIFOREL

E-mail address: liviu.nichiforel@usm.ro

Abstract: *This study examines whether key concepts from EU forest-related strategies have been integrated into the main forest legislation of European countries. We analysed the principal regulatory act of the forestry sector (Forest Code or Forestry Act) in 17 European countries with an established forestry tradition, drawing primarily on the FAOLEX database and complemented by relevant scientific literature on comparative forest law. A deductive qualitative content analysis was applied across five thematic domains: governance and forest administration, ownership and property rights, sustainable forest management, biodiversity conservation, and bioeconomy/financial support.*

Results reveal considerable variation in how these domains are regulated across countries. Notably, several concepts central to current EU forest strategy — such as bioeconomy, old-growth forest protection, ecosystem services, and the long-term use of wood in products — have not yet been directly incorporated into core forest legal acts. Instead, they tend to appear in strategic planning documents rather than in binding legislation. These findings point to a gap between EU-level policy ambition and its translation into national forest law, with implications for how future strategy implementation might be pursued.

Keywords: *forest acts, forest governance, comparative policy analysis, national forest program.*

Navigating prospects of harmonising forestry laws and policies in the East African region

Erick O. OSEWE¹ Ibrahim OSEWE¹ Bogdan POPA¹ Ioan Vasile ABRUDAN²

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Erick O. OSEWE

E-mail address: erick.osewe@unitbv.ro

Abstract: *The East African Community (EAC) partner states share biodiverse transboundary forest ecosystems critical to ecological sustainability and rural livelihoods. Despite treaty obligations under EAC Articles 5, 7 and 114 to harmonise national forestry laws and policies, integration remains incomplete. This study assessed convergence and divergence in national forestry legislation across four EAC partner states with ratified regional forest management protocols. Using a tripartite analytical framework spanning sovereignty, economic dependency and institutional governance, we applied process tracing and binary classification to evaluate legislative coherence with EAC treaty provisions. Economic dependency data from the World Bank were analysed using Mann-Kendall trend tests in RStudio. All four countries shared a historical trajectory from indigenous communal governance through colonial centralisation toward decentralisation and participatory forest management. All showed coherence with Article 5 on environmental sustainability, while only three were consistent with Article 7 on participatory governance, reflecting uneven institutional reform. Agriculture, forestry and fishing contributions to GDP declined significantly across all states ($\tau < 0$, $p < 0.005$), most of it observed in Uganda and Rwanda ($\tau \approx -0.55$), where sectoral dependence exceeded 30% of GDP through the 1990s. Tanzania signed but never ratified the Article 114 protocol, stalling cooperative management. Sovereign assertion, competing economic interests and fragmented political processes remain the principal barriers to harmonisation. These findings suggest that shared ecological and economic trajectories provide a viable foundation for regional integration, contingent on resolving institutional and sovereignty constraints within the EAC governance framework.*

Keywords: *East African region, regional policy integration, forestry law harmonization, , forest governance and transboundary ecosystems.*

Coping mechanisms of rural households to shocks: The role of socio-economic determinants and strategies in Kakamega Forest, Kenya

Ibrahim OSEWE¹ Bogdan POPA¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Ibrahim OSEWE

E-mail address: osewe.ibrahim@unitbv.ro

Abstract: Rural forest communities in developing countries face multiple and compounding shocks that increase their vulnerability and reliance on limited coping options. While many studies have examined how socio-economic factors shape coping strategies, few have explored the combined and interacting effects of these factors on strategy selection across diverse shock types. This study investigates the types of shocks experienced by communities surrounding the Kakamega Forest Ecosystem (KFE) in western Kenya, the coping strategies employed, and how socio-economic characteristics and their interactions influence these responses. Using participatory approaches, primary data were collected through 8 focus group discussions, 17 key informant interviews, and 453 structured household surveys. Data was analysed using Chi-square tests, ANOVA, Poisson, and negative binomial regression models. Economic distress and illness emerged as the most widely acknowledged shocks. Significant differences were found across wealth categories and Community Forest Association (CFA) membership for illness, unemployment, animal disease outbreaks, and economic shocks. Only animal disease shocks varied significantly by gender of household head. Forest harvesting was the most frequently adopted coping strategy, used in response to 78% of shocks, underscoring the forest's buffering role. Consumption reduction was common among poor households during unemployment and economic distress, while productive asset sales were triggered by economic and health-related shocks. Rich CFA members and male headed households were less likely to adopt costly or asset-depleting strategies. The paper demonstrates that forest resources serve primarily as short-term safety nets, underscoring the importance of reducing socio-economic disparities and enhancing forest governance to avoid poverty traps and foster resilient, context-specific policies.

Keywords: forest-dependent communities, coping strategies, socio-economic vulnerability, multiple shocks, Kakamega Forest Ecosystem.

Assessing and mitigating systemic risks: Personal protective equipment deficits and fatal accidents in Romanian forests

Alexandra POPA¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Alexandra POPA

E-mail address: a.popa@fsc.org

Abstract: *Forestry is among the most hazardous economic sectors worldwide, and Romanian forestry consistently records one of the highest rates of fatal occupational accidents in the national economy. This study examines how deficits in personal protective equipment (PPE) contribute to systemic safety risks in Romanian forest operations, focusing on three key stakeholder groups: forest administration staff, harvesting company administrators, and forest workers.*

The research combines policy analysis, questionnaire-based data from 299 forest administration staff and 34 harvesting company administrators, and exploratory interviews with forest workers. It investigates perceived barriers to PPE adoption, enforcement practices, the influence of FSC certification, and potential mechanisms for strengthening safety culture.

Findings show that physical discomfort is the main barrier to PPE use, followed by logistical issues, cost constraints, and limited awareness of safety requirements. The results also reveal a gap between formal compliance and actual field practice, particularly regarding the quality, fit, provision, and consistent use of PPE. FSC certification and personal example appear to support more consistent enforcement, but they do not fully eliminate safety shortcomings.

The study highlights the need to move beyond administrative compliance toward a proactive safety culture shared by policymakers, employers, forest administration staff, and workers. Key recommendations include integrating forestry-specific occupational safety requirements into primary legislation, improving access to ergonomic and certified PPE, strengthening field supervision, and expanding training and education. By identifying practical barriers and enforcement mechanisms, this research contributes to reducing fatal accidents and improving worker protection in Romanian forestry.

Keywords: *Romanian forestry, occupational safety, personal protective equipment, fatal accidents, safety culture, FSC certification.*

Is a forest-based bioeconomy a viable option for Guyana?

Lewis RAWLE¹

¹ Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Lewis RAWLE

E-mail address: rawle.lewis@gmail.com

Abstract: *While Bioeconomy is complex, forests being a key productive sector is a good resource to begin the transitioning to this concept. The objectives of climate change mitigation, reduced dependency on fossil-fuel and environmental safeguard using biogenic resources are relevant and well positioned to deal with issues of population growth and environmental degradation. There are controversies on whether this concept truly results in long-term sustainability, improvement in the environment and opportunities for social and economic equity.*

Guyana has conditions conducive to transitioning to a forest-based bioeconomy. There are large amounts of biological resources, a national framework that can foster inclusive and participative governance, with the precursors for development of coordinated policies and legislative tools, and the opportunities for improved technical capacity and technological modernisation.

Challenges such as infrastructure deficits, technological gaps and the dominance of the newfound oil sector were noted. Escaping the resources curse might very well be the most compelling reason for Guyana to transition to a forest-based bioeconomy. Guyana presents a unique opportunity for empirical evaluation on how forest-based bioeconomy models perform in developing, high-forest-cover countries undergoing structural economic transformation driven by extractive industries.

Keywords: *bioeconomy forest-based sustainable development.*

Translating the EU forest strategy for 2030 into National forest policy: A strategic analysis of implementation opportunities and challenges in Romania

Nicolae TALPĂ¹ Liviu NICHIFOREL² Aureliu-Florin HĂLĂLIȘAN¹ Bogdan POPA¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania.

Corresponding author: Nicolae TALPĂ

E-mail address: nicolae.talpa@unitbv.ro

Abstract: *The EU Forest Strategy for 2030 establishes an ambitious policy framework aimed at strengthening climate resilience, biodiversity conservation, sustainable forest management, forest monitoring, research, innovation, and forest governance across the European Union. While the Strategy provides a common vision, its successful implementation depends on the capacity of Member States to translate European objectives into national policy and management frameworks. This study assesses Romania's preparedness for implementing the EU Forest Strategy for 2030 through a structured strategic policy analysis. The research is based on a systematic examination of the Strategy, identifying its strategic domains, policy commitments, and specific objectives, which were subsequently used to evaluate Romania's forest sector. A SWOT-based analytical framework was applied to identify the strengths, weaknesses, opportunities, and implementation challenges associated with aligning national forest policy with European strategic priorities. The analysis indicates that Romania benefits from well-established sustainable forest management practices, multifunctional forest planning, high biodiversity, and extensive forest monitoring systems. However, effective implementation is constrained by fragmented governance, inconsistent forest-related datasets, limited financial mechanisms supporting ecosystem services, ownership fragmentation, regulatory complexity, and increasing trade-offs between biodiversity conservation, biomass utilization, and rural development. The findings highlight that achieving the objectives of the EU Forest Strategy requires integrated governance, harmonized monitoring systems, stronger institutional coordination, and evidence-based policy instruments capable of balancing environmental, economic, and social objectives. The proposed analytical framework offers a transferable approach for assessing national readiness to implement European forest policy priorities.*

Keywords: *EU forest strategy for 2030, forest policy, policy implementation, forest governance,; SWOT analysis, Romania.*



Forest economics, policy and regulation

- POSTER PRESENTATIONS -

Trends in harvesting certificate cancellations in Romania in the context of the upcoming EUDR

Andrei APĂFĂIAN¹ Vlad CRIȘAN¹ Diana VASILE¹ Constantin Dumitru DOBRE¹

¹ Department of Forest, SCDEP Brasov, National Institute for Research and Development in Forestry Marin Dracea, Brasov, Romania.

Corresponding author: Andrei APĂFĂIAN

E-mail address: andrei_ioan.apafaian@icas.ro

Abstract: *The implementation of the European Union Deforestation Regulation (EUDR) is expected to have a significant impact on the structure of timber supply chains. This is due to the introduction of mandatory due diligence and traceability requirements for operators placing timber products on the European market. However, recent trends indicate that a substantial number of harvesting companies have had their harvesting certificates cancelled, which can be a starting point to compare with the numbers that will occur from 1 January 2027 in connection with the implementation of the regulatory framework.*

The present study examines the dynamics of harvesting certificate cancellations in Romania between 2019 and 2026, and investigates the trends over the last eight years. The development of a database of harvesting companies was initiated.

During the study period, a total of 278 harvesting certificates from 33 counties across Romania were revoked. The number of certificate withdrawals reached its maximum in 2020, summing up 66 companies. This was followed by the lowest number in 2023, with 18 withdrawals recorded. An increase was observed in 2024, with 33 withdrawals, and this was followed by a further moderate increase in 2025, with 35 withdrawals. These temporal patterns suggest that until now, changing economic conditions and evolving market requirements have led to such cancellations.

The findings contribute to understanding the interaction between the trends of harvesting certificate cancellation until the implementation of EUDR that will take place for large and medium operators on 30 December 2026 and for micro and small operators on 30 June 2027.

Keywords: *harvesting companies, legislation, EUDR, certificates.*

Institutional readiness for climate-oriented forest policy implementation: Evidence from Romanian forestry experts

Mihai-Ionut HAPA^{1,2} Mirabela MARIN¹ Nicu Constantin TUDOSE¹
Cezar UNGUREAN¹ Bogdan POPA²

¹ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania;

² Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mihai-Ionut HAPA; E-mail address: ionutmihaihapa@gmail.com

Abstract: *Climate change demands adaptive forest governance and effective policy implementation, while the implementation of technical solutions depends largely on institutional capacity, financial support, governance quality, and stakeholder engagement. Understanding how forestry professionals perceive these enabling conditions is essential for designing effective and implementable forest policies.*

This study explores the perceptions of Romanian forestry stakeholders regarding the institutional preparedness for implementing climate-oriented forest policies. A structured questionnaire was administered to 40 experts representing research institutions, forest management organizations, municipalities, non-governmental organizations, and the wood-processing sector. The responses were analysed using descriptive statistics and comparative analyses to identify common priorities and differences among stakeholder groups.

The results show a broad consensus that strengthening institutional capacity is a prerequisite for effective climate policy implementation in the forestry sector. Respondents reported adequate financial resources, transparent governance, long-term financial sustainability, and reliable information for supporting climate adaptation measures. While general willingness to improve forest management was high, perceptions regarding organizational commitment to behavioural change were lower, highlighting institutional transformation as the main challenge. Varying perspectives among stakeholder categories reflect their diverse roles and differing views on governance effectiveness.

The findings indicate that future forest policies should move beyond technical recommendations, focusing instead on institutional development, cross-sector collaboration, and governance mechanisms that facilitate policy implementation. By providing empirical evidence on stakeholder perceptions, this study contributes to the ongoing discussion on strengthening climate-oriented forest governance and supports the development of more resilient and sustainable forest policy frameworks in Romania.

Keywords: *forest policy, forest governance, institutional capacity, stakeholder perceptions, climate adaptation, Romania.*

Assessing systemic risks and PPE deficits in Romanian forestry

Alexandra POPA¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Alexandra POPA

E-mail address: a.popa@fsc.org

Abstract: *Forestry is a vital pillar of the Romanian bioeconomy, yet it remains one of the most hazardous industrial sectors. While operations occur in remote, geographically isolated sites far from emergency healthcare, the sector consistently ranks among the top three in the national economy for fatal accidents.*

The purpose of this research is to evaluate the critically high rate of occupational hazards in Romanian forestry and to assess the systemic risks—specifically Personal Protective Equipment (PPE) deficits—that contribute to fatal accidents.

A mixed-methods approach was used, including a comprehensive policy analysis of core forestry legislation and primary data collection through questionnaires (forest administration staff and harvesting company managers), as well as qualitative interviews with forest workers.

Results: The study identifies a frequency index for fatal accidents in the forestry sector 25 times higher than the national average. Furthermore, a critical legislative void was identified: specific health and safety (H&S) protocols are entirely absent from primary forestry regulations, such as the Forestry Code and the Statute of the Forestry Employee.

Research findings highlight that physical discomfort is the primary barrier to PPE adoption, reported by 70–80% of stakeholders.

Mitigating these risks requires a shift from "paper compliance" to a proactive safety culture. The study advocates for institutional synergy between environmental and labour authorities to integrate H&S protocols into primary forestry law, as well as raising awareness about the importance of wearing the PPE.

Recommendations include promoting high-quality ergonomic PPE and leveraging voluntary certification schemes like FSC, which currently serves as a critical mechanism for consistency in protecting the forestry workforce where national legislation remains general.

Keywords: *occupational safety, Romanian forestry, systemic risk, personal protective equipment, FSC certification, advocacy.*



Forest geomatics and artificial intelligence

- ORAL PRESENTATIONS -

Quantifying forest structural dynamics through Integration of remote sensing and field-based methods

Samira ALHASSAN¹ Dhananjana RAJAKARUNA¹ Adrian INDREICA²

Petru Tudor STĂNCIOIU² Mihai Daniel NIȚĂ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Samira ALHASSAN

E-mail address: samira.alhassan@unitbv.ro

Abstract: *Forest structure is a key component of ecosystem functioning, influencing biodiversity, habitat quality, productivity, and carbon storage. Understanding how forest structural characteristics change over time and across landscapes is essential for effective forest monitoring and management. However, capturing these changes remains challenging because field-based approaches, although providing detailed measurements of tree-level characteristics, are often limited by spatial coverage and sampling intensity. This study aims to investigate changes in forest structure by integrating remote sensing observations with field-based measurements. Remote sensing datasets, including LiDAR and optical imagery, will be combined with ground-based forest inventory data to examine key structural attributes such as canopy height, canopy cover, tree density, and vertical forest complexity. Field measurements will provide detailed information for validating and improving remote sensing-based estimates, while remote sensing will support the analysis of spatial patterns and structural variation across broader landscapes.*

By combining complementary data sources, this research will develop a multi-scale approach for improving the characterization of forest structural changes. The integrated framework will enhance the ability to detect structural variations associated with natural disturbances, forest management activities, and environmental changes. The outcomes of this study will contribute to advancing forest monitoring techniques by addressing the limitations of individual methods and providing a more comprehensive understanding of forest structure dynamics. This approach has potential applications in sustainable forest management, biodiversity assessment, and ecosystem carbon monitoring.

Keywords: *canopy structure, forest inventory, structural diversity, spatial variability, LiDAR, vegetation dynamics.*

Combining terrestrial inventory and remote-sensing to assess forest dynamics in set aside areas – Vanatori Neamt Natural Park

Ionut BARNOAIEA¹ Cosmin COSOFREȚ¹ Gabriel DUDUMAN¹ Liviu NICHIFOREL¹

¹ Forestry Faculty, Ștefan cel Mare University of Suceava, Universității Street 13, 720229 Suceava, Romania.

Corresponding author: Ionut BARNOAIEA

E-mail address: ionut.barnoaiea@usm.ro

Abstract: *Biodiversity conservation efforts made in the last decades led to the increase of set-aside forests, especially in recently established protected areas. The Vanatori Neamt Nature Park has implemented, in 2007, an internal zoning system, with approximately 615 ha of strictly protected areas. Most of these areas overlap relatively even-aged, coniferous stands, with a rapid dynamic of growth and mortality. To assess the changes in forest structure and health status, several sample plots were set in 2007 in different stands with spruce and fir, using 1000 m² circular plots and one rectangular plot of one hectare. The plots originally overlapped on IKONOS2 satellite images were used to assess the validity of remote sensing volume estimation models. During the last two decades, these areas were severely affected by drought and bark beetles. The terrestrial re-inventory, done in 2025-2026 and combined with ALS scanning of the area, allowed us to assess the mortality rate, health status and volume growth between the two inventory dates. We used successive inventory method to compare the data and compute the growth rate. Results indicate that despite high tree mortality (>33%) and a significant drop in total biomass stock, surviving trees sustained a net growth rate exceeding 2.5 m³ha⁻¹yr⁻¹. Furthermore, canopy gap formation driven by mortality promoted regeneration, ultimately increasing overall structural diversity. The study highlights the value of integrating multi-temporal remote sensing with long-term ground inventories to monitor rapid structural shifts and post-disturbance recovery in protected forest ecosystems.*

Keywords: *strictly protected forests, repeated inventory, multisensor approach.*

Mapping forest structure at regional scales with open access, multi-sensor data, machine learning algorithms and convolutional neural networks

Mihnea CĂȚEANU¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mihnea CĂȚEANU

E-mail address: cateanu.mihnea@unitbv.ro

Abstract: *Accurate mapping of forest height and aboveground biomass (AGB) is fundamental for carbon accounting, ecosystem monitoring and climate mitigation policies. However, traditional inventory methods face severe scalability limitations when applied at regional scales, especially when considering the complex topography of mountainous regions. To address these limitations, this research aims to develop an advanced, regional-scale, medium-resolution (10m) predictive mapping framework for the forested areas located in the Carpathian Mountains in Romania (approx. 66,300 sq. km. in total), corresponding to the state of the forest in the year 2025. The study evaluates the integration of multi-sensor satellite data using ensemble learning and deep learning architectures based on image convolutions. The methodology integrates approx. 1-million discrete, filtered GEDI satellite LiDAR observations of forest height and AGB collected in 2024-25, along with 133 initial features, derived from seasonal composites of Sentinel-1, Sentinel-2, PALSAR and FABDEM data. To ensure an accurate estimation of predictive performance, a rigorous spatial validation was applied. This involved the separation of the study area into a grid of 73 blocks of approx. 40 x 40 km, with 11 of them reserved strictly for post-training validation. The comparative performance of four models was tested: Random Forest (RF), CatBoost, XGBoost and Convolutional Neural Networks (CNN).*

Statistical validation demonstrated the robust predictive capacity of ensemble models, with XGBoost achieving the highest stability among these (MAE of 5.45m for forest height and 59.42 Mg/ha for AGB) and RF or Catboost having relatively close performance. Stratification of residuals highlights very similar issues between the models, with all three exhibiting the well-known “regression to the mean”, where the model overpredicts small values and underpredicts high ones. On the other hand, CNN allows for a better, more robust prediction due to the explicit integration of spatial-textural information, albeit at the cost of significantly higher costs in terms of processing power and time. The synergistic fusion of high-penetration radar with optical indicators, processed through advanced machine/deep learning models, provides a highly viable and scalable instrument for predictive mapping of complex forest ecosystems.

Keywords: *aboveground biomass (AGB), Multi-sensor fusion, spaceborne LiDAR, machine learning, multi-task deep learning.*

Comparative assessment of drought effects on broadleaved and coniferous forests using Sentinel-2 and ERA5-Land data in Cluj County, Romania

Iulia COROIAN¹ Diana FICIOR¹ Luisa ANDRONIE¹ Rodica SOBOLU¹

¹ Department of Land Survey and Exact Sciences, Faculty of Forestry and Cadastre, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Mănăştur St., 400372, Cluj-Napoca, Romania.

Corresponding author: Diana FICIOR

E-mail address: diana.ficior@usamvcluj.ro

Abstract: *Forest ecosystems are increasingly affected by climatic variability and prolonged drought periods, making the identification of spatial patterns of vegetation stress an important component of sustainable forest monitoring. This study aims to assess and compare the response of broadleaved and coniferous forests to drought conditions using freely available satellite, climatic, and topographic data. The analysis focuses on selected forest areas in Cluj County, Romania, and integrates Sentinel-2 Level-2A imagery, Copernicus forest products, ERA5-Land climate data, and digital elevation information. Forest areas are delineated and classified according to dominant leaf type, while multi-temporal Sentinel-2 imagery acquired during comparable summer periods are used to calculate the Normalized Difference Vegetation Index (NDVI), Normalized Difference Moisture Index (NDMI), and Normalized Burn Ratio (NBR). Temporal variations in these spectral indices are analysed in relation to precipitation, temperature, elevation, slope, and aspect. The proposed approach enables the identification of areas characterized by persistent decreases in vegetation vigour and moisture conditions and supports the comparison of spectral responses between broadleaved and coniferous forests. The study provides a reproducible GIS and remote-sensing workflow for regional forest monitoring using exclusively open-access geospatial datasets. In the absence of field observations, the detected changes are interpreted as indicators of potential drought-related vegetation stress rather than confirmed forest degradation.*

Keywords: *Sentinel-2, drought stress, forest monitoring, NDVI, NDMI.*



Digital twin of Săcele – An interactive tool to assess the risks in case of extreme events

Iuliana Adriana CUIBAC PICU¹ Iuliana Maria PÂRVU¹ Adrian PÂRVU¹

Nicoleta PÂRVULESCU¹ Ioana CORNEANU¹

¹ National Center of Cartography, 1A Expoziției Blvd., Sector 1, Bucharest, Romania.

Corresponding author: Iuliana Adriana CUIBAC PICU

E-mail address: iuliana.cuibac@cartografie.ro

Abstract: *Urban areas are increasingly exposed to flood hazards due to climate change, densification and growing urbanization. High resolution photogrammetric datasets can be used to identify the areas with risks in case of extreme events, such as heavy rainfalls, heat waves.*

Much more, simulations of hazards, including meteorological data can provide more accurate locations of affected areas. In this case, solutions prior to the events can be implemented, so increasing the resilience of cities to natural hazards.

This study presents a high-resolution 3D urban model of Săcele, Brasov county, Romania, developed from an airborne photogrammetric dataset acquired in 2025. The 3D city model will be composed of 3D building models, digital terrain model, road and hydrography networks and land cover areas. The analysis will include also areas with risk of floods and heat islands.

So, this virtual replica of the city will be implemented into a web-platform that will allow decision makers and citizens to interact with the digital twin and to extract useful information to make data-based decisions that can improve the population life in the area. The analysis performed in the interactive tool can foster climate resilience.

Keywords: *digital twin, photogrammetry, 3D city models, extreme events.*

Linking rainfall structure and atmospheric conditions to rainfall erosivity: An event-based framework for forest hydrology in tropical regions

Jorge DIAZ-SUAREZ¹ Victor Dan PĂCURAR² Mihai Daniel NIȚĂ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Jorge DIAZ-SUAREZ

E-mail address: jorge.diaz@unitbv.ro

Abstract: *Rainfall is the main driver of soil erosion and one of the key factors controlling hydrological processes in forest ecosystems. However, the erosive response of a rainfall event depends not only on the total amount of precipitation but also on its temporal evolution, spatial organization, and the atmospheric processes responsible for its development. Understanding these controls is essential for improving erosion risk assessment, watershed management, and sustainable forest planning under increasingly variable climatic conditions.*

Cuba provides an exceptional natural laboratory for investigating these relationships. Located in a region where tropical and subtropical atmospheric systems frequently interact, the island is influenced by a wide range of rainfall-producing mechanisms, including local convection, easterly waves, tropical cyclones, and cold fronts. In addition, a national network of approximately 65 automatic rain gauges recording precipitation at 10-minute intervals, although currently spanning a relatively short observation period, provides a valuable opportunity to characterize rainfall events at high temporal resolution and to relate ground observations to satellite- and reanalysis-based datasets.

The objective of this study is to investigate how the spatio-temporal structure of rainfall events, observed by the GPM IMERG satellite product, together with the atmospheric environment described by the ERA5 reanalysis, explains the variability in rainfall intensity and erosive power. Rainfall events are automatically identified from rain gauge observations using a quality-controlled event-based methodology. For each event, rainfall erosivity indices are computed and linked to descriptors of precipitation evolution derived from IMERG and atmospheric variables extracted from ERA5.

By integrating ground observations, satellite precipitation, and atmospheric reanalysis within a common event-based framework, this study aims to identify the meteorological conditions associated with the most erosive rainfall events and to improve the physical understanding of rainfall-driven soil degradation. The proposed approach provides a scientific basis for more robust erosion hazard assessment and hydrological modelling, supporting sustainable forest management and climate adaptation in forested landscapes.

Keywords: *rainfall erosivity, event-based analysis, GPM IMERG, ERA5 reanalysis, forest hydrology, spatio-temporal rainfall structure.*



Using ALS pointcloud for deriving different canopy characteristics

Sergiu FLOREA¹ Mihai Daniel NIȚĂ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Sergiu FLOREA

E-mail address: sergiu.florea@unitbv.ro

Abstract: *Airborne laser scanning (ALS) provides a detailed three-dimensional representation of forest canopies and creates new opportunities for deriving structural indicators over areas considerably larger than can be practically characterized through field measurements alone. In this study, we developed a Python-based processing framework for the automated extraction of forest canopy characteristics from high-density UAV LiDAR point clouds. Data were acquired using a DJI Zenmuse L1 LiDAR sensor mounted on a DJI Matrice 300 RTK, covering approximately 100 ha of forest. Following ground classification and height normalization, the framework derives a suite of canopy metrics describing both vertical and horizontal forest structure, including canopy height, height percentiles, canopy cover, gap fraction, vertical height distribution, canopy surface variability and rugosity, individual-tree and crown delineation, crown area, crown diameter, crown height, and crown shape-related geometric characteristics. Spatially explicit canopy height models and individual-crown products were subsequently generated from the normalized point cloud.*

To evaluate the reliability of the UAV-derived crown characteristics, independent high-density mobile laser scanning (MLS) data collected in 500 m² field plots were used as reference. Corresponding crowns identified from UAV-ALS and field MLS point clouds were compared in terms of their dimensional and geometric characteristics. This multi-scale approach combines the extensive spatial coverage of UAV laser scanning with the detailed representation provided by terrestrial/mobile observations. The developed workflow demonstrates how open and reproducible Python-based point-cloud processing can transform dense UAV LiDAR data into quantitative indicators of canopy structure suitable for forest inventory, structural diversity assessment, habitat characterization, and forest monitoring.

Keywords: ALS, UAV LiDAR, DJI Zenmuse L1, point cloud, canopy structure, crown geometry, MLS, forest inventory.

Fine-grained tree species recognition using taxonomy-aware embedding separation

Mohamed Islam KESKES¹ Mihai Daniel NIȚĂ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mohamed Islam KESKES

E-mail address: mohamed.keskes@unitbv.ro

Abstract: *Accurate tree species identification is essential for biodiversity monitoring, ecological research, forest management, and urban vegetation assessment, yet image-based recognition remains challenging because closely related species often share subtle morphological traits and public biodiversity images vary strongly in organ visibility, season, viewpoint, and quality. This study develops a taxonomy-aware deep learning framework for fine-grained tree species recognition from RGB images by integrating biological hierarchy into angular-margin learning. A balanced dataset of 36 tree species, organized into 12 genera with three species per genus, was constructed from GBIF and iNaturalist images. Images were preprocessed and augmented before being used to fine-tune an ImageNet-pretrained ConvNeXt-Tiny backbone. The proposed TaxaMargin head applies an ArcFace-style cosine classifier with adaptive angular margins, imposing a larger margin when the hardest competing species belongs to the same genus as the ground-truth class. Species-level exponential moving average prototypes and confidence-gated updates were incorporated to stabilize the embedding space and encourage compact class representations. Performance was evaluated using species accuracy, genus accuracy, macro-F1 score, precision, recall, confusion analysis, and confidence-based fallback accuracy. TaxaMargin achieved 81.57% species accuracy, 90.74% genus accuracy, and 82.00% macro-F1, outperforming a standard softmax baseline by 12.57, 11.74, and 15.20 percentage points, respectively. Error analysis showed that many misclassifications were taxonomically structured, with substantial confusion occurring among congeneric species. The confidence-based fallback mechanism further supported reliable genus-level output when species-level confidence was low. These findings demonstrate that taxonomy-aware angular-margin learning can improve fine-grained tree species recognition while producing more biologically interpretable predictions for ecological and forestry applications in practical settings.*

Keywords: *tree species recognition, fine-grained classification, taxonomy-aware learning, angular-margin loss, deep learning.*



Romania's first national high-resolution map of forest tree species via deep learning

Mohamed Islam KESKES¹ Mihai Daniel Niță¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Mohamed Islam KESKES

E-mail address: mohamed.keskes@unitbv.ro

Abstract: *Romania hosts some of Europe's most diverse temperate forests (from Danube lowlands to the Carpathians), but national, high-resolution information on tree species composition is still limited and often outdated. With increasing pressure from disturbance, fragmentation and climate variability, species-level maps are needed to monitor biodiversity, habitat connectivity and forest naturalness, and to support reporting under EU conservation and climate frameworks. We aim to produce Romania's first nationwide 10 m map of dominant forest tree genera and mixed-stand groups using Sentinel-2 imagery aligned with National Forest Inventory plots.*

Keywords: *tree species mapping, Sentinel-2, deep learning, national forest inventory, biodiversity.*

Evaluating LAI estimation accuracy across forest development stages in mountainous forests using hemispherical photography, satellite data, and deep learning

Aya Hamed MOHAMED¹ Petru Tudor STĂNCIOIU² Mihai Daniel NIȚĂ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Aya Hamed MOHAMED

E-mail address: aya.hamed@unitbv.ro

Abstract: Leaf Area Index (LAI) is a key variable for understanding forest canopy structure, carbon dynamics, and energy exchange. However, accurately estimating LAI in mountain forests remains difficult due to complex terrain and highly variable stand structures that challenge both field and satellite methods. In this study, we assessed LAI estimation across four forest development stages: young, pole, mature, and overmature in the Postăvaru Mountains of Romania. We compared field-based measurements using hemispherical photography using Gap Light Analyzer (GLA) with satellite-derived products from MODIS. Field data showed a clear increase in LAI with forest development, from 0.31 in young stands to 3.30 in overmature stands, confirming progressive canopy closure through succession. MODIS LAI products systematically overestimated field values, particularly in early successional stages (2.26 vs. 0.31), and failed to distinguish differences among forest age classes. To enhance estimation accuracy, Sentinel-2 data were applied in two calibrated approaches: (i) a regression-based calibration using the Enhanced Vegetation Index (EVI) and (ii) a deep learning model integrating Sentinel-2 spectral information with digital elevation data. The calibrated model improved agreement with field LAI (RMSE = 1.13; CCC = 0.45), yielding reliable estimates for pole, mature, and overmature stands but limited accuracy in young, open canopies. The deep learning model achieved almost perfect agreement with field measurements ($r = 0.97$; CCC = 0.97; RMSE = 0.34), with minimal bias and low residual error. This approach enabled consistent, wall-to-wall LAI mapping across the mountainous landscape. Overall, no single method performed best across all forest stages: GLA effectively captured on-the-ground trends, the calibrated Sentinel-2 model offered scalable estimates for closed-canopy forests, and MODIS proved unsuitable for stand-level analysis. By linking method performance to forest development stage, this study establishes a stage-specific framework for improving satellite-based LAI estimation and mapping in complex mountain terrain, supporting forest monitoring, biodiversity assessment, and carbon cycle modelling.

Keywords: leaf area index (LAI), hemispherical photography, Sentinel-2, MODIS, forest development stage, mountain ecosystems, remote sensing validation, canopy structure, continuous cover forestry, forest management, shelterwood system.



Site-specific calibration of TMS-4 soil moisture sensors in contrasting forest stands of the Postăvaru Mountain, Romania

Dhananjana RAJAKARUNA¹ Samira ALHASSAN¹ Valentin BALAN¹
Raluca ENESCU² Petru Tudor STANCIOIU² Mihai Daniel NIȚĂ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Dhananjana RAJAKARUNA

E-mail address: rajakaruna.sanduni@unitbv.ro

Abstract: Soil moisture is a key parameter for understanding forest ecohydrological processes and ecosystem functioning, making accurate measurements essential for reliable scientific analyses. TMS-4 soil moisture sensors are an emerging technology that provides continuous, high-frequency measurements, offering valuable insights into rapidly changing environmental conditions. This study evaluated the performance of TMS-4 sensors in two contrasting forest stands on Postăvaru Mountain, Romania, which are an old-growth forest with sandy loam soil (bulk density 1.00 g cm^{-3}) and a spruce plantation with silt loam soil (bulk density 0.78 g cm^{-3}). Laboratory calibration followed the manufacturer's standardized gravimetric protocol, establishing seven moisture conditions ranging from air-dry to saturated to derive site-specific second-order polynomial calibration curves. Volumetric water content (VWC) estimated using custom calibrations was compared with values obtained using the sensor's default settings and generic soil-type presets. Calibration performance differed noticeably between sites. In the spruce plantation, the default calibration closely approximated the custom calibration (mean VWC: 28.82% versus 27.57%), whereas the generic Silt Loam preset underestimated soil moisture (20.48%). In the old-growth forest, the default setting considerably underestimated moisture (33.16%), while the Sandy Loam B preset produced values closer to the custom calibration (42.27% versus 45.36%). These findings may demonstrate that sensor performance is influenced by site-specific soil conditions, showing the need for local calibration or careful preset selection to ensure reliable soil moisture monitoring in heterogeneous forest ecosystems.

Keywords: ecohydrology, forest soils, gravimetric calibration, old-growth forest, spruce plantation, volumetric water content.



Establishing the real-time kinematic positioning accuracy of the Global Navigation Satellite System under forest canopy

Alice-Elena TEȘILEANU¹ Mihnea CĂȚEANU² Larisa-Ștefania BURTEA¹

¹ Department of Geodetic Engineering, Faculty of Geodesy, Technical University of Civil Engineering Bucharest, 122–124 Lacul Tei Boulevard, Sector 2, 020396 Bucharest, Romania;

² Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania.

Corresponding author: Alice-Elena TEȘILEANU

E-mail address: alice_tesileanu@yahoo.com

Abstract: *The use of Global Navigation Satellite System - Real Time Kinematic (GNSS-RTK) technology has expanded significantly in standard surveying work, but the accuracy of measurements is often compromised in areas where sky visibility is reduced. This study evaluates the performance of GNSS positioning in a forested area located on Lempes Hill, Romania. Error quantification was made possible by RTK measurements taken using a Stonex S10 receiver connected to the Romanian Position Determination System (ROMPOS) network, with observation times of 30 and 60 seconds. The coordinates obtained by satellite technology were referenced to control points previously determined using classical surveying methods, which allowed for the establishment of absolute errors. Positioning errors were evaluated in relation to tree proximity and density. The results indicate that the characteristics of natural obstructions, along with the duration of the observation, have a significant impact. In the forested area, increasing observation times improved horizontal accuracy, resulting in a reduction of the Mean Absolute Error (MAE) by approximately 10 cm and the Root Mean Square Error (RMSE) by approximately 15 cm. Similarly, vertical accuracy also improved, with the RMSE decreasing by approximately 25 cm. By defining the precise relationship between environmental constraints and observation duration, this research provides a validated methodology for optimizing GNSS-RTK workflows, offering field surveyors a reliable framework to ensure data integrity in challenging environments.*

Keywords: GNSS-RTK, forest surveying, observation time, positioning accuracy.



Forest geomatics and artificial intelligence

- POSTER PRESENTATIONS -

Building Romanian forest pathways for iLand

Lucian MIZGACIU¹ Petru Tudor STĂNCIOIU² Victor Adrian INDREICA²

Marius PARASCHIV³ Mihai Daniel NIȚĂ¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brasov, Romania;

³ National Institute for Research and Development in Forestry Marin Dracea, 128 Eroilor Blvd, 077190 Voluntari, 077190, Ilfov, Romania.

Corresponding author: Lucian MIZGACIU

E-mail address: lucianmizgaciu@unitbv.ro

Abstract: *iLand is a spatially explicit forest landscape model that simulates forest development, disturbance and management over large areas and long-time horizons. To run realistic management scenarios, iLand needs clear operational pathways: when stands regenerate, when tending and thinning occur, how density is controlled, and when final renewal or continuous-cover interventions are applied. For Romania, these rules exist in technical norms and forest-management plans, but they are not directly structured as model-ready pathways.*

We developed a Romanian business-as-usual silvicultural pathway set for iLand and applied it to the Postăvaru forest landscape, covering 14,528 ha. The workflow translates Romanian technical norms into operational rules for regeneration, cleaning, thinning, sanitary-only periods and final renewal.

The final structure includes 35 managed pathways: 34 genus × site class × management pathways for Fagus, Abies, Picea, Pinus and Quercus, plus one consolidated Other species pathway. An area covering 1,769 ha, or 12.18% of the landscape, situated in the protected area, was kept as a separate non-management class.

The managed area covers 12,759 ha. The largest genus group is Fagus with 5,970 ha, followed by Picea with 3,908 ha, Abies with 1,713 ha, Pinus with 226 ha and Quercus with 187 ha. Conservation management dominates with 5,953 ha, followed by group shelterwood with 3,147 ha and continuous cover with 2,849 ha.

Tending operations were translated into model triggers using stand height, residual density and intervention periodicity. Early cleaning starts at 1–2 m, followed by precommercial thinning at 5–8 m. First commercial thinning is triggered at approximately 10–12 m dominant height for Fagus and Quercus, 12–14 m for Abies, 12–13 m for Picea and 10–13 m for Pinus. Subsequent thinnings were divided into three stages: pole stage, small timber and mature stage, with return intervals of 6–8, 8–10 and 10–12 years for broadleaved and fir pathways, and shorter Picea intervals of 5–6, 6–8 and 8–



10 years. Density control was expressed through residual density index, generally $DI \geq 0.80$, and $DI \geq 0.85$ for *Abies*.

This framework converts Romanian silvicultural practice into a compact, transparent and iLand-ready management architecture, enabling landscape-scale simulations of business-as-usual forest development and future management scenarios in Romanian mountain forests.

Keywords: *iLand, pathways, management, scenarios.*



Creating a 3D model of a forested area by combining field measurements with data from topographic maps

Cornel Cristian TEREȘNEU¹ Cristian Samuel TEREȘNEU¹

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven 1, 500123 Brașov, Romania.

Corresponding author: Cornel Cristian TEREȘNEU

E-mail address: cteresneu@unitbv.ro

Abstract: *Taking measurements (of any kind) is always difficult in forested areas. That is precisely why solutions are still being sought to find the best option. This paper highlights the results obtained for a forested area of approximately 50 ha where ski slopes are planned to be built. To this end, the goal was to create a 3D model as accurate as possible to verify compliance with specific conditions regarding: elevation, slope, aspect, shading, terrain curvature, and runoff directions. The analysed area was divided into 20 basic units, within which a minimum number of coordinates were collected using GNSS technology; a 3D model was created using this data. Subsequently, the topographic and cadastral maps of the area were georeferenced, and the contour lines were extracted through vectorization; another 3D model was created based on this data. Subsequently, in ArcGIS, VBA scripts were used to combine the two models, retaining the portion of the 3D model derived directly from measurements (while enforcing a maximum distance between points) and filling in the remaining gaps with data from the 3D model created using the old maps. The final 3D model was obtained after performing the necessary smoothing to transition between the two variants, also using VBA scripts.*

Keywords: 3D model, GNSS, GIS, VBA.