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Forest and wildlife ecology

- ORAL PRESENTATIONS -

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Changes in Norway spruce climate sensibility along elevational gradients in the Eastern Carpathians

Andrei POPA[1,2,*] Jernej JEVŠENAK[3]
Ionel POPA[1] Ovidiu BADEA[1] Allan BURAS[4]

[1] National Institute for Research and Development in Forestry "Marin Dracea", Bucharest, Romania;

[2] Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Romania;

[3] Department for Forest and Landscape Planning and Monitoring, Slovenian Forestry Institute, Ljubljana, Slovenia.

[4] TUM School of Life Sciences, Technical University of Munich, Freising, Germany.

Corresponding author: Andrei POPA

E-mail address: popa.andrei.dorna@gmail.com

Abstract: *Climate change is affecting forest ecosystems all around the globe, through warming as well as increased drought frequency and intensity. Across much of Europe, climate change has caused a major dieback of Norway spruce (Picea abies L.), an economically important tree species. However, the southeasternmost fringe of this tree species – the Eastern Carpathians – has not yet suffered large-scale dieback. In recent decades, non-stationarity in climate-growth relationships has been observed on a global scale. Thus, studying this phenomenon over time may elucidate the degree to which Norway spruce may be vulnerable to climate-change induced decline in upcoming decades. Under this framework, we analyzed a regional tree-ring network comprising more than 3,000 trees, with the aim of quantifying temporal shifts of climate sensibility (TSCS) since 1950. We defined TSCS as the slope parameter of the regression of climate sensitivity (the correlation coefficient) over time. Given the often-observed contrasting shift of climate sensitivity at low versus high elevations, we were particularly interested in studying potentially TSCS along elevational and spatial gradients. Our results revealed several indications of TSCS for Norway spruce in the Eastern Carpathians. First, at high elevations (>1,100 m a.s.l.), we found that the positive link between summer temperature and spruce growth decreased significantly over the study period. In turn, these trees, over time, featured an increasing positive relationship with late winter temperatures. At low elevations (<800 m a.s.l.), the signal of positive summer Standardised Precipitation-Evapotranspiration Index (SPEI) correlation became more frequent among sites. Our results revealed that TSCS was driven significantly by an elevational climate gradient and a longitudinal continentality gradient. Overall, our findings indicate that Norway spruce is increasingly affected by water limitations under climate change at low elevations, highlighting a potentially rising risk of decline of this species in the Eastern Carpathians.*

Keywords: *temperature, water availability, climate change, tree-ring width, non-stationarity.*

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Case study regarding the involvement of saproxylic insects in the degradation of beech and fir wood from the Şinca Old-Growth Forest

Ionuț-Marian DRAGOMIR[1,*] Gabriela-Aurora ISAIA[1]
Mihai-Leonard DUDUMAN[1,2] Ion-Cătălin PETRIȚAN[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;
[2] Forestry Faculty, Ștefan cel Mare University of Suceava, Romania.

Corresponding author: Ionuț-Marian DRAGOMIR

E-mail address: dragomir.im98@yahoo.com

Abstract: *Deadwood is considered a key element in the functioning of forest ecosystems as it plays an important role in maintaining biodiversity and trophic chains, supporting approximately 30% of global biodiversity. The process of assimilating deadwood into the natural matter cycle can take several hundred years to complete. Communities of saproxylic organisms, such as insects associated with deadwood, change profoundly over time as wood decay advances. Studies addressing the relationship between wood decomposition processes and the composition of invertebrate communities are few and they have focused mainly on the succession of saproxylic insect species in boreal forests, based on quantitative and descriptive data. This succession has been shown to be similar in mixed beech and fir forests in Europe, with beech being particularly investigated due to its prevalence in European forests, and because a remarkable specialization of saproxylic-saproxylophagous-xylophagous species has been observed in relation to it. The only study regarding the issue of successional stages in deadwood in Romania was developed by Ceianu in 1978 and it was used to describe successional stages in spruce wood and bark, not beech or fir, and is not correlated with the stages of wood decomposition. The present work was carried out in The Şinca Old-Growth Forest and aimed to identify the families of saproxylic insects of the dead wood in different classes of decomposition, on the two host species (fir and beech) and according to the size of the assortment on which they were identified. There were placed 5 plots, and in each one logs with a diameter of 10 and 25 cm, respectively, of fir and beech, from degradation classes 1, 2 and 4 (Maser et al. 1979) were placed on the ground. In October 2022, samples with a thickness of 5 cm were cut from each log, and then they were analyzed in the laboratory. The bark of the samples was removed to better observe and inventory the wood entry holes and to measure their diameters in order to be able to identify the family, and then the samples were split to note the depth of wood penetration. There were identified 6 families (plus the subfamily Scolytinae which was quantified separately). The paper presents the percentages in which the families were identified by species, diameter categories, and decomposition classes, as well as the way of association of the different families between them.*

Keywords: *deadwood, saproxylic insects, wood decay classes, beech-fir mixed forest.*

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Phylogenetic study of Quercus section Cerris - investigating evolution to help understand adaptation to climate change

Botond Boldizsár LADOS[1,*] Klára CSEKE[1]

[1] Department of Tree Breeding, Forest Research Institute, University of Sopron, Hungary

Corresponding author: Botond Boldizsár LADOS

E-mail address: lados.botond@uni-sopron.hu

Abstract: *Section Cerris (cork oaks) is the smallest group of oaks in the subgenus Cerris, comprising only 15 species distributed mainly in Western Eurasia. Due to the ecological characteristics of modern species (e.g. drought tolerance), cork oaks are of increasing interest for climate adaptation in forestry (e.g. Q. cerris L.). Investigating the phylogeny of this oak group could provide detailed information to better understand the genetic background of adaptation to modern climate change. Therefore, as a first step, our study investigated the genetic structure of the section and subgenus Cerris, including all species, subspecies and two hybrids in section Cerris, in addition to 12 species from sections Ilex, Cyclobalanopsis and the genus Notholithocarpus. In our genetic analyses, samples of 28 taxa were genotyped by using ddRAD-seq (double digest restriction site-associated DNA sequencing) and the generated genome-wide SNP dataset was mapped to the Q. cerris genome. During our research, we implemented multiple approaches (RAxML, fastSTRUCTURE, PCA) to infer phylogeny. In our results, species of subgenus Cerris were resolved into three monophyletic groups (sections) even with allowing up to 70% missing data per locus. Furthermore, we also detected intrasectional groups of species inside section Cerris, which may indicate the formation of subsections. Based on the loadings of the SNP loci in the PCA method, we found that genomic regions have different roles in species differentiation. Thus, certain chromosomes or parts of chromosomes may have been differentially affected by evolution. In future, studies of functional regions within these outlier regions may provide valuable information on how evolution affects expressed traits (including adaptive ones) in different species. According to these results, conclusions can be drawn for adaptation to modern climate change, which may help to develop adaptation strategies for both forestry and conservation.*

Keywords: *ddRAD-seq, Cork oaks, section Ilex, section Cyclobalanopsis, Notholithocarpus.*

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Genetic patterns of native Hungarian oak (*Quercus frainetto* Ten.) stands on the Balkan Peninsula based on chloroplast microsatellite markers

Klára CSEKE[1,*] Csilla Éva MOLNÁR[1] Botond Boldizsár LADOS[1]
László NAGY[1] Attila BENKE[1]

[1] Department of Tree Breeding, Forest Research Institute, University of Sopron, Hungary.

Corresponding author: Klára CSEKE

E-mail address: cseke.klara@uni-sopron.hu

Abstract: *The Hungarian oak (Quercus frainetto Ten.) is a meso-xerophilous species that belongs to the European white oaks (section Quercus), a not-too-close relative of sessile oak, pubescent oak, and pedunculate oak. The species is native to the Balkan Peninsula, but its distribution range also reaches South Italy and North-West Turkey. The northernmost autochthonous population can be found in North-West Romania. It is non-native to Hungary; the sporadic stands and old individuals found throughout the country are presumably of planted origin and were formerly introduced. Based on the climate envelope models, this oak species will probably be one winner of the changing climate and will expand northward in the future. Although its current importance in forestry is moderate, it can be a basic tree element of xerophilous mixed oak forests on the xeric limits. In this study, ten native populations from the Balkans were analyzed by applying ten chloroplast microsatellite markers in order to describe the genetic pattern of the different geographic regions throughout the main native distribution range. Another goal was to test the cp markers' resolution and usefulness for provenance identification. For this reason, we also checked and analyzed the cp haplotype pattern of five old planted stands from Hungary in parallel with those from the Balkans.*

Keywords: *Quercus frainetto, haplotype, genetic structure, climate change.*

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Climate change effects on tree species composition in the Southern region of the Republic of Moldova

Cosmin COSOFREȚ[1,*] Ciprian PALAGHIANU[1] Nicolae TALPĂ[2]
Alexei SAVIN[1] Laura BOURIAUD[1] Olivier BOURIAUD[1]

[1] Forestry Faculty, Stefan cel Mare University of Suceava, Romania;
[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Cosmin COSOFREȚ
E-mail address: cosmin.cosofret@usm.ro

Abstract: *The Republic of Moldova faces significant challenges due to land degradation and climate change, particularly in the southern region. It is crucial to restore degraded areas with local species adapted to the changing conditions. However, climate change can impact the distribution of these species. Landscape-level models can provide valuable insights for forest owners and managers to anticipate how species may shift and adapt over time. The LandClim model was used in Southern Moldova for the Baimaclia case study to evaluate potential changes in species composition and biomass stock under different climate scenarios. Under the mild climate scenario (RCP26), the LandClim model projected significant fluctuations in biomass stock over the next 100 years, with an average of 175000 tons. However, the extreme climate scenario (RCP85) revealed a sharp and rapid decline in biomass stock over 70 years, reaching a value of approximately 40,000 tons. For the mild climate scenario (RCP26), the model predicted a decline in* Q. pedunculiflora *and* R. pseudoacacia *by 2030. However,* the fast-growing species, B. pendula*, showed signs of recovery. Additionally, an increase in* Q. pubescens and P. sylvestris *was observed from 2050 onwards. In the extreme climate scenario of the Baimaclia case study, R. pseudoacacia maintained steady biomass of 75,000 tons over the first 20 years, while Q. pubescens showed a slight increase. However, between 2030 and 2040, a sharp decline was noticed for the species with lower participation in the composition, such* as Q. petraea *and* robur, C. betulus *and* A. platanoides*. At the same time, the biomass stock of* R. pseudoacacia *began to decline. From 2040-2070,* Q. Pubescens *and* R. pseudoacacia *biomass dropped down, being replaced by* P. sylvestris*, which grew to 50,000 tons in the last ten years of the simulation. In summary, under the mild climate scenario (RCP26), species composition changes occur without management intervention, but the stored biomass remains constant. In contrast, under the extreme climate scenario (RCP85), biomass stocks sharply decline after the first 30 years of simulation, and the species composition shifts dramatically, with P. sylvestris becoming dominant.*

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Bison habitat changes in the context of climate change in Natural Park Vanatori Neamt

Cosmin COSOFREȚ[1,*] Ionuț BARNOAIEA[1] Sebastian CĂTĂNOIU[2]
Laura BOURIAUD[1] Olivier BOURIAUD[1]

[1] Forestry Faculty, Stefan cel Mare University of Suceava, Romania;
[2] Vânători Neamț Natural Park, Romania.

Corresponding author: Cosmin COSOFREȚ
E-mail address: cosmin.cosofret@usm.ro

Abstract: *The European bison (Bison bonasus L.) has been successfully reintroduced in several European countries, but continuous monitoring is crucial to protect and restore its biodiversity and ensure the success of this reintroduction. The European bison's preferences for specific habitat types remain controversial and poorly understood. Initially, it was thought that the species depended highly on forest ecosystems, leading reintroduction efforts to prioritize large forested areas. Climate change will impact the bison's habitat by modifying forest ecosystems, carbon storage, and tree species diversity. Therefore, our study aims to investigate whether climate change or management strategies will alter the current preferences of bison from the Natural Park VanatoriNeamt regarding forest characteristics. The study found that under current management practices and mild climate conditions, carbon stocks in the area doubled over 50 years before declining back to the initial level of 60 tons per hectare. In contrast, the carbon stocks increased to 200 tons per hectare in areas with no management. Carbon stock declines only in extreme climate conditions, regardless of management type. While species diversity increases under current management in mild climates, no management leads to a decrease. However, tree species diversity decreases until 2070 in both climate scenarios and management strategies. Therefore, the potential impact of climate change on bison habitats is a matter of serious concern. These potential changes could push bison to migrate to areas that better meet their ecological preferences, reinforcing the need for adaptive management strategies.*

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Analysis of ichthyofauna composition, species distribution and water quality of the upper Olt River basin

Ionuț CRISTEA[1,*] George SIRBU[2] Georgeta Maria IONESCU[2]
Claudiu PASCA[2] Marius POPA[2]

[1] SCDEP Bucuresti - Wildlife Department, National Institute for Research and Development in Forestry "Marin Drăcea", Bucharest, Romania;

[2] SCDEP Brasov - Wildlife Department, National Institute for Research and Development in Forestry "Marin Drăcea", Brasov, Romania;

Corresponding author: Ionuț CRISTEA

E-mail address: ion_cristea@yahoo.com

Abstract: *The study aims to assess the ichthyofaunal composition of the upper Olt basin, and to determine the conservation status of the existing fish species. At the same time, water quality was determined and possible sources of pollution were identified. Estimates were also made of the biogenic capacity of the water and consequently its productivity. Thus, for the ichthyofauna inventory, sampling stations were carried out on tributaries of the Olt River (23 tributaries with a total of 51 sampling stations. Sampling of macronevertebrates at the same stations identified 10 genera. Water sampling for the qualitative study was carried out for the fauna inventory stations resulting in 41 samples. The field studies carried out in the rivers of the upper Olt basin identified the presence of 7 fish species, of which only the trout has an almost continuous distribution in the entire hydrographic network. Among the fish species of community interest, the presence of the common eel (Barbus meridionalis), the common scoter (Cottus gobio) and the common carp (Sabanejewia aurata) was identified, with fragmented distribution in the streams with permanent flow, on short river segments, in the hilly and foothill areas for the common eel and in the hilly and mountain areas for the common scoter. The analysis of the main water quality parameters shows an adequate water quality, characteristic of mountain rivers, with temperatures generally below 18 degrees Celsius, absence of pollutants, low concentrations of nitrates, nitrites, pH in the biological optimum of fish species, with the presence of phosphates in some of the sampling stations and ammonium ion. Investigations of benthic macro invertebrate communities revealed presence of the main groups of invertebrates in mountain waters (Plecoptera, Trichoptera, Ephemeroptera, Diptera, Amphipoda, Coleoptera, Oligocheta, Platelmintes, Nematoda, Odonata), biological indicators of surface water quality, with continuous distribution in the river sectors but with different abundance over time, depending on the stages of larval development of insects and the frequency of floods.*

Keywords: *ichthyofauna, macro invertebrate, Olt basin, quality parameters, biogenic capacity.*

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Ecosystem services assessment in protected areas in Romania

Roxana CAZACU[1,*] Constantin CAZACU[2] Marius POPA[1]
Georgeta Maria IONESCU[1,3] Ion MIREA[1] Ovidiu IONESCU[1,4]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Faculty of Biology, University of Bucharest,
[3] Carpathian Wildlife Foundation, Romania;
[4] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania

Corresponding author: Roxana CAZACU

E-mail address: roxana.cazacu@gmail.com

Abstract: *Ecosystem services are the benefits that ecosystems are providing to humans. Protected areas are aimed at preserving species and habitats as well as the integrity of ecosystems. Well preserved, natural and semi-natural ecosystems are prone to provide a wider variety of ecosystem services. In the current study we mapped and assessed ecosystems and their services in five protected areas in Romania. In order to do this, we applied biophysical and economic methods to rank the importance and value the services provided by different ecosystems. The protected areas considered here are designated as Natura 2000 sites of community importance three of them from continental and two from alpine biogeographical regions, their surfaces ranging from 350 ha to 24631 ha. Ecosystems were identified in accordance with European MAES classification levels 1 and 2 and mapped to high resolution national land use land cover classification. Ecosystem maps allowed us to identify the spatial distribution of their potential for providing services. We used Common International Classification of Ecosystem Services (CICES v5.1) and expert opinion that ranked the potential to provide a specific service using a scale from 0 – lowest to 5 – highest potential. Also, a quantitative evaluation of ecosystem services was done for the main three classes: provisioning, regulatory and cultural, using statistical data and modeling approaches (eg InVEST model). Monetary valuation was based either on direct market value or using direct and indirect costs. We identified a number of 7 types of ecosystems, a total number of 28 ecosystem services (10 provisioning, 11 regulatory, and 7 cultural). Total ecosystem value for studied protected areas accounted for 983409105 lei/year (196681821 Euro/year) from which the highest value is represented by regulatory services that has a total value of 894252921 lei /year (178850584 Euro/year). We are considering that such study is an important tool for assisting the decision-making process and improve the protected areas management plans.*

Keywords: *ecosystem services, protected areas, monetary valuation.*

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Structural diversity dynamic of sessile-oak mixed forests driven by the dominant tree species

Any Mary PETRIȚAN[1,*] Stefan PETREA[1] Oliver MERCE[1] Daniel Ond TURCU[1]
Virgil SCĂRLĂTESCU[1] Andrei Ioan APĂFĂIAN[1] Ion Cătălin PETRIȚAN[2]

[1] SCDEP Brasov - Department of Forest, National Institute for Research-Development in Forestry ''Marin Drăcea'', Romania;

[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Any Mary PETRIȚAN

E-mail address: apetritan@gmail.com

Abstract: *Old-growth forests are 'hotspots' of diversity and reference for managed forests. Despite the increasing interest, there is still little knowledge about the diversity of such forest and its temporal variation. Based on inventory data from two 10-yearly censuses in 20 circular plots of 1000 m^2, 12 dominated by sessile oak (over 50% of the stand volume) and 8 by beech, randomly scattered in the Runcu Grosi Nature Reserve, we studied the dynamics of the structural diversity of mixed sessile oak - beech old-growth forests and how it is influenced by the dominant species. Neighborhood indices of individual trees were used to quantify spatial structure by small-scale variations in tree positions, species, and sizes. A slight decrease in tree species richness was observed for both stand types (from 3.1 to 2.7 in beech- and from 4.8 to 4.6 in oak dominated stands). Regardless of the dominant species, the mean value of uniform angle index was 0.5, with minimal temporal variation, indicating a random distribution of trees. The species mixture index (Mi) significantly differed between sessile oak-dominated and beech-dominated stands in both censuses. Beech-dominated stands are more homogeneous in terms of species mixture of neighboring trees (Mi = 0.39) compared to sessile oak-dominated stands (Mi = 0.68). The mean Mi decreased to 0.19 in beech, and to 0.46 in oak dominated stands, what suggest a temporal increase of the degree of stand homogenization in terms of small-scale species mixtures. The mean dominance (0.5) and Gini (0.7) indices were similar in both stand types, and slightly changed between censuses. In general, the old-growth forests surveyed showed little change in diversity, probably due to the short period of investigation. But in the context of ongoing climate change, this could change and therefore monitoring of these valuable forests should be continued and intensified.*

Keywords: *old growth forests, structural diversity, diversity dynamics.*

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Analysing the adaptive reaction of European beech provenances from the perspective of quality traits

Emanuel BEȘLIU[1,2,*] Alexandru Lucian CURTU[2] Marius BUDEANU[1]

[1] SCDEP Brasov - National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Emanuel BEȘLIU

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

Abstract: *The morphological characteristics of a tree's stem determine its economic value and can also reveal its level of adaptation to specific environments.Provenance tests are considered a suitable method for testing different populations across various environments to estimate forest tree species' performance and adaptive capacity. Given the current concerns for finding and promoting resilient tree populations, the present survey aims to evaluate the adaptative reactionof European beech in the Carpathian region of Romaniafrom the perspective of quality traits. Four European beech provenance trials, which are part of two international provenance networks, were tested for Stem quality (Sq), Forking (Fk), and Branch diameter (Bd) at the ages of 24 and 27 before planting. The variation of the studied traits across environments was tested using an ordinal logistic regression model for categorical variables and a linear model for the numerical variables. In the 1995series, in themore favourable environmental conditions of the Carbunari trial, there was a significantly lower presence of forked trees and lower values for Bd compared tothe Sacele trial, where the number of trees with severe defects was notably higher. Regarding the 1998 series, there were significantly fewer trees with multiple base stem forks in the Alesd trial, as well as considerably lower Bd, and a significantly higher number of trees with straight stems, compared with the Fantanele trial.The tested provenances manifested different reactions in the test environments, indicating the need for caution in transferring the forest reproductive material.The quality of the beech stems was conditioned by the environment, which seems to significantly influence the performance of the provenances. The warm-humid and hot-humid environments favoured the adaptation process of international provenances.In specific conditions, the assisted transfer of provenances can be a feasible solution for increasing the qualityof the Romanian beech stands.*

Keywords: *Fagus sylvatica; provenance trials; quality traits; adaptive reaction; assisted migration*.

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Reindeer husbandry meets forestry and wind power in Finland – from uncontrolled impacts to holistic land-use management

Mikko JOKINEN[1,*]

[1] Natural Resource Institute, Finland.

Corresponding author: Mikko JOKINEN

E-mail address: mikko.jokinen@luke.fi

Abstract: *The reindeer husbandry area covers a third of Finland's territory, andthe whole of northern Finland. The reindeer economy has a legal right to exploit theland owned by both the state and private individuals and companies.There are numerous other land uses in the reindeer husbandry area, the most important of which areforestry and tourism. However, the newest and fastest growing sector iswind energy production, which is part of the so-called green transitionand considered as climate measure. Reindeer husbandry is a traditional livelihood that faces major challenges in adapting to rapidly expanding and changing land use. Forestry has been practiced on a large scale since the 1950s, resulting in the loss of old forests and good pastures that are important for reindeer husbandry. According to our research, reindeer herders are critical of forestry, but there are significant regional differences. In the northernmost part of Finland, where forests are owned by the state, attitudes towards forestry are also more critical. The state has a social responsibility to implement sustainable land use. There is no such political requirement for privately owned land. Wind energy production is a new industry whose effects on reindeer and reindeer husbandry are not sufficiently known. Reindeer economy is concerned about the potential negative impacts, which are seen as adding to previousadaptation effects. From the viewpoint of sustainable land-use planning it is problematic that either companies, herders or authorities do not know simultaneous and cumulative forestry and wind energy effects on reindeer herding. In this paper, our research team proposes a more holistic and regional approach to land use planning that recognises these simultaneous effects. Without such strategic planning, there is a risk that forests will be used in an ecologically and socially unsustainable way, increasing the risk of environmental conflicts.We think that land-use planning in reindeer husbandry area can be improved by studying the multiple effects on reindeer and understanding practices ofreindeer husbandry. It is scientific, social and political process.*

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Aspects regarding the main indicators for characterization of forest ecosistems in the Bârgău Montains area

Valentin LUPȘAN[1,*]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania

Corresponding author: Valentin LUPȘAN

E-mail address: lupsan.valentin@unitbv.ro

Asbtract: *Management the huge natural resources of forest ecosystems, on a new scientific basis, based on extensive research, mathematical modeling of their laws of biological functioning, by interacting with environmental factors and the anthropic factor, can positively or negatively influence ecosystems being a topical topic at national, European and global level.The inventory works carried out at the local level took into account the methodology of inventorying the stands at national level in the works of the National Forestry Inventory. The sampling used at the Bârgau Mountains level is based on a systematic network of squares with the 4 km side (indentially with the national network). The obtained results refer to: the network dimensioning by calculating to ensure optimal layered and multiphase repetitive sampling. It was foreseen the estimation of the area of forests and of the volume by species from the Bârgău Mountains area, by age classes, by stand density categories, and other. The present research also has a pronounced practical character because based on a rich research material, a number of indicators are used for forest production activity and a unitary estimation of the wood resources in the area of the Bârgău Mountains.*

Keywords: *Bârgău Mountains, forest ecosystems, statistical indicators.*

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- POSTER PRESENTATIONS -

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Measurements on the monumental willow trees of Romania

Diana VASILE[1,*] Andrei Ioan APĂFĂIAN[1] Raluca ENESCU[2]
Virgil SCĂRLĂTESCU[3] Vlad CRIȘAN[1] Simona COMAN[1]

[1] SCDEP Brasov - National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[3] SCDEP Mihăiești - National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Diana VASILE

E-mail address: diana_vasile@ymail.com

Abstract: *Monumental trees with large girth, great height and very old are important for biodiversity, and have an important cultural, botanical, symbolic or landscape value as well. The aim of the research were to identified and measure the monumental willow trees of Romania, and to register their main data (including their health status). 25 monumental willow specimens were identified and measured in the surface of 22 Romanian localities, within the radius of 14 counties. The most frequent species with monumental dimensions of genus Salix is White willow (Salix alba; 13 specimens) and Weeping willow (Salix babylonica; 9 specimens). Most of the specimens were located in the park (32%) or on the river bank (28%). In terms of health status, 40% of the measured trees are in very good and good condition and 60% are unfortunately in a bad condition. Due to their benefits and attractiveness, any kind of documentation about monumental trees is welcome and all the monumental specimens must receive as soon as possible, legal protection at the local or national level.*

Keywords: *genus, identified, monumental tree, specimen, willow.*

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First insights into the genetic pattern of native Hungarian ash (*Fraxinus angustifolia* Vahl subsp. *danubialis*) and common ash (*Fraxinus excelsior* L.) populations and their putative hybrids

Csilla Éva MOLNÁR[1,*] László NAGY[1] András KOLTAY[1]
Botond Boldizsár LADOS[1] Attila BENKE[1] Klára CSEKE[1]

[1] Forest Research Institute, University of Sopron, Hungary;

Corresponding author: Csilla É. Molnár

E-mail address: molnar.csilla.eva@uni-sopron.hu

Abstract: *The genetic patterns of Hungarian ash (Fraxinus angustifolia Vahl subsp. danubialis), common ash (Fraxinus excelsior L.), and their hybrid populations in Hungary were investigated for the first time with sixteen nuclear microsatellite markers. The objective was to confirm that the applied method effectively distinguished the two ash species based on their genetic patterns, at the population level, and at the individual level. Furthermore, putative hybrids identified with intermediate or mixed morphological traits were also selected for genetic analysis. Samples were collected from seven different regions in Hungary. Hungarian ash samples were collected from the south-west (Ormánság and Kaszó) and north-east (Bereg) of the country, while two common ash populations were sampled from central-west Hungary (Bakony and Keszthelyi mts). Two Common ash-dominated stands were also selected in Central Hungary (Kisszékely and Makád), where several putative hybrid individuals occurred. The main population diversity indicators were determined based on the nuclear genotype data. Principal Coordinate Analysis (PCoA) based on the genetic distance matrix was chosen for multivariate analysis, in conjunction with a Structure analysis using Bayesian assignment. The putative Hungarian and common ash populations exhibited a clear separation, with the presumed hybrid samples predominantly belonging to the common ash group, with the exception of four individuals whose allele composition was more similar to that of the Hungarian ash group. It is likely that, due to backcrossing, the gene stock of one of the original parent species is dominant in the genetic pattern of suspected hybrid populations. Furthermore, twelve common ash samples (out of the total of 30 collected) from the Kisszékely population exhibited a distinct separation from the other individuals of the stock. The distinctive geographical pattern of the Gemenc floodplain may also be observed in this group.*

Keywords: *Fraxinus, taxonomy, population genetics, hybridization.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Phoretic mite communities associated with *Ips typographus* (Linnaeus, 1758) and *Ips duplicatus* (Sahlber, 1836) (Coleoptera: Scolytinae) in a Norway spruce forest of Romania

Dragoș TOMA[1,*] Gabriela-Aurora ISAIA[2] Carol DIETER[2]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

Corresponding author: Dragoș TOMA

E-mail address: dragost93@gmail.com

Abstract: *European Spruce Bark Beetle Ips typographus (Linnaeus, 1758) is considered the most destructive and aggressive pest of Norway spruce in Europe. Recently, Ips duplicatus (Sahlberg, 1836), another species of bark beetle, primarily affecting the genus Picea, native to Russia, the Baltic States, and East Asia, has expanded its range westwards in Europe. Most commonly, the attack of Ips duplicatus on spruce trees is carried out together with Ips typographus, as both species exhibit similar behavior and biology. In spruce stands, bark beetle populations are closely associated with various organisms such as fungi, nematodes, and mites. Mites, due to the lack of specialized dispersal organs for covering long distances, use bark beetles through a phenomenon known as phoresy. While phoretic mites and their relationship with Ips typographus have been extensively studied in Europe, very few studies have focused on the populations of phoretic mites associated with Ips duplicatus. The aim of this study is to analyze and document the communities of phoretic mites and their complex relationship with the two species of bark beetles in the same location. The research was conducted in a stand located at the lower limit of spruce, where the two pest species have developed outbreaks together. Over 50,000 beetles were collected using wing-type pheromone traps, of which 4,348 were analyzed for the determination of phoretic mites (2,413 Ips typographus; 1,935 Ips duplicatus). In total, nine species of phoretic mites were identified, of which only six were found on Ips duplicatus. Among the nine species, Dendrolaelaps disetus (Hirschmann, 1960), Elattoma sp., and Paraleius cf. leontonychus (Berlese, 1910) are reported for the first time in Romania. The results highlighted that although Ips typographus beetles were significantly more phorezed than Ips duplicatus beetles throughout the entire flight period, the peaks of phoretic rates were similar. ONE-WAY PERMANOVA test revealed significant differences between the two phoretic mite communities, differences also highlighted by diversity indices. These differences are most likely due to the presence of certain mite species only on Ips typographus beetles, as well as differences between the populations of common species. Regarding the location of phoretic mites on the insects' bodies, this varied depending on the mite species and the host.*

Keywords: *Norway spruce, Ips typographus, Ips duplicatus, phoresy, phoretic mites, community.*

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FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Natura 2000 beetle species from the "Fr. Deubel" and "Ed. Scheeser-G. Theiss-E. Geist" Collections of the Faculty of Silviculture and Forest Engineering-Brașov

Ionuț-Marian DRAGOMIR[1,*] Daniel-Kazimir KURZELUK[2]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] Research and Development Institute for Plant Protection of Bucharest, Romania.

Corresponding author: Ionuț-Marian DRAGOMIR

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

Abstract: *In 1944, following the requisitioning of the building that housed the Saxon Museum of Bârsa Country, the inventory registers were either lost or destroyed. Consequently, the collections labeled "Ed. Scheeser," "G. Theiss," and "E. Geist," apart from the "Fr. Deubel" collection, have not been examined to date. The collections comprise 10 genera and 10 species, with the "Fr. Deubel" collection containing 33 specimens representing these 10 genera and species. In contrast, the "Ed. Scheeser," "G. Theiss," and "E. Geist" collections consist of 50 specimens from 8 genera and 8 species. These specimens were sourced from 13 localities or areas for the "Fr. Deubel" collection and 15 localities or areas for the "Ed. Scheeser," "G. Theiss," and "E. Geist" collections. Published data indicate that five localities are referenced in two studies on the coleopteran fauna of Transylvania, published between 1910 and 1925. However, the majority of records remain uninventoried in these works. The significant value of the studied specimens is attributed to their age and the status of the species as protected, for which collection is currently prohibited. Despite incomplete collection data, these specimens provide crucial zoogeographic documentation of the historical distribution of the studied species in Romania. Additionally, they serve as evidence of the presence of these species at the time, and potentially to the present day, in areas that are now designated as protected. This greatly enhances the conservation value of these locations.*

Keywords: *Coleoptera collection, The Saxon Museum of Bârsa Country, Natura 2000, beetle species.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Modules in case of forest fire intervention and the use of sensors for fire detection in the high fire risk area

Flaviu-Nicolae MAN[1,*] Alin Olimpiu EPURE[2]

[1] Transilvania University of Brasov, Romania;

[2] Technical University of Cluj Napoca, Romania.

Corresponding author: Flaviu-Nicolae MAN

E-mail address: manflaviu@yahoo.com

Abstract: *The increasing frequency and severity of forest fires due to climate change pose significant threats to ecosystems and human communities. This study examines forest fire intervention models and measures in continentally and in Eastern Europe, focusing on their effectiveness in mitigating wildfire impacts. The study systematically reviews scientific literature and grey literature, utilizing geospatial, statistical, and machine learning methods to identify key drivers of forest fires and evaluate intervention strategies. Findings highlight the importance of integrating advanced modeling techniques and continuous monitoring to enhance fire management practices. Fire detection using sensors are widely used these days, and if the device can collect and report air quality data's in real-time, and these data will be reported to certain departments, intervention can be much quicker and successful with less damages and less costly. Recommendations for policymakers and emergency responders include adopting data-driven approaches and fostering regional collaboration to build resilience against forest fires. This research provides valuable insights for improving forest fire management in Romania and contributes to broader efforts in mitigating wildfire risks in Eastern Europe.*

Keywords: *fire, forest, forestry, intervention, sensors.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

A new site with *Quercus pubescens* Willd. in the Vrancea Subcarpathians: an important forest genetic resource for reconstructing degraded lands

Bogdan-Ionuț PLEȘCA[1,*] Ciprian TUDOR[1,2] József Pál FRINK[1]
Cristinel CONSTANDACHE[1] Laurențiu POPOVICI[1] Ioana Maria PLEȘCA[1]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Bogdan Ionuț PLEȘCA

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

Abstract: *Identifying, describing, and mapping new populations of downy oak (Quercus pubescens Willd.) is essential for understanding ecological diversity and conserving this valuable species in the context of climate change. This study investigates a newly identified population of downy oak, highlighting its role as a significant forest genetic resource for the restoration of degraded lands. The research includes a comprehensive analysis of the population's ecological and phytocoenological context, plant community, and soil characteristics, aiming to improve knowledge of its habitat requirements, highlight conservation priorities, and provide strategic recommendations for future restoration and research efforts. The study was conducted in the lower basin of the Putna River in Vrancea Subcarpathians, covering approximately 35 hectares, with 40% included in the national forest fund and 60% designated as wooded pasture with a density greater than 0.4. Dominant soils include typical and lithic regosols and erodosols, with chemical analyses indicating a slightly alkaline pH, moderate carbonate content, and low levels of humus and nitrogen. The studied phytocoenoses includes Q. pubescens, Q. petraea, Fraxinus ornus, Pyrus communis, and Pinus nigra, with a shrub layer of Cornus mas, C. sanguinea, Prunus tenella, Berberis vulgaris, Ligustrum vulgare, and Cotinus coggygria. The herbaceous layer features xerothermophilous and xeromezophilous species typical of silvosteppe and eroded lands. These phytocoenoses belong to the Fraxino orni-Cotinion Soó 1960 alliance and the Cotino-Quercetum pubescentis Soó (1931) 1932 association. Future restoration efforts should prioritize conserving and expanding this downy oak population, enhancing soil health through targeted management, and implementing a robust long-term monitoring program to facilitate adaptive management and ensure sustainable ecosystem recovery.*

Keywords: *Quercus pubescens, forest genetic resources, degraded lands, plant community, conservation strategies.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Genetic variation of *Quercus petraea* (Matt) Liebl. provenances in two Romanian common garden experiments

Ioana Maria PLEȘCA[1,*] Ecaterina Nicoleta APOSTOL[1] Bogdan Ionuț PLEȘCA[1]
Robert Cristian IVAN[1] Ana Maria UNGUREANU[1,2]

[1] National Institute for Research and Development in Forestry ”Marin Drăcea”, Romania;
[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Ioana Maria PLEȘCA

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

Abstract: *To assess the interspecific genetic variability of sessile oak (Quercus petraea (Matt) Liebl.) and identify the most well-adapted and high-performing provenances, research was conducted in two comparative trials comprising 31 native sessile oak provenances from six regions of provenance. At 45 years after establishment of the plantation, phenotypic evaluations included survival rate, diameter at 1.30 meters height, total height, pruned height, stem straightness, trunk shape, and branch insertion angle. Analysis of variance revealed statistically significant differences between provenances for most traits in both trials. Significant differences were also observed between testing sites for all traits except diameter at 1.30 meters height and trunk shape. Phenotypic correlations among the traits and with geographic gradients of their areas of origin revealed significant correlations of varying intensities, highlighting the potential for multi-trait selection. Therefore, the forward selection strategy should prioritize growth-related traits (such as larger diameters and heights) and, where possible, consider stem form characteristics (such as lower stem straightness values). The results confirmed the non-optimality of local provenances hypothesis, as non-local provenances outperformed local ones in both trials. At the two testing sites, the most valuable provenances from a silvo-economic perspective and those best adapted to site conditions were identified and proposed as "Tested Sources" for the regions where they were evaluated. This study offers important insights into the phenotypic variability of sessile oak, with significant implications for enhancing tree improvement strategies and conserving forest genetic resources.*

Keywords: *genetic variability, Quercus petraea, comparative trial, phenotypic correlations, forward selection strategy.*

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FACULTY OF SILVICULTURE AND FOREST ENGINEERING

The health state of some pine stands and their behaviour on degraded lands from forest steppe site of Subcarpathians of Curvature

Ciprian TUDOR[1,2,*] Cristinel CONSTANDACHE[1]
Laurentiu POPOVICI[1] Valentina AGA[1,2]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Ciprian TUDOR

E-mail address: ciprianttudor210@gmail.com

Abstract: *The ecological restoration of inefficient lands for the development of agricultural cultures was achieved by creating artificial plantations with pine species adapted to extreme environmental conditions. The research was carried out in four representative research plots located in the old pine stands from the hilly internal forest steppe site (Ssd) of the Subcarpathians of Curvature, in the Livada-Râmnicu Sărat improvement perimeter. The representative research plots were classified by the nature of degradation and its intensity. The methods aimed to investigate the state of health of pine stands and to quantify the damages caused by zonal abiotic factors from the perspective of two indicators: the death rate (Gu) and damage degree (Gv). The extent of defoliation was tested on Kraft positional classes, using the standard defoliation scale and the Kraft classification system, to reflect the state of health in vertical structure. Against the background of the accentuated defoliation in the aestival season, the old pine stands showing a moderate death rate tendency for both species: Gu between 1.62 and 2.44 for Scots pine species, respectively between 2.02 and 2.34 for Black pine species. The Gv showing a severe damage in the case of the Scots pine stands, with the intensity of 25.73%, respectively a moderate damage in the case of the Black pine stands, with a intensity of 22.73%, the damages being caused by quite and frequent breaks or falls. The significant differences between defoliation means of both pine species are met in the 1, 2 and 4 Kraft classes ($p<0.05$), the extent of the defoliation being more pronounced in the case of Black pine species. The diagnosis of the health state of the pine stands is achieved by applying a differentiated management, in order to increase the resistance and stability of the stands to severe climatic impacts.*

Keywords: *defoliation, death rate, damage degree, Scots pine, degraded lands.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Chloroplast DNA variation and genetic differentiation in Swietenia species

Liuder Isidoro RODRÍGUEZ COCA[1,*] Elena CIOCÎRLAN[1] Alexandru Lucian CURTU[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Liuder Isidoro RODRÍGUEZ COCA

E-mail address: liuder.coca@unitbv.ro

Abstract: *The genus Swietenia includes two species of mahogany: Swietenia macrophylla (King.), commonly known as Honduran mahogany, and S.mahagoni (L.) Jacq, commonly known as Cuban mahogany. There have been reports of morphologically intermediate forms (MIF) between Cuban and Honduran mahogany that have been found in various Caribbean islands due to the cultivation of Honduran mahagony.Genetic diversity and differentiation in two Mahogany species (Cuban and Honduran mahogany) occurring in Cuba were investigated using three chloroplast microsatellite markers (cpSSRs). This study analyzed genetic diversity in five standsof Swietenia species from Cuba, focusing on the distribution and frequency of cpDNAhaplotypes across populations. Cp DNA haplotype H3 was the most frequent in all populations. Two cp DNA haplotypes (H1 and H2) were found only in the Honduran mahogany population. Emigdio population demonstrated the highest chloroplast DNA variation, with seven haplotypes identified. The overall genetic diversity, measured by expected heterozygosity (HE), was 0.543. Analysis of Molecular Variance (AMOVA) revealed that a significant proportion (94%) of the total genetic variance resided within populations. Genetic differentiation (FST) values based on multilocus genotypes are 0.195. The result highlights the complex genetic structure and significant intra-population diversity of Swietenia species in Cuba, providing critical insights for conservation and management strategies aimed at preserving genetic resources and ensuring the sustainability of these tree species.*

Keywords: *mahogany, Swietenia, hybridization, chloroplast DNA.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Genetic structure of two small, isolated *Pinus cembra* populations from the Brasov region

Mihai Bogdan FĂNĂȚAN[1,*] George Iulian STANCIULESCU[1] Iulia ENE[1]
Marina SHELLER[1] Alexandru Lucian CURTU[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Mihai B. FĂNĂȚAN[1]

E-mail address: fanatanbogdan@yahoo.com

Abstract: *It is generally accepted thatdistribution range fragmentation can restrict gene flow among populations and generate genetic differentiation. Small populations are generallyprone to elevated inbreeding and genetic drift. Three populations of Pinus cembra from Carpathian Mountains and two populations from Siberia (var. sibirica) were analyzed at the cpSSR and nSSR loci. The study of cpDNA diversity, using 3 microsatellite markers showed high levels of genetic diversity (He=0.808) in all populations and two common haplotypes were found among the Carpathian and Siberian populations. The polymorphisms at 10 nuclear nSSR markers showed relatively high values of genetic diversity (He=0.616). Genetic distances between Romanian and Siberian were higher, ranging from 0.638 to 0.471. Although the patterns of differentiation indicated two distinct groups according to geographical location, the Magura Codlei population is closer to the Siberian populations.The results may be useful for further studies about evolution of the Pinus cembra in Romania as well as for the elaboration of management strategies.*

Keywords: *Pinus cembra, relict populations, fragmentation, genetic diversity.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Does heterozygosity affect bud burst and architectural tree characteristics? A case study for European beech

Mihnea-Ioan-Cezar CIOCÎRLAN[1,2,*] Elena CIOCÎRLAN[1] Gheorghe Raul RADU[2]
Dănuț CHIRA[2] Oliver GAILING[1,3] Ourania GRIGORIADOU-ZORMPA[3]
Mihai-Daniel NIȚĂ[1] Alexandru Lucian CURTU[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[3] Department of Forest Genetics and Forest Tree Breeding, Büsgen-Institute Georg-August University of Göttingen, Göttingen, Germany.

Corresponding author: Mihnea-Ioan-Cezar CIOCÎRLAN

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

Abstract: *In the context of climate change effects, forest management has to focus on speciesthat have adapted and responded to them, proving plasticity through their regulation mechanisms. European beech (Fagus sylvatica L.) is one of the most widespread forest tree species in Europe and Romania, so bringing as much new information as possible regarding the interaction between genetics, phenology, architectural traits of a tree, and site conditions is essential. In this study, we aimed to monitor the spring and autumn phenology of55 beech individuals for one year and to associate these data with their heterozygosity based on six microsatellites (gSSRs, genomic simple sequence repeats) and six expressed sequence tag microsatellites (EST-SSRs). We also aimed to evaluate the architectural traits (breast diameter, heights of the tree and trunk, total volume, number and length of branches, and crown diameter) of trees through non-destructive terrestrial laser scanning (TLS), and based on them, to calculate the individual Hegyicompetition index, slenderness, and forking. We tested the association between all of these data. The onset of bud burst and senescence, as well as the length of the growing season, varied significantly and inversely proportionally with the altitudinal gradient. There was a difference of 14 days between the individuals located at the extremities of the altitudinal gradient in the onset of bud burst, 15 days in the onset of senescence, and 30 days in the length of the growing season. We obtained a very significant and positive correlation between altitude and bud burst (0.9) and a very significant but negative one with the length of the growing season (-0.91). The increase in competition directly implies a decrease in DBH and crown dimensions, especially by neighbors closer to 4 m. The stem's slenderness significantly increased with increasing competition. Our results revealed a significant and positive relationship between individual heterozygosity and the length of the growing season, as well as with the trunk volume and DBH.*

Keywords: *European beech, heterozygosity, microsatellites, bud burst, the length of growing season, 3D tree shape, TLS.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Analysis of windbreakage of Douglas fir provenance trials established in Romania

Emanuel STOICA[1,2,*] Alin Mădălin ALEXANDRU[1,2] Georgeta MIHAI[1]
Alexandru Lucian CURTU[2] Virgil SCĂRLĂTESCU[3]

[1] SCDEP Voluntari - Department of Forest Genetics and Tree Breeding, National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[3] SCDEP Mihăiești - National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Emanuel STOICA

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

Abstract: *Douglas fir (Pseudotsuga menziesii (Mirb.) Franco) is an important commercial species in the western region of North America and ranks among the most valuable trees species due to its high-quality timber, rapid growth rate, and resistance to diseases and insects. Douglas fir covers an area of about 14.4 million hectares in the USA, 4.5 million hectares in Canada, over 823.534 hectares at the European level, and approximately 12.700 hectares in Romania.In 1977, three comparative trials were initiated in Alesd (with 57 provenances), Faget (with 48 provenances), and Pades (with 48 provenances) to evaluate the adaptability and performance of this species under Romanian conditions.These provenance trials are located in distinct regions of Romania, each representing different environmental conditions.The material investigated as part of this study consisted of provenances from the USA, Canada, Germany, France, and Romania.An unexpected challenge has emerged in the windbreakage, particularly in the Alesd trial. The main focus of our study was to assess the broken trees across the three sites. The analysis revealed that Alesd (13.6%) experienced significantly higher windbreakage rates than Faget (3.5%) andPades (7.2%). The analysis of broken trees in these Douglas fir provenance trials in Romania, with a focus on the Alesd trial, has provided crucial insights into the challenge of cultivating this species in diverse Romanian conditions. The higher incidence of windbreakage in Alesd underscores the complex interactions between genetic factors and environmental conditions in determining provenance performance and resilience. Provenances that demonstrate both good growth and lower windbreakage rates should be prioritized for further testing and potential inclusion in the breeding program.*

Keywords: *Douglas fir, provenance trials, broken trees, windbreakage.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Genetic variation and adaptability of pedunculate oak (*Quercus robur* L.) in a common garden experiment in Central Romania

Ana-Maria UNGUREANU[1,2,*] Ecaterina Nicoleta APOSTOL[2]
Robert Cristian IVAN[2] Alexandru Lucian CURTU[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;
[2] SCDEP Brasov - National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Ana-Maria UNGUREANU

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

Abstract: *Common garden experiments represents one of the most used type of research which allows to determine intraspecific genetic variation of trees species. In Romania, genetic variability of pedunculate oak (Quercus robur L.) and not only, tested through this type of experiment, has registered an increased interest in the recent years due to the adaptability of forest species to climate changes. By analyzing 11 pedunculate oak provenances in Reghin common garden (Reghin Forest District, Mureș county), this study aims to determine the most adapted provenances, to analyse the growth performances of local, national and international provenances and also to determine the influence of testing site on provenance development. Survival rate for each provenance was very low, with values ranging between 8% to 42%, and it was visibly affected in time by site conditions. The data obtained for growth traits are homogeneous within provenances, with correlation coefficient (r = 0.57) and standard deviation (SD = 0.30) which indicates a moderate correlation between Theight [m] and DBH [cm]. Also, adaptive traits (stem shape, trunk shape, branches thickness and insertion angle) are characterized by homogeneity according to ANOVA test, which indicates that there are not statistically significant differences between the meanvalues. The results show differences in provenances adaptability and resistance (national provenances from south of Romania are less adapted and resistant than local and international provenances) and this is very important in a future process of preserving valuable genotypesfor tree breeding programs.*

Keywords: *pedunculate oak, common garden, provenances, adaptability, genetic variation, resistance.*

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Forest and wildlife management

- ORAL PRESENTATIONS -

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Analysis of human-bear conflicts from the last 10 years in Romania

Ramon Romulus JURJ[1,*] Constantina JURJ[2] Alexandru GRIDAN[1]
Georgeta Maria IONESCU[1] Ancuța FEDORCA[1] Mihai FEDORCA[1,3]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Carpathian Wildlife Foundation, Romania;
[3] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Ramon JURJ

E-mail address: ramon@icaswildlife.ro

Abstract: *In the last decade, there has been an increase in the number of conflict situations between humans and bears and their diversification. Many human activities have extended deeper into the bear's habitat. The research aimed to investigate the main stakeholders and analyze the available data through: questionnaire survey, research interview, focus group, study of social documents and analysis of the content of communication on the theme of human-bear conflicts. The study was carried out for information collected in the period 2014-2023 at the national level. For the last 10 years, there has been an increase in the number of cases and the amounts awarded for compensation and an actual increase in the number of claims. The months of the year with the most damage records are September and August. The counties with the most damage that have reached the stage of awarding compensation are: Harghita and Mureș. Among the events resulting in the accidental killing of some bears, Harghita county ranks first, followed by Covasna with almost half the number of cases, then Brașov. The most frequently recorded bycatch events are in Bacău and Covasna. Direct human-bear conflict can be divided in: Injuring people during activities in the bear's habitat (herding/grazing, recreational activities, forestry work) and Injuring people near human settlements (households, gardens, crops agricultural). As in any field and on any subject, polarization does nothing good for either man or bear. A balancing of views in a constructive dialogue and the adoption of a package of measures agreeable to all parties involved would bring major benefits to the goal of human-bear coexistence. Not every group may be completely satisfied, but compromises are necessary on all sides to ensure the long-term perpetuation of the bear species and the restoration of acceptance in some local communities.*

Keywords: *human-bear conflict, human-bear coexistence, injuring people.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Beaver management in the site Natura 2000 ROSCI 170 - The forest and the eutrophic marsh Prejmer

Georgeta – Maria IONESCU[1,2,*] Daniel VIȘAN[1,2]
Ovidiu IONESCU[2,3] Alexandru GRIDAN[1,2] Claudiu PASCA[1,2]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Carpathian Wildlife Foundation, Romania;
[3] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Georgeta - Maria IONESCU

E-mail address: titi@icaswildlife.ro

Abstract: *The beaver was reintroduced to Romania in the Olt river basin in 1998 after its disappearance for more than 200 years. The inventory of the beaver population inside the ROSCI 0170 - The forest and the eutrophic marsh Prejmer, site was carried out using the burrow inventory method combined with direct observations and also photo-video cameras. The conservation status of the species was determined taking into account the conservation status assessment matrix for the species, habitat, pressures and threats. Following the works carried out and analysis, a population of 24-28 specimens was estimated, representing approximately 0.1-0.15% of the national population. The species density in ROSCI 0170 is about 7-8 individuals per km 2. The beaver occupies an area of approximately 110 ha spread over a third of the site's surface. The 11 pressures and threats identified for the beaver inside the site determined the development of 17 measures, of which 11 are active measures and 6 are management measures. The provided measures were developed in such a way as to take into account the economic, social and cultural conditions of the local communities, as well as the local and regional particularities of the area, with priority being given to the management objectives of the natural protected area.*

Keywods: *beaver, management, distribution, conservation, protected aria.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Developing management measures in Natura 2000 Sites from Brașov metropolitan area

Alexandru GRIDAN[1,2,*] Bianca BÎRZA[1]
Ramon JURJ[1,2] Ancuța FEDORCA[1,2]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Carpathian Wildlife Foundation, Romania;

Corresponding author: Alexandru GRIDAN

E-mail address: gridanalex@gmail.com

Abstract: *The extended urban area around the city of Brașov, created for economic and social development, borders important natural habitats in terms of biodiversity. Certain natural habitats and the wild animal species that inhabit them, in the vicinity of the Brașov metropolitan area, have been included in the NATURA 2000 network of protected areas. The bear, wolf, and lynx are some of the species with special requirements regarding habitat quality, and their conservation and management is a difficult task in Brașov metropolitan area due to the high anthropogenic pressure. To ensure the conservation of these large carnivore species, monitoring actions and development of management measures are necessary, considering their ecological requirements while also ensuring sustainable development of the metropolitan area. The development of these management measures was based on inventory and mapping studies of the species and impact studies in the three targeted sites: ROSCI 0170 - The forest and eutrophic marshes from Prejmer, ROSCI 0195 Piatra Mare, and ROSCI 0207 Postăvarul. To estimate population size and distribution, the following methodologies were used: i) tracking on transects, and ii) predefined stations (scent station, trap cameras, direct observations). Following this analysis, the main management measures were established to conserve habitats and species, ensure connectivity, and reduce damage and conflicts. In conclusion, the analysed sites in the Brașov metropolitan area provide natural conditions for ensuring the conservation and active management of large carnivore populations, ensuring their favourable conservation status.*

Keywords: *protected area, management, carnivoures, monitoring.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Effect of fertilization on the nutrient uptake of black locust (*Robinia pseudoacacia* L.) in lowland plantations

Attila BENKE[1,*] Tamás SÜLE[1]
Valter TOLDI[1] Katalin BERECZKI[1]

[1] Forest Research Institute, University of Sopron, Hungary.

Corresponding author: Attila BENKE

E-mail address: benke.attila@uni-sopron.hu

Abstract: *Climate change-induced alterations in soil conditions pose increased challenges for both naturally managed forest stands and tree plantations. For the latter, the use of improved varieties with a wider range of site tolerance can provide a solution to maintain production security under changing ecological conditions. For this reason, knowledge of the ability of different varieties to utilize poor site conditions is considered a priority. The nutrient content of plant tissues may be related to the nutrient utilization capacity of the plant and, thus, to the plant's ability to exploit the ecological conditions of the area. In the present study, we investigated the nutrient utilization capacity of black locust (Robinia pseudoacacia L.) clones in plantations established in poor sandy soils, based on the nutrient content accumulated in their leaf tissues under different doses of chemical and organic fertilizer application. Based on our studies conducted over three years, we found that complex (chemical) fertilizer treatments had a lower effect on plant nutrient uptake (leaf element accumulation), although the effect varied between experimental sites. In contrast to chemical, organic fertilizer treatments had a more significant effect on the element content of plant leaves; pure organic fertilizer and combined organic-chemical fertilizer treatments significantly increased the nitrogen, potassium, magnesium, iron and zinc content of plant tissues. It is true, however, that this effect was only temporary and that no statistically significant difference was observed in the plantation in the 2nd year after application compared to the control treatment. Our studies also revealed differential element accumulation of the black locust clones tested in each experiment, suggesting a genetic determination of nutrient utilization capacity. Overall, our results may provide valuable information for research aimed at revealing the physiological background of site tolerance of plants and for studies aimed at developing fertilization technologies for black locust plantations.*

Keywords: *plantation forestry, nutrient accumulation, leaf tissue, poor-quality soil, fertilizer.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

First step in standardising the collection of game statistics in Romania: a case study AJVPS Prahova

Ion MIREA[1,2,*] Danie Ștefan ILIE[3] Mihai FEDORCA[1,2]
Ancuța FEDORCA[1,4] Ramon JURJ[1] Alex GRIDAN[1]
Roxana CAZACU[1] Daniel IORDACHE[2]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;
[3] S.C.Direct Hunting S.R.L., Chiojdeanca, Prahova, Romania;
[4] Carpathian Wildlife Foundation, Romania.

Corresponding author: Ion MIREA

E-mail address: ion.mirea78@gmail.com

Abstract: *The adoption of integrated management decisions on wild game species by natural resource managers must be supported by data collected uniformly using frameworks and methodologies that allow comparisons between projects and across time. Given that hunting statistics can represent a source of reliable data for monitoring population trends in game species, a standardized framework was created in Romania for the collection and analysis of this data in an interactive digital system within the digital application "managementcinegetic.ro". Here we describe a case study on the use of the application and hunting statistics by AJVPS Prahova for (i) record of issued hunting authorizations (ii) record of achieved hunting quotas (iii) record of hunting effort (iv) record of individual hunting achievements. We have described the application and the scientific and socio-economic utility generated. Built-in legal and technical challenges are mentioned here. Reports, analysis and interpretation methods are also presented. It is recommended to use the software application to collect information from the field in a standardized way, which requires the involvement of stakeholders as part of the monitoring process. Software applications were designed only after clear objectives for the monitoring program were defined. Making hunting data open access will improve collaboration and information transfer to scientific and professional sectors. . The app can also be adopted by other entities, which would make the hunting data more useful for population monitoring and wildlife policymaking on a national scale.*

Keywords: *app, monitoring, game species, hunting.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Impact of forest management practices on ground vegetation in a pedunculate oak forest

Maria Alexandra BAROGA[1,*] Victor Adrian INDREICA[1]
Jorge CURIEL-YUSTE[2] Ion Cătălin PETRIȚAN[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;
[2] Basque Centre for Climate Change, BC3, Spain.

Corresponding author: Maria Alexandra BAROGA

E-mail address: malexandrabaroga@gmail.com

Abstract: *Natural resources as forests, soils and water, as well as biodiversity and carbon storage, are the main areas of interest for scientific research. The impact of silvicultural interventions on the forest ecosystem and consequently on forest soils and herbaceous layer is of great interest in order to determine the best management practices for a sustainable future. As part of the HoliSoils project funded by Horizon 2020 programme, one experimental area was established in a pedunculate oak forest aged 150 years, located in Brașov county, Romania. The aim was to evaluate the impact of different intensity silvicultural interventions on forest soil processes and physico-chemical properties, as well as on the ground vegetation. The study was carried out in four experimental blocks of 4800 m2 established in December 2021. During January and February 2022, silvicultural interventions of different intensity were performed, simulating clear-cutting and thinning, with control areas also maintained. Following the interventions, microclimatic conditions at ground level were recorded using TMS-4 dataloggers and soil sampling cores were extracted in order to determine the concentration of organic carbon (C), total nitrogen (N), carbon to nitrogen ratio (C:N), and PH. Light conditions were assessed using hemispherical photos, while plant species in the herbaceous layer were recorded using the phytosociological relevé method. The analyses conducted in this study show that following the silvicultural interventions carried out in the studied forest stand, no significant changes were recorded in the soil properties or in the composition of ground vegetation in the first two years after the interventions. The application of the treatment did not lead to systematic changes in the floristic composition, as indicated by the similarity analysis between the categories of plots where intensive management intervention and low-intensity intervention were performed, compared to the control area.*

Keywords: *Quercus robur, forest soil, carbon content, herbaceous layer, sustainable management.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Monitoring wildlife species using photo-trap cameras – case study Buzau and Prahova counties

Mihai FEDORCA[1,2,*] Ion MIREA[1,2] Ancuța FEDORCA[2,3]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[3] Carpathian Wildlife Foundation, Romania.

Corresponding author: Mihai FEDORCA

E-mail address: mihai.fedorca@yahoo.com

Abstract: *Monitoring wildlife has been a primary concern in recent years; quality data are needed to assess population status, species interaction, habitat use, and breeding of some elusive species. Using photo-trap cameras is a new trend in wildlife research, revealing new information regarding elusive aspects of species and individuals. Our study was conducted on 11 hunting grounds from Buzau and Prahova counties, located in the mountainous and hilly regions of the South-Eastern Carpathians. In the last two years, 55 units in total have been used of three photo-trap camera models. Brown bear (Ursus arctos) has been selected as the target species in this study. Some preliminary monitoring methods were needed to ensure the best locations for the camera placement, such as snow/mud tracking and marking signs identifications. After the installation, the cameras remain in the field for different time series to identify the influence of trap days. The pictures and/or videos were recorded in the camera's internal storage and were accessed either online or manually downloaded. After the data was analyzed, the results showed the differences between the two counties in the number of identified individuals, the months with the most recorded individuals, the hours of the day in which the species was active, and most importantly, the number of species identified.*

Keywords: *brown bear, wildlife monitoring, photo trap cameras, wildlife management.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Perspectives on human – wildlife accidents reporting in Romania

Florin Lucian TOIU[1,*] Iulia BACIU[1] Ancuța FEDORCA[1,2]
Roxana CAZACU[3] Giorgiana VODA[1] Lucica Catalin TOIU[1] Ovidiu IONESCU[2,4]

[1] SCDEP Brasov - National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[2] Carpathian Wildlife Foundation, Romania;

[3] SCDEP Voluntari - National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[4] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Florin Lucian TOIU

E-mail address: florinluciantoiu@yahoo.com

Abstract: *Conservation of wildlife is challenging for the decision-makers most of the time when wildlife attacks humans or cause damages. Most of the time the incidents between people and wild animals, especially large carnivores (bears and wolves), occurs in hot spots where the population densities are high. Human-wildlife accidents (HWA) is a well-known research area which started from many years ago because roads are an important source of mortality for large mammals and may act as barriers for wildlife populations. To ensure the human-wildlife coexistence and long-term benefits, as well as to prevent conflicts, there is a clear need of implementation of specific wildlife management and strategies. For this reason, it is necessary to analyze the compensation scheme for human-wildlife accidents, which includes current practices, legislative structure, and the scientific literature. Several meetings have been organised with the stakeholders and decision makers in wildlife damage management to discuss how to optimize the entire process of accident recording and reporting. The stakeholders' attitude and opinion has been analysed using paper and online questionnaires. 63 responses have been collected by representatives from the Ministry of Environment, National Environmental Protection Agency, Forest Guard, Police Administration, regional road administration, protected area manager, hunting ground manager, and free-practice veterinary doctor. Half of the respondents belong to the middle age category (36-50 years), which indicates a certain openness to the digitalization of existing workflows. Moreover, most of them came from Brasov area which is dealing with an increasing bear mortality caused by road and train accidents. A main solution for the HWA reporting is the development of a digital tool. In the compensation scheme there are many actors from different entities involved and a digital workflow would facilitate their work. The most frequently encountered benefits mentioned by the subjects were: time-efficiency, traceability of the documents, the development of local preventing measures, support of the entire process of recording, reporting, and evaluating of the damage.*

Keywords: *brown bear, human-wildlife-accidents, stakeholder attitude, digitalization.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Projected changes in the natural forests of the Austrian-Hungarian border region under climate change

László NAGY[1,*] Norbert MÓRICZ[1]

[1] Forest Research Institute, University of Sopron, Hungary.

Corresponding author: László NAGY

E-mail address: nagy.laszlo@uni-sopron.hu

Abstract: *The strategy of assisted migration is becoming increasingly important for enhancing or maintaining forest resilience in the context of climate change. This proactive conservation approach involves the intentional translocation of species, populations, or genotypes to areas outside their historical ranges, where future climatic conditions are anticipated to be compatible with their adaptive capacities. In forestry, assisted migration is employed to address several urgent challenges, including climate adaptation, biodiversity conservation, and the preservation of ecosystem services. The potential range shift, future species distribution and vulnerability of European beech and sessile oak have been assessed for the border region of Austria and Hungary based on continental-scale species distribution models. The projected decrease in occurrence probabilities indicated a notable risk of habitat loss for both species. In order to maintain the native forest cover, a local forest reproductive material transfer and use strategy has been developed, accompanied by recommendations for the transfer and relocation of FRM within the area. As part of the implementation of this strategy, six field trials have been set up in the region to demonstrate the concept and to investigate the long-term effects of the transfer. The first results for the juvenile age are presented.*

Keywords: *climate change, assisted migration, adaptive forest management, provenance trial, forest reproductive material.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Study on the conservative management of Bat Species in ROSCI0207 Postăvarul și ROSCI0195 Piatra Mare

Cezar Georgian SPĂTARU[1,2,*] Levente BARTI[2]
George Eugen SÎRBU[1,2] Flaviu VODĂ[1,2]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Carpathian Wildlife Foundation, Romania;

Corresponding author: Cezar Georgian SPĂTARU

E-mail address: sptrcezar@yahoo.com

Abstract: *Conservation measures are concrete actions and mechanisms that need to be implemented for a Natura 2000 site to achieve its conservation objectives. It is mandatory to establish these necessary measures, whether they are applied within individual sites or, in some cases, even outside the site boundaries or across multiple sites. In the initial phase, using the inventory method and monitoring stations, species distribution and presence were assessed in the field based on the specific standard form for each site. From this perspective, the aim was also to estimate the population at the site level. In addition to the species Myotis myotis, Rhinolophus hipposideros, and Barbastella barbastellus for both sites, and Rhinolophus ferrumequinum additionally for the Postăvarul site, a number of new species have been recorded. These include Myotis bechsteinii, Myotis mystacinus, Myotis brandtii, Myotis nattereri, Pipistrellus pipistrellus, Nyctalus noctule, Eptesicus serotinus, Vespertilio murinus, and Plecotus auratus. The conservation status of the bat species identified in the two sites has been assessed as favorable in terms of all the 3 following parameters: population size of the species, habitat of the species, and future prospects of the species. In the socio-economic context of the site, management measures have been formulated to address the identified present and future pressures and threats for the bat species.*

Keywords: *Natura 2000, conservative management, Chiroptera.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Ungulate browsing impact in western Romania

Darius HARDALAU[1,*] Ovidiu IONESCU[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Darius HARDALAU

E-mail address: darius.hardalau@unitbv.ro

Abstract: *In recent decades, ungulate populations in Romania, especially roe deer, red deer, and fallow deer, have experienced a notable increase in both numbers and range. This upward trend has raised concerns as these ungulates reach higher densities, leading to significant impacts on agriculture and forests. One of the damages to the forested area is represented by browsing, which refers to all forms of feeding damage other than bark stripping. The overabundance of ungulates in the Western plains of Romania has started to create real problems for the young oak-dominated tree regenerations, and in some cases, artificial regeneration has had to be replanted. This study aims to investigate the intensity of this phenomenon in young tree stands, identify ungulate preferences, and suggest proper management strategies to prevent and combat browsing. The study area is located in the Western Plains of Romania, in forested areas managed by O.S. Tinca. Both artificial and natural regeneration were the subjects of the study, totaling around 100 hectares. Browsing intensity in some stands is higher than 80%, while in properly fenced areas, the intensity is considerably lower. To control this phenomenon, strategies from both the forest manager and wildlife manager had to be adopted.*

Keywords: *ungulate, deer, browsing, oak stands, regeneration.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Wildlife-vehicle collisions in Brasov County: an analysis of the prevention actions

Iulia BACIU[1,2,*] Mihai FEDORCA[1] Ancuța FEDORCA[2,3]
Flaviu VODĂ[2] Ovidiu IONESCU[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;
[2] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[3] Carpathian Wildlife Foundation, Romania;

Corresponding author: Iulia BACIU

E-mail address: iuliaa.baciu@yahoo.com

Abstract: *Car accidents with wildlife species pose a real danger to human dimension and may cause imbalances within the mammal populations. Romania is in full development of the road infrastructure, therefore barriers to animals' movement will increase in the near future. This paper aims to establish the monitoring methodology of the most dangerous road sectors from Brasov county according to the literature and practictioners experience, and to reveal a pattern for efficient prevention measures specific to the area's features for medium-sized and large mammals. Road signs proved to be ineffective, and warning systems not adapted in time cannot be a long-term solution. In parallel, the existing bridges are used as underpasses but they need to be cleaned to facilitate the crossing. The risk mitigation actions should be selected according to the location characteristics and to the most significant landscape predictors which, if assessed and interpreted properly can lead to a significant decrease in the number of collisions.*

Keywords: *car accidents, population imbalance, risk mitigation, mortality, large mammals.*

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Forest and wildlife management

- POSTER PRESENTATIONS -

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Comparative study of exploitable stands with Norway spruce, from Harghitei, Bârgăului and Suhard Mountains

Valentin LUPȘAN[1,*] Gábor MOLNÁR[2] Marian TRISCIUC[3]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] Sapientia University, Sfântul Gheorghe, Covasna county, Romania;

[3] National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Valentin LUPȘAN

E-mail address: lupsan.valentin@unitbv.ro

Abstract: *Comparative study of exploitable spruce stands, in the geographical units of the Harghitei, Bârgăului and Suhard Mountains. These stands are of the same age, grow on the same seasonal conditions but in different geographical units. The study covers a period of 20 years. The objectives of the study are the comparative study of habitats, seasonal characteristics, biometric characteristics (evolution of growth in volume, in diameter and height, in the base area, growth of annual rings) in direct correlation with climatic conditions.*

Keywords: *biometrics indicators, norway spruce, exploitable stands.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Evolution of some structural, qualitative and stability parameters in Norway spruce stands from risk areas to disturbing factors

Radu VLAD[1] Alexandra STEFAN[1,*] Gheorghe STEFAN[1]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

Corresponding author: Alexandra STEFAN

E-mail address: ispravnic.alexandra@gmail.com

Abstract: *Knowing the dynamics of some structural, qualitative and stability parameters in Norway spruce stands are very important elements in the management of forest ecosystems from risk areas to the disturbing factors. The research material consisted of two long-term permanent plots installed in Norway spruce stands in 1991 and re-evaluated in 1999, 2004, 2016, 2023 years. Research aspects relate to the evolution of some main biometric, structural, of stability and qualitative indicators were addressed. The obtained results showed that the researched stands were significantly affected by the destructive action of the wind mainly and the snow, having as a favorizing factor the injuries produced by cervids. The number of trees·ha-1 that decrease significantly influences the other analyzed structural parameters, the production and the specific productivity of the affected Norway spruce stands. The dynamics of the average diameter was influenced by the corresponding reduction in the number of trees and by the distribution of the number of trees by diameter categories. The average growth of the main production has specific values far below the optimum of the current age. Against the background of the relatively constant value of the damage frequency, above of 75% in the studied stands, the percentage occupied by wood with trunk rot, indicates that the number of injured trees is significant. The stability parameters (the slenderness coefficient characteristic to the average tree and per stand), studied evolutionarily, indicate that the stands fall into the vulnerable area, respectively in the area with reduced vulnerability to the wind action. It was found the existence of high-risk points for the production of felling caused by the wind, for the stands researched in the Tomnatic Experimental Base, this aspect is indicating a strong decrease in individual and group stability, having as a favoring factor cervids damage.*

Keywords: *Norway spruce, structural parameters, quality, stability.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

iPhone digital technology versus traditional methods: analyzing tree and stand measurement

Gheorghe-Marian TUDORAN[1,*] Avram CICSA[2] Alexandru-Claudiu DOBRE[2]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Gheorghe Marian TUDORAN

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

Abstract: *Digital tools for measuring trees have become increasingly useful in forestry. This research aimed to compare two different methods for measuring trees and stands. The study was conducted on 26 circular plots, each 500 m² (471 trees), systematically located in a mixed coniferous and beech stand in the Romanian Carpathians. For each tree in the sample plots, circumference and height were measured. In parallel with traditional measurements, the Arboreal Forest application, integrated into iOS (Apple Inc.) and used on the iPhone 15 Pro, was employed to measure tree diameter and average height at the plot level. Compared to traditional measurements, using the iPhone yielded volume differences ranging from -4.7 to +3.1 m³ (the average volume of the sample plots being 28.7 m³), with a mean square error of 0.07 m³ (6.7%). The average measurement time per sample plot was 2 minutes and 5 seconds longer when using the iPhone. Despite this, iPhone technology proved to be a quick and efficient way to collect essential tree data.*

Keywords: *Arboreal Forest, tree diameter, tree height, stand volume, mixed stand.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

The survival of oak seedlings in an agroforestry system near Craiova (southern-eastern Romania): preliminary results

Cristian Mihai ENESCU[1,*]

[1] Department of Soil Sciences, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania.

Corresponding author: Cristian Mihai ENESCU

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

Abstract: *Agroforestry systems play an important role in mitigating the effects of climate change, especially in fragile environments, such the ones from southern-eastern Romania, where drought represents the main challenge for the young plantations. In 2023, twenty square plots (24m x 24m) containing a mixture of forest species and agricultural crops were planted. In 11 out of the 20 plots, four oak species, namely pedunculate oak (Quercus robur L.), red oak (Q. rubra L.), Turkey oak (Q, cerris L.) and sessile oak [Q. petraea (Matt.) Liebl.] were among the main tree species planted in an agroforestry experiment located in Cârcea, near Craiova. The aim of this study was to assess the survival rate of the planted oak seedlings. In addition, data regarding temperature and relative humidity were collected by the aid of six HoBo sensors (Onset Computer Corporation). The results of this study represent another proof of the importance of introducing oak species in mixed-cultures across southern-eastern Romania.*

Keywords: *agroforestry, oak, Quercus, seedlings, survival.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

The ecological reconstruction of the forest ecosystems affected by harmful climatic factors within the Magura Odobesti protected natural area

Cristinel CONSTANDACHE[1] Laurențiu POPOVICI[1,*]
Ciprian TUDOR[1] Virgil IVAN[1]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Laurențiu POPOVICI

E-mail address: laursilva@yahoo.com

Abstract: *The beech trees in the upper of the natural protected area Măgura Odobești (ROSPA 0075) were heavily affected by breaks and felling caused by the phenomenon of "freezing rain" and/or snow and wind, starting in 2015. The researches focused primarily on the evaluation of the structure of the affected stands and on the natural regeneration installed continuing with the identification of the possibilities of ecological reconstruction, in the conditions of the installation and quick expansion of the fast growing species on lands with a high slope and sometimes, with rock on the surface. In the situations where the natural regeneration of the basic species (beech, sessile oak, cherry etc.) has been identified, the proposed solutions were aimed at the simultaneous application of the works to help the natural regeneration and the works to complete it. In the case of non-regenerated or poorly regenerated areas, plantations with 60% gorun and 40% cherry, sycamore were proposed on an area of 11.7 ha and sowing in trays (50% beech and 50% cherry, sycamore), on an area of 25.01 ha; works carried out starting from spring 2021. For the monitoring of the regeneration and the analysis of the evolution and diversity of the newly installed crops, a system of long-term research surfaces was placed in representative situations. The paper presents the results of the research on the composition of naturally and artificially regeneration, maintenance by species, their dimensional characteristics (of the stem, crown and root system), the spatial arrangement in relation to seasonal climate and topographical factors. At the end of 2023, the average percentage of success (maintenance) for plantations was 27.0 - 85.0%, and for sowing 62.44 - 81.65%. The lowest maintenance percentages were recorded at approx. 25% of the plantations, affected by harmful climatic factors (drought, extreme temperatures, torrential rainfall etc.).*

Keywords: *ecological reconstruction, ecosystems affected, climatic factors.*

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Forest engineering

- ORAL PRESENTATIONS -

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Blockchain technology in forest supply chains

Lukas STOPFER[1,*]

[1] University of Freiburg, Germany.

Corresponding author: Lukas STOPFER

E-mail address: Lukas.Stopfer@foresteng.uni-freiburg.de

Abstract: *Blockchain technology has the potential to revolutionize the forestry industry by providing a transparent and secure method for tracking and verifying the origin and movements of forest products. By enabling secure tracking of forest products, blockchain can improve the forestry industry. Transactions in the supply chain can be recorded in a decentralized ledger. This increases transparency and traceability, helping to combat illegal logging, deforestation and fraudulent labelling. The technology can also streamline processes and reduce errors and fraud, leading to cost savings and increased confidence in the sustainability of products. Blockchain also has the potential to track CO_2. But there are challenges, including ensuring accurate data and engaging actors. However, it is important to note that the implementation of blockchain technology in the forestry industry is still in its early stages, and there are challenges that need to be overcome such as ensuring the accuracy of the data recorded on the blockchain and ensuring the participation of all relevant stakeholders in the supply chain. In the joint project "Blockchain technology as a driver for the digitalization of forestry", potentials are being specified, the technical prerequisites are being worked out and the potential and acceptance of the market participants are being determined through a large representative survey. The presentation will present the results of a feasibility study on the use of a blockchain-mapped supply chain for the entire forestry and timber industry, from forest to customer. At the same time, the follow-up project to implement a prototype blockchain application in wood supply chain will show initial results, opportunities and challenges. In addition, the technical and software requirements and possible implementation options for the use of blockchain technology in forestry business processes will be discussed. Furthermore, the results of the nationwide survey among different actors in the forestry-wood chain are explained and classified.*

Keywords: *blockchain, supply chain, transparency, tracking, tracing.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Open air woodchip storage and spray coating: a study case

Gianni PICCHI[1] Carla NATI[1,*]

[1] CNR-IBE, Italy.

Corresponding author: Carla NATI

E-mail address: carla.nati@cnr.it

Abstract: *An acrylic crusting product developed for the coal energy industry was tested to protect stored woodchips. In the test carried out, two conical wood chips piles made both of fresh and dry material were superficially treated with an acrylic solution diluted in water, while other two piles worked as controls. To monitor the piles' temperature variation, thermal sensors were placed in the inner part of the five piles during their construction. Moisture content (MC) and dry matter (DM) variations in woodchip piles were recorded. The piles treated with the coating agent did not show any significant differences with the untreated piles: in wet material, the protective film slightly reduced the moisture dispersal from the pile from evaporation rather than limiting water intake from rain; in dry material, this confirms the inability of the coating agent to limit water intake from rainfall.*

Keywords: *wood chips; storage; fuel quality; moisture content; energy content.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Comparison of three types of skidders: time consumption and production costs

Antonio ZUMBO[1] Stanimir STOILOV[2] Iliya NENOV[2]
George ANGELOV[2] Angelo MAMMOLITI[1] Andrea R. PROTO[1,*]

[1] Department of AGRARIA, Mediterranean University of Reggio Calabria, Reggio Calabria, Italy;
[2] Department of Technologies and Mechanization of Forestry, University of Forestry, Sofia, Bulgaria.

Corresponding author: Andrea R. PROTO

E-mail address: andrea.proto@unirc.it

Asbtract: *Cable skidders are the most used timber extraction machines in Central and Eastern Europe. Cable skidders and many adapted skidders were used to increase productivity and to reduce labor. This work compared the work cycles, productivity and costs of three types of skidders investigated in similar coniferous stands: a dedicated cable skidder, a dedicated grapple skidder and an adapted skidder whose drivetrain is similar to those of the dedicated skidders. The comparison of delay-free work cycles of the three skidders showed the largest share is occupied by travel loaded. The grapple skidder demonstrates the highest average speed of 3.97 km/h, followed by the cable skidder at 3.79 km/h, and the adapted skidder with an average speed of 3.31 km/h. The average delay-free productivity of the studied skidders is highest for adapted skidder (17.93 m^3·PMH-1), followed by grapple skidder with a slightly lower rate (17.90 m3·PMH-1), and cable skidder (14.53 m^3·PMH-1). In conclusion, it can be said that the average payload volume of the grapple skidder is less than the maximum payload of the machine. This is due to the narrow skidding roads and because this type of skidder is not suitable for the specific site-selective felling with marked single and small groups of trees. The dedicated cable skidder, and the adapted cable skidders are very close in productivity.*

Keywords: *forest operation; mechanization; performance; time-motion study.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Assessment of the sustainability of a forest yard carried out with high level of mechanization in mixed chestnut coppices

Rodolfo PICCHIO[1,*] Bruno FEMIA[1]
Francesco LATTERINI[2] Rachele VENANZI[1]

[1] Tuscia University, Italy;
[2] Polish Academy of Sciences, Warsaw, Poland.

Corresponding author: Rodolfo PICCHIO

E-mail address: r.picchio@unitus.it

Asbtract: *The objective of this study is to provide analytical data applicable to complex large-scale studies concerning greenhouse gas emissions (GHG) resulting from forest logging. Specifically, we compare traditional systems with fully mechanized systems. Our study focuses on a 30-hectare coppice predominantly composed of chestnut trees in central Italy, within the Mediterranean region. We conducted a comparison between semi-mechanized and mechanized felling systems, measuring the working times for various phases (displacement, cleaning, felling, set-up, and delay). Subsequently, we calculated productivity in terms of volume per unit time. Additionally, we analyzed other operations, including bunching, extraction, and stacking, performed using a forwarder. These operations were examined based on the type of assortment treated (cut-to-length or brushwood). Finally, we assessed chipping operation of the brushwood and recorded the working times to calculate the net and gross work productivity. The results indicate that the mechanical felling system is the most productive, albeit at the expense of higher emissions. Conversely, the semi-mechanical system is more favorable in terms of emissions. Regarding extraction operations, brushwood management proves advantageous due to its ease of handling and ability to reduce phase times. However, stem management is more efficient in terms of transported volume and overall productivity in extracted volume. In conclusion, high mechanization offers clear advantages in work productivity. Even in chestnut coppices, it remains a viable solution, despite the inevitable increase in greenhouse gas emissions compared to traditional chainsaw-based logging. Operator training remains a fundamental aspect for optimizing skills in complex machinery use.*

Keywords: *forest logging, felling, extraction, green house gasses.*

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Analysis of soil disturbances in a oak coppice, due to forest operations carried out with advanced mechanization

Rachele VENANZI[1,*] Linda RUGGIERO[1]
Francesco LATTERINI[2] Rodolfo PICCHIO[1]

[1] Tuscia University, Italy;
[2] Polish Academy of Sciences, Warsaw, Poland.

Corresponding author: Rachele VENANZI

E-mail address: venanzi@unitus.it

Abstract: *Forest management has varying impacts on soils, depending on the machinery used and site conditions. To minimize the impact on forest ecosystems, adopting good practices can enhance ecosystem resilience and reduce the environmental effects of forest operations. This study aims to assess soil damage resulting from two logging methodologies within a productive silvicultural system. Specific indicators were selected for field and laboratory evaluation of soil impacts after intervention. In the investigated areas, intermediate mechanization (using a winch) and advanced mechanization (using a forwarder) both caused disturbance due to exposure related to the silvicultural system. However, this impact is considered 'light,' and recovery is estimated to take 2 to 3 years.*

Keywords: *forest operations, soil disturbance, forest mechanization, ground based extraction.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Development and evaluation of automated postural classification models in forest operations using deep learning-based computer vision

Gabriel Osei FORKUO[1,*] Stelian Alexandru BORZ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Gabriel Osei FORKUO

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

Abstract: *Postural classification of forest workers is crucial for identifying ergonomic risk factors and preventing musculoskeletal disorders (MSDs), and several manual methods have been developed and used so far for such evaluations. The OWAS method is popular in postural classification for forest operations, but it is time-consuming. However, it holds the potential for automation through deep learning and computer vision techniques. In this study, a dataset of 5040 RGB images was created from video files in forest operations. Data augmentation was applied using rotation, translation, and reflection. Then pre-trained ResNet-50, MobileNet-v2, ShuffleNet and GoogLeNet deep learning models were set up using the Deep Network Designer and Transfer Learning apps in MATLAB R2023b. Stochastic gradient descent with momentum optimizer was used for updating models' parameters, and the trainNetwork function of MATLAB was used to train the models using a mini-batch size of 10, maximum epochs of 6, and a learning rate of 0.0001. The models' performance was evaluated using the accuracy, precision, recall, F-score, and probability scores. The results indicate that the models were highly accurate and reliable, with validation accuracies of 89.29%, 85.45%, 87.57%, and 92.33% for ResNet-50, MobileNet-v2, ShuffleNet, and GoogLeNet, respectively. Additionally, the test accuracy was 88.76%, 84.26% 86.77% and 92.33% for ResNet50, MobileNet-v2, ShuffleNet and GoogLeNet respectively. All performance metrics were consistently high, and GoogLeNet was the most effective model for classifying various postures. Using these models in forest operations offline can automate, speed up, and improve accuracy, which is beneficial for evaluating working postures using large datasets. It can also aid in early intervention measures for musculoskeletal disorders in forest workers and enhance health and safety standards. However, ensuring model robustness, data quality, and confirming validation procedures are vital for accurate real-world application.*

Keywords: *ergonomic risk factors, musculoskeletal disorders, transfer learning, working postures, performance metrics.*

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FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Tracing the timber from forest to the mill: an application of the SURF algorithm to fingerprint truckloads based on photographs taken at their ends

Mirella ELIAS[1,*] Stelian Alexandru BORZ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Mirella ELIAS

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

Abstract: *Tracking the path of wood from the forest to the mill is essential for preserving the integrity of the supply chain, guaranteeing legal compliance, and streamlining logistics. Precise tracking ensures sustainable forest management, deters illicit logging, and provides transparency. Both conventional tracking techniques and modern technologies face important challenges. The shape and arrangement of logs in the trucks could be important features for truckload fingerprinting and matching. This study focuses on using SURF (Speeded Up Robust Features) algorithm to fingerprint and match photographs taken at the truck ends based on a local experiment, with the goal of evaluating the performance of image matching. Photographs used in this study were extracted from 39 video files and cropped to remove the background and depict only the area with logs in each photograph. The algorithm uses key point descriptors to extract relevant information and to match photographs based on regions with notable variations in intensity. It identifies unique points in a photograph and uses effective, scale-invariant descriptors to characterize these locations. Matching of the key points in photographs is made possible by these descriptors, which gather details about the local photograph region surrounding each key point, and the result is a correlation metric which is a measure of the similarity between the key points descriptors. As the main findings, comparison of photographs of different truckloads produced a correlation metric close to 0. Photographs of the same truck but with a slightly different field of view produced a correlation metric of more than 0.1 and less than 1, and those of the same truck and same field of view produced a correlation metric of 1, making this way a clear differentiation between the comparison outcomes. Moreover, the algorithm can identify the extra logs in the destination images based on some features in SURF algorithm which can detect the non-matching points between the images and draw those non-matching points in the origin images. These findings clearly indicate the potential of the algorithm in fingerprinting and successfully matching the truckloads based on photographs taken at different points in the supply chain. This smart solution is affordable and time saving, being useful for tracking logs from the forest to the mill. Further studies could be set up to check the accuracy of other algorithms, as well as to use video data for matching.*

Keywords: *supply chain, tracking, wood, truckload, SURF, key point descriptor, matching.*

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Learning curves, forest operators of mechanised harvesting systems and simulators: a systematic review

Ana Alexandra REYES ROBALINO[1,*] Stelian Alexandru BORZ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Ana Alexandra REYES ROBALINO

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

Abstract: *The learning process, which includes the reception and assimilation of knowledge, consists of several stages. A properly trained forest operator is essential for efficient logging operations. Learning on fully mechanised forest harvesting machines is risky and very expensive. In this context, the use of simulators as virtual reality (VR) tools plays a key role in the learning process, improving profitability and safety. This systematic literature review synthesises relevant studies from around the world obtained from various databases, addressing different concepts related to learning and simulations. It provides a comprehensive overview of learning curves, influencing aspects, machine simulators, operators, and other factors relevant to research. By emphasising the critical importance of pre-training, the review illustrates how the learning process unfolds in a controlled and safe environment. It identifies factors influencing VR-based learning and their impact on the transition to the real world experiences. The findings demonstrate that thorough, well-timed training, structured planning, instant feedback and appropriate guidance can substantially improve learning, efficiency, productivity and safety in the workplace. This review also highlights the need for more extensive studies on the long-term effectiveness of simulator learning in forest operations, while identifying some future research gaps, particularly with regard to the learners and their learning process using simulators.*

Keywords: *learning curves, simulators, mechanised timber harvesting, human factor.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Assessing sustainability in forest operations: a systematic review

Laura Susana LLERENA CRUZ[1,*] Stelian Alexandru BORZ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Laura Susana LLERENA CRUZ

E-mail address: laura.llerena@unitbv.ro

Abstract: *Forests cover nearly one-third of Earth's land surface, supporting millions of livelihoods and a varied range of wildlife, especially in vulnerable populations. Society extensively uses timber harvested from forests in industries such as construction, furniture making, fuelwood, bioenergy, and paper production, contributing significantly to economic activities worldwide. Effective forest management involves a series of activities essential for social progress and environmental sustainability. These activities include tree planting and nursery development to ensure a constant supply of new plants, as well as meticulous planning and execution of timber harvesting, maximizing productivity and minimizing environmental impact. Forest operations (FO) strive to optimize forest utilization for regeneration, biodiversity enhancement, societal benefits, economic profitability for the company, and safety for workers and surrounding communities. The purpose of this systematic literature review is to examine studies on sustainability assessment in forestry operations over a period of 30 years. The bibliography was obtained from online sources, using terms such as "forest operations", "sustainability assessment" and "harvesting". Were identified and analyzed 150 scientific articles published worldwide between 1994 and 2024, highlighting the main assessment frameworks such as: the Montreal process, REDD+, FSC, etc. Twenty-three frameworks for assessing sustainability in forestry operations at different global, national, regional and local scales have been compiled. Finally, the results underline the urgent need to respect the logging cycles of conifer species in particular, as well as to create conservation policies for certain areas with a unique forest ecosystem and to develop strategies to secure forest resources and economic development for future generations.*

Keywords: *forests, sustainability assessment, timber harvesting, biodiversity, logging cycles.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Postural risk assessment in wood measurement: a follow-up study to explore new measurement options and to check the repeatability of outcomes when using digital options

Stelian Alexandru BORZ[1] Eugen IORDACHE[1] Marina Viorela MARCU[1,*]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Marina Viorela MARCU

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

Abstract: *Technology development and digitalization has brought new opportunities in many industrial sectors, including forestry. Wood measurement is an important process, that in many regions changes from manual activities to the use of digital tools, and the validation of new approaches is necessary to ensure the sustainability of the sector. This study was setup mainly as a follow-up exercise so as to validate the results on the exposure to postural risks when using digital tools to measure the logs. In addition, the study explores the postural condition of a new measurement option, namely scanning of wood loaded into trucks. Our findings indicate that previous assessments on using digital tools to measure the wood are valid as they do not imply high postural risks. In addition, measuring the wood loaded into trucks by scanning seems also to be an option that, although generating a slightly higher risk index, is still suitable on the long term. Manual wood measurement options remain consistently challenging under a postural risk index point of view, and the results of this study validate this outcome as found by others. From a postural assessment perspective, transition to digital tools in wood measurement seems to be a sustainable option on the long term but it will require the development or extending of existing algorithms so as to be able to extract useful information form the collected data.*

Keywords: *wood measurement, digital tools, health risk, ergonomics, posture.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Fuel consumption and time use in alpine cable yarder operations

Raffaele SPINELLI[1,*] Natascia MAGAGNOTTI[1] Giulio COSOLA[2]
Banjamin ENGLER[3] Stefan LEITNER[4] Renato VIDONI[4]

[1] CNR IBE, Italy;
[2] Conaibo, Italy;
[3] HNEE Eberswalde, Germany;
[4] Free University Bolzano, South Tyrol, Italy;

Corresponding author: Raffaele SPINELLI

E-mail address: rtaffaele.spinelli@ibe.cnr.it

Abstract: *Due to their peculiar work mechanics and conditions, cable yarders have a very large potential for energy recovery, and it is clear that new models will be increasingly fuel-efficient. However, best results are obtained if the yarding operation is optimized as a whole – not just in its yarder component. A first step in that direction consists of determining reference fuel use figures for the different components of a yarding operation. To that end, the Authors monitored 5 yarder operators in the Italian Alps, collecting detailed fuel and time use data for 12 operations – each corresponding to one individual sale. Overall, the dataset represented 12 operations that covered 40 ha and produced 6090 m^3 of timber. That task required 8500 worker hours and 28900 l of diesel fuel. 33 cable lines were set up, with a mean span of 370 m (tower tip to end mast). The data included all time and fuel consumption required for turning trees in the forest into logs stacked at a roadside yard. Fuel and time were accurately allocated to the following tasks: relocation; set up and dismantle; production; crew commute; major delay events. Concerning production, fuel use was further divided between: felling; extraction; processing and/or loading; two-staging (when performed). To our knowledge, this is so far the only scientific study offering real-life data about the fuel consumption and time use of European yarding operations. Moreover, our data represent typical small scale operations conducted by private companies, which are prevalent in the Alps. The study offers a detailed breakdown of fuel and time use, as well as reference figures for fuel consumption per m^3- by task.*

Keywords: *cable, logging, operations, efficiency, productivity.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

First trial of a prototype chain-flail delimber on a short-rotation poplar plantation

Natascia MAGAGNOTTI[1,2,*] Raffaele SPINELLI[1,2]

[1] Consiglio Nazionale delle Ricerche – Istituto per la Bioeconomia (CNR IBE), Firenze, Italy;

[2] Australian Forest Operations Research Alliance - University of the Sunshine Coast (AFORA USC), Maroochydore DC, Queensland, Australia.

Corresponding author: Natascia MAGAGNOTTI

E-mail address: natascia.magagnotti@ibe.cnr.it

Abstract: Small tree size represents a main challenge for single-tree handling techniques and caps harvesting productivity in medium rotation industrial plantations. That challenge is best met by a shift towards mass-handling. Chain flail delimber-debarkers (CFDD) can easily handle more trees per cycle, boosting productivity especially when handling small trees. Chain-flail technology is not at all new - in fact, it was considered an old idea already inthe late 1980s- and it is used in many regions to produce high-quality fiber for manufacturing pulpwood. Until now, however, commercial CFDD were too heavy, powerful and expensive for easyuse in thinning operations or in European short rotation plantations (SRP).Therefore, an Italian company designed and developed a compact CFDD for the European small-scale SRPs. That machine had to be much lighter and cheaper than any similar products, and the prototype did meet those requirements, weighing 4 t and carrying a tentative price tag ⩽ 100k €. The chainflail prototype was built from a pre-existing root cleaner, consisting of a box-like structure fitted withtwo rotating flail drums. Each drumcarried 20 flails, consisting of 6 hardened chain links each.The original root-cleaner was designed for vertical feeding, so that conversion into a CFDD required turning the unit 90°, as a first step. Then, an infeed table was installed, for supporting incoming tree bunches. On the other end of the flail unit, a metal chute was added for holding that stem portion that had passed through the flail. The chute ended with a bump plate for indexing trees. That first prototype was installed on a roll-on roll-off platform and mounted on a truck, which also powered the flail drums through its hydraulic PTO. The equipment was tested in a controlled experiment in Western Slovakia for 5 days. During the test it was fed by a 13-t excavator-based loader fitted with a grapple saw, which also performed crosscutting. The test was performed on 16 carefully measured wood piles representing “strong” and “weak” trees, i.e. trees with a mean diameter at breast height (DBH) of 12 and 10 cm, respectively. The trial was successful, resulting in high productivity and no mechanical downtime. Delimbing and crosscutting quality were as good as those obtained with a standard processor head. Productivity ranged between 2.5 and 4.7 BDT/SMH andit was 40% higher for the “weak” treatment compared with the “strong” one. Delimbing quality was considered satisfactory by the factory production managers on site and at the receiving facility. The machine worked best with the smallest trees, which are a challenge for all other options. In general, the new compact CFDD may become the best option for handling the small trees offered by European small-scale SRPs, which cannot be efficiently harvested with the cut-to-length system.

Keywords: *productivity, efficiency, logging, small tree, harvesting.*

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Forest engineering

- POSTER PRESENTATIONS -

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The real cost of forest resources conservation: The case of the Rodna Mountains National Park

Leon Costan URSA[1,*]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Leon-Costan URSA

E-mail address: leon.ursa@unitbv.ro

Abstract: *The study provides an analysis of the impact of forest conservation, as a result of the restriction of access to resources for the inhabitants of the Rodnei Mountains National Park, the second largest national park in Romania. Thus, since 1990, when the Rodnei Mountains National Park was established, most of the owners of forest areas in the park - private and municipalities, have been against it. Protecting areas for biodiversity conservation in the Rodnei Mountains National Park leads to limitations in the use of land and resources, causing disadvantages for people who rely directly on the use of these resources. In addition, there are also some certain benefits for society. To assess the benefits but also the disadvantages for people who rely directly on the use of forest resources we used mixed methods: document analysis, participatory observation, data collection interviewing stakeholder and a questionnaire survey in the community. We found that the attitudes of local residents towards the conservation of forest resources were mainly influenced by socio-economic variables: occupation, education, age and gender of the respondents. The results indicate that the conservation status of forests had an important impact on local socio-economic conditions, easily observed in both positive and negative effects. It was also concluded that, at this moment, the benefits from the conservation of forest resources are much lower, compared to the benefits from the sustainable management of forest resources.*

Keywords: *conservation, cost, impact, forest, resources.*

Transilvania University of Brasov
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25 years monitoring of atmospheric deposition in the Rarau Mountains (Eastern Romanian Carpathians)

Marius CURCA[1,*] Amelia BUCULEI[1]
Ștefan LECA[1] Carmen IACOBAN[1]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Marius CURCA

E-mail address: curcamarius28@gmail.com

Abstract: *Temporal trends in atmospheric deposition (measured throughfall and open field bulk deposition) were evaluated for the period 1998 – 2022 using data from the ICP Forests Level II network – SSI Rarau. The research consisted of quantitative evaluation of precipitation flow, determination of the concentration in mineral ions and analysis of ion deposition considered to have a polluting effect: S-SO_4, N-NO_3, N-NH_4 and chlorine. The multiannual average amount of precipitation in open field was 794 mm, without a significant trend and under the canopy 514 mm with an insignificant decreasing trend from 535 to 490 mm. The recorded precipitation had a slightly acidic character with a multiannual average of pH 5.2 both in throughfall and bulk deposition. A significant increasing trend has been observed since 2006 from pH 5 to 5.4. Trends for the atmospheric deposition of sulphur (S) and inorganic nitrogen (inorg-N) to forests put in evidence a significant decreasing, from high deposition in 1998 – 2006 period to low deposition in 2022. The capacity of the crown to retention/filtration was most evident in the case of chlorine. All deposition of pollutants (S-SO_4, N-NO_3, N-NH_4) corresponded almost the same with the pollutant emission reductions from Europe.*

Keywords: *atmospheric deposition, pollutant, acidification, sulphur deposition, nitrogen deposition.*

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FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Size-growth relationship for Norway spruce (*Picea abies* (L.) H. Karst) silver fir (*Abies alba* Mill.) and beech (*Fagus sylvatica* L.) stands from the north of the Eastern Carpathians

Alexandra STEFAN (ISPRAVNIC)[1,2,*] Răzvan Vasile CÂMPU[1]

Gheorghe STEFAN[1,2] Radu VLAD[2]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] SCDEP Câmpulung Moldovenesc - National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Alexandra STEFAN (ISPRAVNIC)

E-mail address: ispravnic.alexandra@gmail.com

Abstract: *Mixed stands can develop differently depending on the mode of regeneration or the growth characteristics of the different component species, which can considerably slow down the development of other species. They can provide more forest functions and services much more efficiently than monocultures. The experimental plots were located in Management unit I Demacușa, the Tomnatic Experimental Base. The research stands are between 80 and 120 years old. Field measurements took place in 2016-2017, when permanent experimental plots of 10,000 m^2 (100 m x 100 m) were installed, in homogeneous areas that are representative for the general conditions of the stands. The results showed that the growth-size relationship expresses the link between the volume of trees and their dimensions, is another indicator for expressing the growth and development of the mixed stands. Also, it can highlight the competition and the differences in growth between the constituent individuals of the stand. Applying this method to mixed stands can highlight how the proportion of blends alters the hierarchy between trees in a population, whether the main species of the mixture can favor the distribution of growth to small trees compared to pure stands. The distribution of the volume by diameters categories indicates that the Norway spruce holds the largest share, but with a significant contribution also of the main species of mixture from the stand (beech, fir and sycamore maple).*

Keywords: *mixed stands, growth, development, monocultures, volume.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Structure of some Norway spruce (*Picea abies* L.) stands in the north of the Eastern Carpathians

Gheorghe ŞTEFAN[1,2] Răzvan Vasile CÂMPU[1] Alexandra ŞTEFAN[1,2,*]
Radu VLAD[2] Any Mary PETRIȚAN[3]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] SCDEP Câmpulung Moldovenesc - National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[3] SCDEP Brasov - Department of Forest, National Institute for Research-Development in Forestry ''Marin Drăcea'', Romania.

Corresponding author: Alexandra STEFAN (ISPRAVNIC)

E-mail address: ispravnic.alexandra@gmail.com

Abstract: *Norway spruce (Picea abies (L.) Karst.) is one of the most important species of commercial trees in European mountain forests. It is mainly cultivated in echien stands which are managed in specific pruning systems. Our objective was to evaluate the structure of managed stands, according to cultural operations (thinning) and the number of trees used in planting scheme. The aspects analyzed were the diameter distribution, spatial distributions and spatial structure of trees. The studies were carried out in two permanent experimental blocks, created in 1977. The first experimental block was installed in Norway spruce stand using four variants of planting scheme and the second block was with three variants of thinnings intensity. For each experimental block, the position of the trees and the main dendrometric characteristics were collected. Spatial distribution and structure of stands was analyzed using several indices.*

Keywords: *Norway spruce, planting scheme, spatial distribution and indices.*

Transilvania University of Brasov
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Recycled materials. A successful revival of wooden products for a circular bioeconomy

Andrei Ioan APĂFĂIAN[1,*] Raul RADU[1]
Vlad CRIŞAN[1] Diana VASILE[1]

[1] SCDEP Brasov - National Institute for Research and Development in Forestry "Marin Drăcea", Romania.

Corresponding author: Andrei Ioan APĂFĂIAN

E-mail address: apafaian.andrei@gmail.com

Abstract: In the 21'st century, managing used materials that ended their lifespan through recycling due to the valuable secondary materials they contain, is a key element in the European Union environmental policy. The Green Deal, Circular Economy & Zero Pollution Action Plans are tackling on these aspects with the main goal to absorb the potential of wood waste and to reduce their effects on health and environment while keeping in the economy valuable resources by applying appropriate waste management policies. The aim of this study was to estimate the percentage of wood waste entering the production process of one of the biggest company that is activating on the Romanian market by analyzing their sustainability reports. Across Europe wood waste is produced in large quantities from sources such as municipal waste, wood industry sector or from demolition and construction. Across the member states of the European Union over 50 million tons are produce yearly, this figures being constant over the last years. Even though, technologies are being developed on a constant basis due to the fact that specific wood waste has to be first decontaminated in order to be further processed, large quantity goes to landfills. In Romania there are specialized companies that are using wooden products such as pre/post-consumer and post-industrial wood waste that can be integrated in their production processes. In the last years the quantities that were recycled had grown, accounting over 10% from the total wood input in the case of some companies from the forest industry by having a substantial influence on the growth of the bio-economy sector.

Keywords: *bio-economy, recycling, added value, environment, policy.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Extracting small-sized eucalyptus logs by farm tractors equipped with backhoe grapples: a simulation of cycle time, productivity and efficiency in Thai short-rotation forestry

Tomi KAAKKURIVAARA[1,*] Nopparat KAAKKURIVAARA[2] Stelian Alexandru BORZ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] Kasetsart University, Bangkok, Thailand.

Corresponding author: Tomi KAAKKURIVAARA

E-mail address: tomi.kaakkurivaara@unitbv.ro

Abstract: *Identifying effective methods for sustainable harvesting in short-rotation planted forests has recently gained importance. Practice in such forests may be highly variable from one place to another, and models are required to better understand the effectiveness of planted forest management and to make better decisions. A simulation experiment was setup in this study to understand how the productive performance of farm tractors, which is a common technical option in Thailand, is affected when extracting small-sized eucalyptus payloads sourced by very short cycles. Two tractors (hereafter T1 and T2) of different class size and fitted with backhoe grapples were selected and monitored via GPS. Operational events were extracted from GPS data, and were characterized by their speed, while payload size was estimated based on manual measurement done in the field. Then, simulations were carried out to see how moving speed and payload size may affect the productive performance as a function of extraction distance. There were important differences in speed and payload size which caused high differences in performance as the extraction distance increased. For instance, the number of daily work cycles were similar for both machines in a distance range of up to 100 m; daily production (m3), productivity (m3/h), and efficiency (h/m3), on the other hand, have shown important differences, with the higher size class T1 were more performant. Payload size and moving speed had a strong effect on efficiency, tripling the unit time for T2 at a distance of 1000 m. Since these machines are frequently used interchangeably, the average extraction distance should be limited to 50 m for T2. T1 maintains higher daily production and a greater number of work cycles at longer distances, highlighting the importance of choosing the appropriate tractor size for varying extraction distances in short-rotation eucalyptus forestry.*

Keywords: *plantation forestry, speed, performance, models, time consumption.*

Transilvania University of Brasov
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Assessment of wood quality at spruce trees affected by a forest fire

Alexandru OLARU-ZAFIESCU[1] Alice Elena TESILEANU[1]
Ionuț MITOFAN[1] Elena Camelia MUȘAT[1,*]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Elena Camelia MUȘAT

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

Abstract: *The wood quality is of particular interest from an economic point of view, which can only be achieved by managing forests according to certain strict rules and by applying treatments that promote the growth of valuable trees and of a large volume of working wood. Even if all these requirements are met, disruptive factors can occur, such as forest fires, which, depending on the degree of intensity, can produce major economic losses. The aim of the paper was to evaluate the wood quality at spruce trees affected by a forest fire, using non-destructive methods based on sound waves propagation through the wood. The measurements were made in a forest administrated by R.P.L.P. Piatra Craiului R.A. Zărnești. The field investigations involved measurements on 15 spruce trees (Picea abies L.), at two levels on the trunk, using the sonic tomograph Arbotom and the sonometer Fakopp. The values of the sound speeds obtained by using the sonometer were higher than in the case of the Arbotom tomograph, but these differences do not influence the interpretation of the health status of the trees and the quality of wood. Thus, from all the 15 analyzed trees, at three of them both tools indicated structural defects.*

Keywords: *forest fires, quality, spruce, tomograph, sonometer.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

The impact of forest fires on trees development and wood quality, using non-destructive and destructive methods

Alice Elena TESILEANU[1] Alexandru OLARU-ZAFIESCU[1]
Ionuț MITOFAN[1] Elena Camelia MUȘAT[1,*]

Corresponding author: Elena Camelia MUȘAT

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

Abstract: *Forest fires are a major and significant problem for the biodiversity and health of forest ecosystems. Their impact on biodiversity has become increasingly evident and concerning in recent years as fires are the main cause of considerable losses of woody mass, but also lead to losses that are difficult to estimate in terms of environmental impact. The aim of the paper was to assess the impact of forest fires on subsequent trees development and on wood quality, by using nondestructive and destructive methods. The field investigations were carried out in a forest managed by the Braşov Forestry District, which was affected by a litter fire. For achieving the purposed goal, 12 trees (hornbeam and beech) were investigated using various methods for wood quality assessment were applied, which involved the use of the IML Resi F500-S resistograph and the Arbotom tomograph, as well as destructive methods, based on the extraction of growth cores using the Pressler drill. Following the visual assessment of the trees, four of them did not present external defects, at four were identified wounds, and the others were affected by rot at the base of the trunk. The investigations carried out by the tomograph led to the idea that ten trees did not showed internal defects, but the others were affected by the fire, because they presented structural changes inside the trunk or other irregularities that leaded to reduced sounds speeds propagation through wood. The resistograms indicated that three of the investigates trees were structurally healthy, while others showed degradations that lead to the reduction of the relative resistances to drilling or even at the loss of these resistances.*

Keywords: *forest fires, quality, hornbeam, beech, tomograph, resistograph.*

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Investigation of changes in air quality levels during debarking operations

Tolga OZTURK[1] Ebru BILICI[2,3,*]
Muhittin INAN[1] Batin YER[1]

[1] İÜC Faculty of Forestry, Forest Engineering Department, Istanbul, Turkey;
[2] University of Idaho Experimental Forest, College of Natural Resources, Moscow, U.S.A.;
[3] Forestry Department, Dereli Vocational School, Giresun University, Giresun, Turkey.

Corresponding author: Ebru BILICI

E-mail address: ebru.bilici@giresun.edu.tr

Abstract: *Debarking of coniferous timber is an essential process in the wood production industry in Türkiye. One of the most time-consuming stages in the production of coniferous trees is debarking of the logs. Operating a chainsaw for debarking releases air pollutants such as bark residues, dust, sawdust, and fuel materials. This situation greatly diminishes air quality, posing a serious health risk for workers who breathe in the polluted air daily. Additionally, it negatively impacts the surrounding environment, leading to broader ecological consequences and the degradation of natural habitats. This study aims to investigate the impact of the debarking process on worker health and environmental impacts in black pine (Pinus nigra A.) plantations in Sarıyer region. The air pollution parameters $PM_{2.5}$, PM_{10}, CO_2 and HCHO levels during the debarking process were measured using a Temtop M2000 air quality meter. The results showed that when comparing these values to standard air quality metrics, it's clear that the peak values of $PM_{2.5}$, PM_{10}, and CO_2 result in a "Very Unhealthy" environment. The average values for all three are classified as "Unhealthy" for $PM_{2.5}$, and "Moderate" for PM_{10} and CO_2. The study results emphasize that the log debarking process is associated with bark volume, CO_2 release and $PM_{2.5}$ levels. Workers in harvesting must use maximum protective equipment, especially respirators. Raising awareness and training forest workers on protective equipment use is also crucial. These findings can help develop effective policies for worker health and environmental air quality.*

Keywords: *timber harvesting, debarking, air quality, Temtop M2000.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Planning stream protection zone harvesting with a LiDAR-based Single Tree Inventory (STI) and developing GIS tool

Ebru BILICI[1,2,*] Robert F. KEEF[1]

Timothy E. LINK[3] Furkan CAKMAK[4]

[1] College of Natural Resources, University of Idaho Experimental Forest, Moscow, U.S.A.;

[2] Forestry Department, Dereli Vocational School, Giresun University, Giresun, Turkey;

[3] Department of Forest, Rangeland and Fire Sciences, University of Idaho, Moscow, U.S.A.;

[4] Washington State University, Political Science, Washington, U.S.A.

Corresponding author: Ebru BILICI

E-mail address: ebru.bilici@giresun.edu.tr

Abstract: *Stream Protection Zone harvesting is an important aspect of sustainable forestry management. It involves carefully planning and executing logging activities in areas adjacent to streams and rivers to ensure that water quality is maintained and aquatic habitats are protected.It aims to minimize the impact of harvesting on aquatic ecosystems, especially stream temperature. According to Idaho's Forest Practices Act (IFPA), Class I streams have the potential to spawn, rear, or migrate fish, or provide domestic water supplies. Stream Protection zone harvesting can affect these functions through changes in the amount of solar radiation reaching the water, thermal changes, and increased sedimentation. Idaho's new Streamside Tree Retention Rule or Shade Rule limits the amount of harvesting allowed near streams. Trees within three designated zones can be harvested based on weight factors defined in the Idaho Forest Practices Act. Lidar-based single tree inventory (STI) was developed for the University of Idaho Experimental Forest in 2019 and includes height, canopy closure, DBH, gross volume, and probability of defect. In this study, with the help of STI data, an operational planning tool has been developed using ArcGIS and Python to evaluate harvest planning and pre-implementation analysis. It provides detailed information on different methods to implement riparian prescriptions. These methodologies were developed for areas with different stream functions or management objectives. Use of our new planning tool with single tree inventory data can help ensure that riparian prescriptions are implemented cost-effectively in ways that comply with the IFPA while meeting management objectives.*

Keywords: *Single tree inventory, Stream protection zone, harvesting, LiDAR.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Evaluation of post-fire salvage logging in the Mediterranean Area

Salvatore F. PAPANDREA[1] Maria Francesca CATALDO[1] Giuseppe BOMBINO[1]
Pasquale A. MARZILIANO[1] Andrea R. PROTO[1,*]

[1] Department of AGRARIA, Mediterranean University of Reggio Calabria, Reggio Calabria, Italy.

Corresponding author: Andrea R. PROTO

E-mail address: andrea.proto@unirc.it

Abstract: *Forest resources are subject to natural disasters (i.e. wildfires, winter storms, avalanches) and anthropogenic factors (i.e. illegal forest harvesting, unsuitable land use changes, excessive usage of forest resources). Forest fires are one of the factors that gravely damage forest resources and compromise negatively the sustainable management. In Europe, in the last few decades, about 65,000 fires per year have affected a forested area of about 500,000 ha. Wildfires in the Mediterranean environment have always been crucial for forest ecosystem protection and regeneration. Over 95% of fires in the Mediterranean area are caused by humans, with extreme events increasingly often showing extraordinary characteristics in terms of magnitude and complexity, as happened in Italy in 2021 within an area of more than 10,000 ha in a single episode. Forest fires have an important amount of economic value loss on forest products and this loss increases as they stay longer in forests before salvage logging operation starts. To mitigate these negative effects, post-fire salvage logging should begin immediately after a fire to remove fire-damaged timber and prepare the site for regeneration. The area study falls in Aspromonte Massif, where in August 2021, in approximately 10 days more than 5,000 hectares of forest was burnt. In this study, post-fires logging operations were studied to determine optimal operational techniques that minimize the time spent on logging and reduce the environmental impact after forest fires. Also, a time-motion study was adopted to determine productivity rates and wood extraction costs and develop skidding time prediction models for post-fire salvage logging.*

Keywords: *winching; harvesting operation; performance; wood deterioration.*

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AND FOREST ENGINEERING

Geomatics, informatics, modelling and statistics

- ORAL PRESENTATIONS -

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Econometric model for the forest sector

Liviu-Stelian BEGU[1,*] Andreea-Oana BEGU[1]

[1] The Bucharest University of Economic Studies, Romania.

Corresponding author: Liviu-Stelian BEGU

E-mail address: liviu.begu@csie.ase.ro

Abstract: *The econometric model is developed based on statistical analysis and has as variables: the demand for wood, the supply of wood, the internal and external prices of wood, the price of land with forests, forested area and so on. Each equation of the model is tested in terms of validity, as well as each parameter obtained. In addition to these variables, the model also uses time series on the change in wood mass in the last 20 years. The data used are official data from national statistics as well as European Union statistics. Based on the model, different scenarios can be performed regarding the variables used. Also, predictions of these variables can be made for periods between 3-5 years. Also, based on the model, international comparisons can be made to show the different trends in the evolution of the forestry sector.*

Keywords: *C530, C150, Q510, Q430, C310.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Urban forestry- safety assessment

Levente DIMÉN[1,*] Alexandra DREGHICI[1]

[1] 1 Decembrie 1918 University of Alba Iulia, Romania.

Corresponding author: Levente DIMEN

E-mail address: , ldimen@uab.ro

Abstract: *This paper aims to present a GIS-aided safety aspects, related to the non-invasive assessment of trees in urban green areas. The goal is to create an urban GIS-based evidence of the green areas focused on hidden tree pathology, in order to increase the safety of urban parks and provide an instrument for decision-making to eliminate trees that pose a danger to citizens due to hidden pathology. This is especially important in light of the tremendous physical destruction, injury, loss of life, and economic damage caused by wind disasters, as well as concurrent heavy rains and flooding, which have become increasingly common in recent decades. Improved observational capabilities and recordings of such events have led to greater public awareness of severe weather events.*

Keywords: *green cadastre, climate change, GIS, urban forestry.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Ground surface retrieval in forest areas using satellite LiDAR data

Mihnea CĂȚEANU[1,*]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

Corresponding author: Mihnea CĂȚEANU

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

Abstract: *Digital Terrain Models (DTMs) have been widely used for a long time in forestry applications, such as the planning of harvesting operations, the estimation of forest parameters (for example tree/stand height, carbon stock, ABG etc.) or the modelling of phenomena such as wildfire spread, slope stability, flood risk and so on. One of the most useful technologies for the collection of data used for DTM generation in forestry applications is LiDAR (Light Detection and Ranging), because it has the potential to record ground data in forested areas, as the laser pulses can penetrate the canopy cover. Two satellite LiDAR missions are currently on-going and provide freely available data at a near-global coverage: ICESat-2 (Ice, Cloud and land Elevation Satellite) and GEDI (Global Ecosystem Dynamics Investigation), both operated by NASA. The purpose of this study is to evaluate the accuracy of ground surface retrieval for these two satellite missions, for an area of approx. 250 square km located in the Alba county of Romania which is covered by forests of different types in a proportion larger than 50 percent. LiDAR data collected between 2019 and 2013 was evaluated by comparing the estimated ground elevation values with a 1-metre resolution DTM obtained from ALS (Airborne Laser Scanning) data. Results show that both data sources are characterized by the presence of severe outliers, but overall ICESat-2 ground elevation estimates fare better, both in open areas and under the forest canopy. On the other hand, GEDI data has a much better spatial coverage, as the sensor is mounted on the ISS which is characterized by an orbital precession. In terms of the external factors considered in this analysis, in both cases the accuracy appears to be influenced by ground conditions (slope, landform, terrain ruggedness), the season of acquisition and the season of acquisition.*

Keywords: *GEDI, ICESat-2, LiDAR, Digital Terrain Model, elevation accuracy.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Evaluating the precision and reliability of tree measurement data from different scanner devices

Sergiu-Constantin FLOREA[1,*] Mihai-Daniel NIȚĂ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

Corresponding author: Sergiu FLOREA

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

Abstract: *The assessment of forest inventory parameters has recently garnered significant attention, emphasizing the need for precise and reliable measurement methods. This study addresses the challenge of accurately measuring tree parameters, including diameter at breast height equivalent (DBH_Equiv), observed height (H_Obs), observed volume (Vol_Obs), confidence in measurements, and 360-degree scan quality (Scan_360). The research compares the performance of four different measurement tools: StoneX, GeoSLAM, and FJDynamics models P1 and S1. Using box plot analysis, we examined the distribution and variance of the parameters for each tool. The study employed a comparative design to identify the tool that provides the most consistent and accurate measurements. The findings indicate that the GeoSLAM tool exhibits the least variance in DBH_Equiv and H_Obs measurements, suggesting higher consistency and reliability compared to the other tools. FJD_P1 and FJD_S1 show similar performance in Vol_Obs and Scan_360 parameters, with noticeable outliers affecting the consistency. StoneX, despite having the highest range in DBH_Equiv and H_Obs, demonstrated superior performance in measurement confidence. In conclusion, the GeoSLAM tool is recommended for its reliability in DBH_Equiv and H_Obs measurements, while FJD tools are preferable for volumetric assessments. One possible explanation for this outcome is that GeoSLAM excels at orienting points at lower levels, providing accurate DBH estimation but lacks the point density in the crown, leading to less accurate volume estimation. The FJD tools, despite their higher variability in DBH and height, offer better post-processing capabilities, resulting in more accurate volumetric estimations. These findings underscore the need for standardization and calibration across different devices to ensure consistent and accurate forestry measurements.*

Keywords: *MLS, device performance comparison, forestry measurements.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Developing an AI tool for monitoring forest systems

Mohamed-Islam KESKES[1,*] Mihai-Daniel NIȚĂ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Mohamed Islam KESKES

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

Abstract: *Forests, vital ecosystems rich in biodiversity, require effective management to maintain their health. Traditional methods like manual surveys are labor-intensive and limited. Advanced tools are needed to address threats such as infestations, diseases, illegal logging, and wildfires. AI offers a transformative solution by analyzing data from satellites, drones, and sensors, providing insights into tree stress and predicting future events like wildfires. This enables early intervention and efficient resource use in forest management. Using advanced algorithms, we developed an AI platform: MySIS-AI (Monitor Your System with AI), a cutting-edge tool designed to streamline the training and deployment of machine learning models and AI applications in forestry. MySIS-AI uses the ResNet-50 model, a 50-layer deep learning model renowned for its high accuracy in complex image classification tasks. Trained on the ImageNet dataset, which includes over 1 million images across 1,000 categories, this robust pre-trained model enables an effective analyze and classify new satellite images. Additionally, it is fed with ground truth forest inventory data collected from economically significant Romanian forests, providing detailed information about tree species, biomass, and forest health. Furthermore, This AI incorporates GEDI (Global Ecosystem Dynamics Investigation) data, which offers high-resolution laser-ranging observations of forest structure globally. These observations include precise measurements of tree canopy height, vertical structure, and surface elevations, allowing for a three-dimensional understanding of forest environments. The integration of GEDI data with ground truth inventory data ensures that MySIS-AI can accurately monitor forest changes, assess ecosystem health, and support sustainable forest management practices. The platform excels at processing diverse data types, including satellite imagery, LiDAR data, and other forest-related datasets. Utilizing self-learning techniques, this AI can automatically identify relevant features within these varied data sources, enhancing the model's predictive capabilities and providing powerful solutions tailored to specific forest management needs.*

Keywords: *AI, deep learning, forest monitoring, algorithms.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Analysis of the influence of historical canopy disturbances on the hydrological regime in the Dâmbovița Valley watershed, upstream of Pecineagu reservoir

Ioana Alexandra NICOLAE[1,*] Mihai Daniel NIȚĂ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

Corresponding author: Ioana Alexandra NICOLAE

E-mail address: ioana.nica@unitbv.ro

Abstract: *Water availability and quality in many parts of the world are increasingly threatened by overuse, misuse and pollution, and these are strongly influenced by the forests (Ekhuemelo, 2016). The importance of forests and trees involves improving the water cycle and groundwater recharge, reducing runoff, filtering pollutants from water, flood control and stormwater regulation (Ekhuemelo, 2014). Changes in land cover, including deforestation, can lead to reduced evapotranspiration and increased surface temperatures, as well as disruption of the hydrological cycle and decreased moisture circulation (Githui et al., 2009). Our goal was to analyze the impact of forest disturbance on the hydrological regime (flow) in Valea Dambovitei using the SWAT hydrological model. To set up SWAT, four components were required: Digital Elevation Model (DEM) retrieved from SRTM, with a spatial resolution of 20 m, soil databases retrieved from the forestry plans prepared by INCDS for the period 1986 to 1996 provided by Ocolul Silvic Campulung, land use data were retrieved from the Griffiths 2013 study, which used the Landsat archive and the meteorological data needed were retrieved from the model integrated in SWAT. The SWAT model was run for the entire Valea Dambovitei watershed in three scenarios: baseline scenario (current use), Scenario 70 - 90 : the land use database was created by identifying disturbances in the forest canopy by digitizing Corona imagery and Landsat satellite imagery data on forest cover loss identified in the Potapov and Hansen studies for the period 1985-2012, Scenario 90 - 20 : the land use database was created using Landsat satellite imagery data on forest cover loss identified in the Potapov and Hansen surveys for the period 1985-2012 and Sentinel-2 data available in the Google Earth Engine platform. After running the model, flows, surface runoff and sediment were determined. In the baseline scenario it is noticeable that the simulated flows are lower than the measured ones. The application of the SWAT model for the three scenarios revealed pronounced daily flows during periods of major events caused by disturbances in the forest caused by clear-cutting leading to land-use category changes. In the Valea Dâmbovița catchment the annual runoff shows different trends depending on the land use scenarios. The simulated surface runoff shows an increase in runoff as a result of a reduction in the area occupied by forest. The mean annual alluvial transport shows a decrease in sediment transport by 11% in the 70-90 scenario and 33% in the 90-20 scenario due to the reduction in forest cover, with the trend being more pronounced in the 90-20 scenario when forest cover was reduced by 38%. Our research shows that knowledge of the hydrological impacts of watersheds is urgently needed due the increasing disturbances in forest ecosystems and water resources. To sustainably manage these resources it is necessary to consider the impacts of disturbances and to develop appropriate strategies for forest and water conservation and restoration.*

Keywords: *SWAT, hydrological model, satellite imagery, flow, forest disturbances.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Mapping forest height in Cuba using remote sensing

Jorge DIAZ SUAREZ[1,*] Ioan CIORNEI[2] Mihai Daniel NIȚĂ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] "Ștefan cel Mare" University from Suceava, Romania.

Corresponding author: Jorge DIAZ SUAREZ

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

Abstract: *The development of different global forest structure products in the last five years are associated with the advent of new technological improvements like space-borne LiDAR, Deep Learning and the increased computational power. Global forest structure products are challenging because of the inherent variability of forest on the planet. From the user's perspective the accuracy of the product in the estimation of forest heights or density in their specific conditions is the main issue. This study focused on validating a data set derived from GEDI. The main characteristic of the product is forest height, and the field survey has been done with the Arboreal APP. According to the results we emphasized that global forest structure products derived from remote sensing can be applied even in the specific conditions of the Western part of Cuba, the greatest island in the Caribbean Sea.*

Keywords: *forest heights, GEDI, Cuba, Arboreal.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Influence of Forest Structure on Leaf Area Index (LAI) in Postavaru Mountain using Hemispheric Photography and Terrestrial LiDAR

Mohamed AYA[1,*] Petru Tudor STĂNCIOIU[1] Mihai Daniel NIȚĂ[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Mohamed AYA

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

Abstract: *The Leaf Area Index (LAI) is a critical ecological metric representing the leaf surface area per unit ground area, crucial for various ecological processes such as photosynthesis, carbon cycling and hydrological processes. This study explores the impact of forest structure on LAI in the Postavaru Mountain region, distinguished by diverse forest development stages. The primary objective is to determine which forest characteristics - namely diameter at breast height (DBH), tree height, basal area, and age - most significantly affect LAI. Hemispheric photography, processed through WinSCANOPY, provided LAI measurements, while terrestrial LiDAR scanning yielded detailed forest structural parameters. Analysis of 60 field plots indicated an average LAI of 4, with values ranging from 0.1 to 6. Statistical assessments revealed that forest structure has a pronounced effect on LAI, with additional moderate influences from morphometric factors such as slope and aspect. These insights enhance our understanding of forest structure-LAI interactions, contributing to better forest management and ecological evaluation practices.*

Keywords: *Leaf Area Index (LAI), forest structure, hemispheric photography, terrestrial LiDAR, Postavaru Mountain, forest management, ecological assessment.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Potential of harvested wood products in greenhouse gas mitigation: a Romanian perspective

Cosmin Ion BRAGA[1,*] Ștefan PETREA[1,2] Alexandru ZAHARIA[1]
Tibor SERBAN[1] Alexandru Bogdan CUCU[1] Gheorghe Raul RADU[1]

[1] National Institute for Research and Development in Forestry "Marin Drăcea", Romania;
[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Cosmin BRAGA

E-mail address: bragac.icas@gmail.com

Abstract: *Climate change represents one of the biggest challenges for society today. Furthermore, the forest ecosystem plays an essential role in mitigation global warming through its capacity to capture atmospheric carbon dioxide. Thus, carbon sequestration from forest can occur in living biomass and dead wood, as well as in litter and soil. An important fraction of the above ground biomass from trees is harvested annually and stored in harvested wood products (HWP), often for many decades. With nearly 7 million hectares of forest cover (~29% of its total area), Romania provides significant HWP at the EU level, making it an important contributor to the annual carbon budget. This study used the IPCC production accounting method to estimate the HWP carbon storage, using the FAOSTAT database, specific to Romania's forestry sector. During the historical period from 1960 to 2020, the total carbon stock varied from 28.2 TgC in 1960 to 59.2 TgC in 2020, with the most significant trend being more the doubling in the value of sawnwood. Besides, the carbon stock of annual inflow from domestic production recorded a minimum value of 0,6 TgC in 1994 and a maximum value of 2.5 Tg C in 2013. One the other hand, the balance between carbon removals and emissions from HWP, especially during 1990-2001, were significantly influenced by changes of forest legislation and the collapse of the wood processing industry, due to the transitional political regime. Our work demonstrated that HWP have considerable potential to continue supporting GHG mitigation. By using national data and the Tier II method, we can reduce uncertainty associated with carbon stocks in the HWP for our country. The results of this research will contribute to assessing the role of forests and HWP in Romania's GHG reporting commitments.*

Keywords: *forestry database, biomass, harvested wood products, carbon storage.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Reconstruction and analysis of historical point clouds for erosion monitoring: evolution of gullies from 1983 to present

Mihai Daniel NIȚĂ[1,*] Finlandia BARBOSA[2] José Luis GARCÍA RODRÍGUEZ[2]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[2] Escuela Técnica Superior de Ingeniería de Montes, Forestal y del Medio Natural, Universidad Politécnica de Madrid, Spain.

Corresponding author: Mihai Daniel NIȚĂ

E-mail address: nita.mihai.daniel@gmail.com

Abstract: *In this study, we present a comprehensive reconstruction of a historical point cloud from 1983, achieved through advanced data integration techniques for erosion monitoring. Utilizing a pixel size of 0.5, we effectively overlapped the historical point cloud data with contemporary data obtained from drone surveys. This approach enabled a detailed analysis of gully evolution and erosion patterns over time. The comparison between historical (grey points) and current (colored points) point clouds provides a clear visualization of the development and progression of gullies in both 2D and 3D formats. Additionally, the integration of these point clouds with field data collected during the period enhances the correlation and validation of observed changes. Our findings underscore the value of combining historical datasets with modern technology to gain insights into long-term erosion dynamics and gully evolution.*

Keywords: *point cloud reconstruction, erosion monitoring, gully evolution, historical data, drone surveys, environmental dynamics, 2D and 3D visualization, long-term analysis.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Considerations on GNSS data analysis, according to EPN guidelines

Mihaela-Simina PUIA[1,*] Vlad SORTA[1] Miluță FLUERAȘ[2]

[1] National Center for Cartography, Romania;

[2] Geodesy and ROMPOS Department, National Center for Cartography, Romania.

Corresponding author: Mihaela-Simina PUIA

E-mail address: mihaela.puia@cartografie.ro

Abstract: *The development of GNSS reference stations networks at national or regional level has led to the need to integrate them into European and international networks. This involves the coordinate computation of GNSS antennas for the reference stations, both in ETRF and ITRF/IGS systems ensuring a high precision and accuracy. This task can only be achieved by performing a rigorous data analysis using scientific software, designed for this purpose. In this context, the certification of the coordinates of the stations in the National GNSS Network by the European specialized forum, namely at EPN, represents the last step to be taken, in order to fully integrate the Romanian Position Determination System – ROMPOS into the European network, according to EPN Guidelines.*

Keywords: *GNSS, EPN, IGS, Bernese GNSS Software.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

Modelling photogrammetric dataset in order to enhance urban planning

Iuliana Maria PÂRVU Iuliana Adriana CUIBAC PICU

Corresponding author:

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

Abstract: *This paper explores the application of photogrammetric datasets to enhance urban planning through the development of detailed 3D city models. Using high-precision photogrammetric data, a Digital Terrain Model (DTM) was derived from dense image matchingpoint cloud, in orderto accurately extract the ground of the urban landscape. A Digital Surface Model (DSM) is also produced, capturing all features, including buildings and vegetation. The subtraction of the DTM from the DSM produces a normalized Digital Surface Model (nDSM), isolating the height of above-ground features such as buildings. The nDSM is important to extract building heights. Using building footprints and the extracted height values, a LoD2 building model was made. These models provide accurate representations of buildings, including roof shapes and heights, crucial for urban planning tasks such as infrastructure design, and environmental analysis. This approach will try todemonstrate how integrating photogrammetry with advanced modeling techniques can significantly improve the accuracy and utility of urban planning tools.*

Keywords: *DSM, DTM, 3D building models, photogrammetry.*

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Geomatics, informatics, modelling and statistics

- POSTER PRESENTATIONS -

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

iPhone Measure app in today's forestry: a survey on the accuracy of measuring tree characteristics

Andrei Ioan APĂFĂIAN[1] Andrei AVASILOAIE[2,3] Maria Magdalena VASILESCU[2,*]

[1] SCDEP Brasov - National Institute for Research and Development in Forestry "Marin Drăcea", Romania;

[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

[3] Moineşti Forest District, National Forest Administration Romsilva, Romania.

Corresponding author: Maria Magdalena VASILESCU

E-mail address: vasilescumm@unitbv.ro

Abstract: *In the light of digitisation trend that is constantly developing in the forestry sector, this study aims to assess the potential of modern software applications such as the Measure app, a free and widely-used application integrated into the latest smartphone models that are running on the iOS operating system. Among it's features, it can be used for the measurement of diameter at breast height (DBH) of trees. The study also highlights the impact of diameter measurement errors on tree- and stand-level basal area. To achieve the objectives of the study, DBH was measured for 888 trees in a mixed forest stand using a caliper and the Measure app built-in operating system iOS 14. Besides this, girth at the level of 1.30 m was measured using a tape. The accuracy in measuring breast height diameters using Measure app was quantified through mean error (ME), the absolute mean error (AME), and the root mean squared error (RMSE). The results indicated a proclivity for underestimation of diameters when the app was utilized, resulting in a mean DBH underestimation of 0.17-0.89 cm. The AME ranged from 0.96 cm to 1.51 cm, while the RMSE varied between 1.15 cm and 1.92 cm when the iPhone Measure app was used. Consequently, the ±5% frequency of individual errors when estimating basal area was reduced by approximately half when the app was used as opposed to the caliper. Furthermore, the risk of recording errors >10% in tree basal area estimation was 26 times higher. The tendency to underestimate DBH when the iPhone Measure app was used resulted in an underestimation of stand basal area by approximately 4.1%. While the iPhone Measure app is a convenient digital measurement tool, it still requires upgrades of certain details to achieve the accuracy of the caliper. Consequently, in the near future, this type of application can be used on a wider scale to collect field data related to tree and stand characteristics.*

Keywords: *diameter at breast height, basal area, tree, Measure app, error.*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

R code on detecting peak discharge

Valentina AGA[1,*]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Valentina AGA

E-mail address: aga.valentina@yahoo.com

Abstract: *Peak discharge is pivotal in hydrology and is defined as the maximum instantaneous rate of water flow at a given point during or after a rainfall event or snowmelt. It plays a crucial role in triggering channelized debris flows and is significantly influenced by rainfall regimes and characteristics. It is important to know the effect of the shape and size of a basin on runoff and discharge, to understand the relationship between forests and peak discharge. The processes of the hydrologic cycle including evaporation, condensation, precipitation, interception, infiltration, transpiration, runoff, and storage play a very important role in the estimation of the peak discharge. Besides these, other factors that influence the peak discharge are the soil type and geology, the cover vegetation and land use, topography and slope of the watershed, and human activities. Building R code contained more steps, firstly adding the packages (dplyr, lubridate, ggplot2, purr, gridExtra), the second step is to convert a column named "timestamp" in a data frame to a POSIXct format, forwards R code calculates the rolling average of a numeric vector "x", and the rolling average of water level differences. The next step is that the code identifies the start and end timestamps for each event based on certain conditions and calculates additional event-related information where the result is stored in a new data frame named events. After all these steps is necessary to export the identified events to a CSV file and filter the events that contain the difference in water level is greater than or equal to 7. In the end, the code saves the combined plot as an image file named at the specified location. As well as results, the most important is the comparison of code scenarios with manual delineation.*

Keywords: *peak discharge, R code.*

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A comparative study of different methods for acquiring and processing aerial images

Lemonia RAGIA[1,*] Mihai Daniel NIȚĂ[2]

[1] Hellenic Open University, Patras, Greece;

[2] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania.

Corresponding author: Lemonia RAGIA,

E-mail address: ragia.lemonia@ac.eap.gr

Asbtract: *This research investigates the comparative efficacy of various methods for capturing and processing aerial images. In the context of rapidly evolving technologies and the digitalization of numerous activities, photogrammetric systems for aerial imaging have gained significant importance. This study addresses the critical need to integrate digital models, cadastral plans, orthophotos, and 3D space modeling into planning, monitoring, and development systems. The study employs advanced measurement, recording, analysis, and modeling techniques to highlight the technological steps necessary for producing high-precision photogrammetric digital products. These techniques provide a detailed representation of terrestrial surfaces and aerial spaces. By comparing different methods of data acquisition and processing, the research offers valuable insights into selecting appropriate techniques for aerial and terrestrial space measurements.The work involves the use of state-of-the-art sensors and software applications, including Agisoft Photoscan, to generate ortho-rectified plans and digital elevation models (DEMs). The analysis also examines the altimetric accuracy of DEMs by comparing elevation points determined using GNSS technology and total stations.*

Keywords: *aerial imaging, photogrammetry, digital elevation model, data processing, GNSS, remote sensing, Agisoft Photoscan*

Transilvania University of Brasov
FACULTY OF SILVICULTURE AND FOREST ENGINEERING

The use of Geographic Information Systems in the planning of bicycle routes in the Zănoaga - Bran area

Cornel Cristian TEREȘNEU[1,*] Cristian Samuel TEREȘNEU[1]

[1] Faculty of Silviculture and forest engineering, Transilvania University of Brasov, Romania;

Corresponding author: Cornel Cristian TEREȘNEU

E-mail address: cteresneu@unitbv.ro

Abstract: *Everyday life is increasingly challenging and so the need to relax (when you can) takes on new coordinates. Due to the fact that recent climate changes have made winters increasingly scarce in precipitation and snow periods shorter, there has been a growing concern to increase the offer of summer (relaxation) sports. In the Zănoaga area of loc. Bran an extensive sports complex is being developed. Appropriate IT facilities have been used for the development of bicycle routes, some of which are highlighted in the present work. Long trails are being developed, trails that are used by a certain segment of cyclists, as well as shorter trails with varying degrees of difficulty. These have (mainly) used the means provided by geographical information systems through VBA programming, which have been used to design trails of certain degrees of difficulty. A program has also been created using such sequences, which guides athletes to a particular route according to their experience, age, courage and the type of bike they use.*

Keywords: *sports complex, GIS, VBA.*